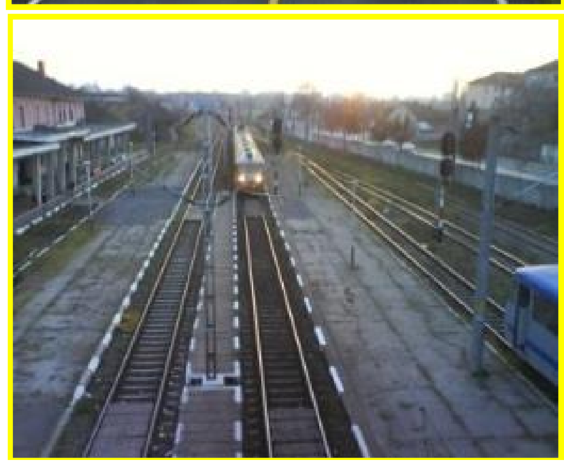
Romania General Transport Master Plan

Revised Final Report on the Master Plan
Short, Medium and Long Term



UNIUNEA EUROPEANA GUVERNUL ROMANIEI Instrumente structurale 2007-2013

Asistență tehnică pentru elaborarea unui Master Plan General de Transport
CCI: 2007 RO 161 RO 003
Cod Proiect: POST/2011/4/1/0

PROGRAMUL OPERAȚIONAL SECTORIAL TRANSPORT TRANS *Mobilitate în România. Conexiuni cu Europa.*

Prepared by: Iain Mobbs, Frank Mohan, Geoff Clarke
Johan Els

Checked by: C. D. G. Bell
Craig Bell
Regional Director

Approved by: Martin Bright
Martin Bright
Director

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Rev No	Comments	Checked by	Approved by	Date
1	First Draft for Client Comment	CB	MJB	19/08/2013
2	Revised following Client Comments	CB	MJB	29/08/2014
3	Revised following Client Comments	CB	MJB	30/09/2014

Strada Polona, Nr. 68-72, Sector 1, Bucuresti, Romania
Telephone: +4 021 316 1163 Website: http://www.aecom.com

Job No: 60268467 Reference: Revised Final Master Plan Date Created: September 2014

IMPORTANT NOTE

The current draft document should be read strictly from the perspective of the following:

CAVEATS

Status of current document

1. The current document is a working draft of the Master Plan Report. This version is not final and will be updated with the results of more detailed analysis which is being carried out in particular for the rail, ports, airports and intermodal transport sectors. The updating process will be done in parallel with the incoroporation of the feed-back collected from the public consultation process.
2. The Strategic Environmental Assessment (SEA) procedure (including the Appropriate Assessment) is ongoing. Upon completion its conclusions will be incorporated in the final version of the Master Plan report.

Coverage of the Master Plan

3. The Master Plan refers to the major objectives of the national transport system. Therefore it is a high-level planning instrument relevant for major interventions (projects and other actions) with significance for the objectives of the national transport system – which are suitable for modelling, apprasial and prioritisation at Master Plan level. This means a range of small scale interventions are not within the scope of the Master Plan, which does not mean they shouldn't be financed by the Ministry of Transport, but that the Master Plan is not a proper instrument for planning it and therefore that there should be a different process of defining, planning and prioritising such interventions. Typical interventions outside the scope of the Master Plan are:

    (i) Actions required for the day-to-day running of business (regular operations and maintenance activities of the various entities under MoT), e.g. administrative buildings,office equipment, consumables, operating costs, regular maintenance, etc.

    (ii) Investments of nature of such small size and detailed nature that goes well below the Master Plan level, e.g. small scale renewals/rehabilitations of small rail stations, small scale safety interventions, small scale intra-zone interventions which cannot be modelled, etc.

4. In addition, there is another group of projects not evaluated within the Master Planning exercise. These are the "Reference Case" projects i.e. those already committed investments which had finacing already decided (and often were already under construction) at the time of defining the "Reference Case" for the purpose of the National Transport Model (year 2013). The list and map of the committed "Reference Case" projects assumed to continue to be implemented "by default" is provided in Annex …

Time horizon of the Master Plan

5. The Master Plan planning horizon is the year 2030. Given the level of uncertainty associated with long-term forecasting, any action beyond the year 2030 should be reconfirmed on the basis of an updated plan (e.g. carried out within 10 years time i.e. in 2025).
6. However, for more volatile sectors, especially airports – where the level of uncertainty in the traffic forecast is much higher than e.g. for roads sector, the Master Plan horizon to be taken up for implementation should not exceed the year 2020, whilst any projects beyond 2020 should be re-confirmed on the basis of the actual market (demand/traffic) developments.

Level of analysis and relation with Feasibility Studies

7. The level of the Master Plan analysis is high by its very nature. Consequently and in order to ensure a fair comparison basis across projects and thus a relevant comparison of their economic performance indicators, high-level uniform assumptions have been made on the project costs (based on average values per km/type of infrastructure/type of terrain). This means the cost estimates used in the Master Plan do not necessarily match precisely more detailed estimates from e.g. existing Feasibility Studies (FS), which is not an error but a methodological choice. However, normally the difference between the

Master Plan estimates and FS values should not exceed <25-30%>, which is the usual approximation margin for this level of analysis.

8. Inherent from the high level of analysis is the approximation of the economic performance, which because of (i) the margin in the cost estimation and (ii) the scale of the economic benefits (i.e. some local benefits –e.g. intra-zone- might not be captured by the National Transport Model) should be considered preliminary until a more detailed analysis at the level of each project is carried out further at FS level. A methodological consequence was the choice of not excluding projects at the usual threshold of the economic discount rate (5%) but lowering the pass/fail bar to 3% EIRR at this level, whilst the final decision on the economic acceptance of any project would be (re-)confirmed on the basis of the more detailed analysis of both the costs and benefits at FS level.

9. The same logic applies to the technical solutions. The Master Plan defined generic measures (interventions) to serve the specific operational objectives defined in response to the problems identified – e.g. "Improve travel speeds on Bucharest – West Road Corridor". To enable model testing, costing and economic appraisal, certain preliminary technical solutions have been defined e.g. 2x2 motorway/express-way, rehabilitation of a rail section to a specific speed, extension of a passenger terminal to a certain capacity, etc. Such technical solutions will need to be however reconfirmed at the level of each particular project within the FS on the basis of a detailed options analysis including more detailed cost, capacity, economic and environmental impact analyses. In this respect it is imperative that the ToR for the new Feasibility Studies launched for the Master Plan projects includes clear and explicit provisions for such capacity and options analysis.

10. Similarly, the recommended approach - which will have to be reconfirmed for each case within Feasibility Studies - is that the infrastructure should be designed in such a way as to allow future development (for example from an expressway profile to a motorway profile, from 2 lanes to 3 lanes per direction, etc) if and when such developments are justified by the demand and covered by funding sources.

Conclusions

11. In summary, this Master Plan has been produced at a point in time based upon the best information available at that time and underpinned by a robust process which has been used to appraise the various schemes being proposed. There will be changes which occur over time which will impact upon the costs, standards and performance of each individual infrastructure scheme proposed. These include, inter alia:

    (i) Changes in the timetable for implementation of other schemes, across all modes, which impact upon the scheme in question;

    (ii) Improved information as a consequence of feasibility, or other, studies in to the particular scheme; and

    (iii) External factors, such as changes in the macro level economic performance of the country, which impact upon forecast demand for a particular scheme.

12. Each of these will potentially affect the required standard of the improvement, the costs of implementation and the economic merit of an individual scheme. It is important therefore that the Master Plan is seen as a live document which provides a robust platform for moving the transport sector forward, but which also needs to be maintained and reviewed over time in order to ensure that the objectives for improving the transport sector are met.

13. This Master Plan Report will be supported by a separate Implementation Plan which will outline the schedule for when projects will be delivered. The Implementation Plan will take into account project maturity and eligibility for alternative funding streams, criteria which have not been included in the multi criteria assessment which has been used to develop the Master Plan list of projects. It is therefore possible that in the Implementation Plan projects will be delivered in a different order to that indicated in the prioritised list of projects in this Master Plan Report.

The way the Master Plan fulfills the ex-ante conditionalities defines in the reference document
EUROPEAN COMMISSION, Directorate-General- Regional and Urban Policy, DRAFT -“Guidance on Ex ante Conditionality for the European Structural and Investment Funds”, PART II, “Criteria for fulfilment

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	**Elements of non-fulfilment**
The existence of a comprehensive transport plan or plans or framework or frameworks for transport investment which:		
• The relevant operational programme and where appropriate, the Partnership Agreement contains a reference to the name of the plan or framework and provides a hyperlink to the documents(s).	NO	Master Plan not yet approved
– ***complies with legal requirements for strategic environmental assessment :***		
• An environmental report has been prepared in which the likely significant effects on the environement of the implementation of the plan or framework and reasonable alternatives taking into account the objectives and the geographical scope of the comprehensive transport plan or framework, are identified, described and evaluated.	YES	
• The draft plan or framework and the environmental report have been made available to the public and the authorities with specific environmental responsibilities designated by the Member States who are likely to be concerned by the environemental effects of the implementing plans.	NO	The draft plan has been made available to the public and the authorities on October 2012 and October 2013 . Each chapter from Environmental Report have been presented in the working group. The final Environmental Report will be make available after Appropriate Assessment will be approved by MECC. The final Environmental Report must include the conclusion of Appropriate Assessment.
• In case of possible significant transboundary effects, the draft plan or framework and the environmental report have been forwarded to the relevant/affected Member States.	NO	In case of possible significant transboundary effects the Final Environmental Report and Master Plan will be forwarded to the relevant/affected Member States. Responsibility to inform the relevant/affected Member States lies the central public authority promoting the plan (in this case the Ministry of Transport), on the recommendation of the Ministry of Environment and Climate Change. It is recommended that the establishment of States which are notified to be performed by the central public authority promotes plan with the Ministry of Environment and Climate Change. In according with GD 1076/2004 Art. 22 (2) din HG 1076/2004 menţionează că *„În cazul în care*

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	Elements of non-fulfilment
		implementarea planului sau programului poate avea efecte semnificative transfrontieră, titularul, prin intermediul autorităţii publice centrale care promovează planul sau programul, este obligat să transmită proiectul de plan sau de program şi raportul de mediu elaborat pentru acesta, în limba engleză, autorităţilor centrale de mediu din statele posibil afectate, în termen de maximum 20 de zile calendaristice de la finalizarea raportului de mediu, conform art. 21 alin. (3)".
• The environmental report and the opinions expressed in the relevant consultations (including as appropriate transboundary ones) have been duly taken into account during the preparation of the comprehensive transport plan or framework.	NO	See previous.
• When the plan or framework has been adopted, the authorities with environmental responsibilities, the public and any Member State consulted, are informed and the following items have been made available to them: the plan or framework as adopted, the statement referred to in Article 9(1) of the SEA Directive and the measures concerning monitoring referred to in Article 10 of the SEA Directive.	NO	See previous.
– sets out the contribution to the single European Transport Area consistent with Article 10 of Regulation (EU) No1315/2013 of the European Parliament and of the Council, including priorities for investments in the core TEN-T network and the comprehensive network where investment from the ERDF and CF is envisaged; and secondary connectivity.	**YES**	
• The investment priorities included in the comprehensive transport plan or framework connect the identified main nodes (see the list in annex) and provide for connections with neighbouring countries' transport infrastructure networks. The Member State shall also demonstrate how its investments in secondary connectivity will contribute to the single European Transport Area[57].	YES	
• The comprehensive transport plan or framework includes measures that are necessary for:		
ensuring enhanced accessibility and connectivity for all regions of the Union while taking into consideration the specific case of islands, isolated networks and sparsely populated, remote and outermost regions;	YES	
ensuring optimal integration of the transport modes and interoperability within transport modes;	YES	
bridging missing links and removing bottlenecks, in particular in cross-border sections;	YES	
promoting the efficient and sustainable use of the infrastructure and, where necessary,	YES	

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	Elements of non-fulfilment
increase the capacity;		
improving or maintaining the quality of infrastructure in terms of safety, security, efficiency, climate and where appropriate disaster resilience, environmental performances, social conditions, accessibility for all users, including elderly people, persons with reduced mobility and disabled passengers, as well as the quality of services and continuity of traffic flows;	YES	
implementing and deploying telematic applications as well as promoting innovative technological development;	YES	
• Particular consideration shall also be given in the comprehensive transport plan or framework to measures that are necessary for:		
ensuring fuel security through increased energy efficiency and promoting the use of alternative and in particular low or zero carbon energy sources and propulsion systems;	YES	
mitigating exposure of urban areas to negative effects of transiting rail and road transport;	YES	
removing administrative and technical barriers, in particular to the interoperability of the trans-European transport network and to competition.	YES	
- ***sets out a realistic and mature pipeline for projects envisaged for support from the ERDF and CF***		
- The plan or framework for transport investments includes a table containing :		
a list of prioritised projects (studies, upgrading or works) that the Member State envisages launching over the period and asking for support from the ERDF and CF.	NO	To be included in separate Strategy Report containing Implementation Plan
the name of the authorities and stakeholders involved in the lead of these projects, the foreseen expenditures and a financing plan,	NO	To be included in separate Strategy Report containing Implementation Plan
a realistic timetable for delivery of the projects identified indicating dates for feasibility studies, a Cost Benefit Analysis, EIA procedure58, an implementation timetable including procurement and permission procedures, and for potential state aid notification (per phase for bigger projects).	NO	To be included in separate Strategy Report containing Implementation Plan
- ***Measures to ensure the capacity of intermediary bodies and beneficiaries to deliver the project pipeline.***		
- The Member State has provided an adequate description of the measures already in place to ensure the capacity of intermediary bodies and beneficiaries to deliver the project pipeline:		
These measures are based on the analysis of both the bottlenecks and of the weaknesses of intermediary bodies and beneficiaries to deliver timely the project pipeline, as regards:		

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	Elements of non-fulfilment
tendering (including tenders without competition, irregularities)	NO	To be included in the Final version of the Master Plan
implementing environmental requirements,	NO	To be included in the Final version of the Master Plan
developing and prioritising a mature project pipeline,	YES	
financial project management,	NO	To be included in the Final version of the Master Plan
funding for maintenance and operations,	YES	
administrative burden and red tape,	NO	To be included in the Final version of the Master Plan
managing complex systems (ITS such as ETCS-ERTMS, VTMIS, RIS, emaritime services and air traffic management system).	YES	
They include training and appropriate internal procedures to monitor and identifiy potential delays and to ensure a smooth and effective procurement;	NO	MT are still in the process of establishing new organizational structures
A early warning system is in place to identify and solve any difficulties rising from intermediary bodies and beneficiairies when delivering the project pipeline;	NO	MT are still in the process of establishing new organizational structures
Adequate assistance schemes are in place to help beneficiaries during procedure and implementation to be able to replace projects quickly when implementation is blocked.	NO	MT are still in the process of establishing new organizational structures

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Glossary and Terminology

ACN	The Administration of Navigable Channels in Romania
AIS	Automatic Information System to track ships
APDF	The Administration of the River Ports in Romania, located in Giurgiu
Base Year	2011, the year for which the National Transport Model was calibrated.
CESTRIN	The Centre of Research and Road Technical Studies in Romania, part of CNADNR
CFR Calatori	The publicly-owned passenger train operating company
CFR Infrastructure (also CFR SA)	The publicly-owned rail infrastructure company
CFR Marfa	The publicly-owned freight train operating company
CNADNR	The Administration of National Roads and Motorways in Romania
Desiro Train	A modern diesel multiple unit train
DMU	Diesel multiple unit: typically a 2 or 4 car set that can be coupled together and can be driven from either end.
ECR	AECOM Existing Conditions Report
EMU	Electric multiple unit
Euro RAP	European Road Assessment Programme, an international organisation dealing with road safety
Fairway	The navigable part of the River Danube
GDP	Gross Domestic Product
GJT	Generalised Journey Time. It includes waiting, access time and fares (converted to time equivalents)
GTMP	General Transport Master Plan
ILS	Instrument Landing System
Intermodal Transport	Transport that uses two or more modes, for example road and rail, or water and road.
Inter-Regio	Limited stop passenger rail services
NAPA	North Adriatic Ports Association
NTM	National Transport Model
Passenger kms	The aggregate distance travelled by passengers
PCN	Pavement Classification a measure of the loading capacity of runways and taxiways
PSC	Public Service Contract, the agreement between the government and rail operators to provide socially necessary rail services
Push-pull	A type of loco-hauled train operation where the train can be driven from either end
Push Tug	The type of tug used on the River Danube to push barges
Reference Case	The transport networks that would exist if existing committed projects were completed. It forms a reference against which “new” projects can be assessed.
Regio	Stopping passenger rail services
Tonne kms	The aggregate distance freight is carried
UNTRR	National Union of Road Hauliers from Romania
UTI	Unité du Transport Intermodal, a container or unit load

Introduction

1 Introduction

1.1.1 The Ministry of Transport (MT) appointed AECOM in April 2012 to produce a General Transport Master Plan (GTMP) for Romania.

1.1.2 The General Transport Master Plan will provide a clear strategy for the development of Romania's transport sector for the next 20 years. To be of value it needs to provide implementable solutions to Romania's transport problems and challenges.

1.1.3 The Master Plan identifies the projects and policies which best meet Romania's National transport needs over the next 5-20 years, for all modes of transport, and providing a sound, analytical basis for the choice of those policies and projects.

1.1.4 The completion of the Master Plan is conditionality for European Commission approval of the Strategic Operational Programme for Transport (SOPT) for the 2014-2020 programming period and will support other decisions required for the optimal planning of transport infrastructure investment.

1.1.5 The Master Plan has been developed following the advice of the European Commission[1], and in co-operation with the JASPERS unit in Bucharest.

1.1.6 A Transport Master Plan is not an end in itself. The Master Plan must contribute to Romania's economic development in a sustainable manner. The high level outcomes that the Master Plan will produce are:

***Outcome** 1: A long term plan which will contribute to Romania's national economy in a sustainable way.*

1.1.7 The Plan's duration will be 15 years, and the whole programme of projects will take longer than that to implement. This is logical since large transport infrastructure projects typically take 5-10 years from inception to implementation, and their impacts last for 50+ years, although convention assumes that the economic life of transport projects is 30 years.[2] This approach also implies a consistent approach to transport policy over a long period of time, which transcends political expediencies.

1.1.8 Secondly, the primary purpose of the Plan is to define the projects and policies that will have an impact at a National level, and on the European TEN-T corridors.

***Outcome 2:** More efficient spending of financial resources on transport.*

1.1.9 The key word here is "efficient". Every country in the EU has a greater perceived need for improved transport investment than the financial resources available to meet that need, and this will not change in the next 15-20 years. Therefore, given the limited financial resources available, the emphasis must be on projects and policies that give a good economic return, and which perform a useful function.

***Outcome 3:** Improved connections and therefore improved trade with neighbouring countries.*

1.1.10 The Plan recognises not only that Romania is part of the European Union, which at its heart is an Economic Union with free trade and fair competition between its members, but that it also has important markets (relatively undeveloped at the moment) to the Ukraine, and Moldova.

[1] *See EC Letters dated 27/09/2013 and 11/12/2013*

[2] *For more details see National Guide for Transport Project Evaluation, Volume 2, Appendix A: Guidance for Economic and Financial Cost Benefit Analysis and Risk Analysis. AECOM.*

Outcome 4: *Higher productivity for Romanian industry and services, and therefore higher economic growth and improved standards of living.*

1.1.11 Efficient transport systems reduce costs for industry and individuals. For industry, this means lower costs and increased productivity, less resource tied up in inventories, and more competitive products and larger markets for those products. For transport operators, better transport means lower costs and higher utilisation of vehicles and staff. For individuals, better transport saves time, and provides wider choice of work, consumer goods, and leisure opportunities.

1.1.12 The Cost-Benefit Analysis captures the majority of these productivity benefits.

Outcome 5: *A sustainable transport system.*

1.1.13 The word sustainable embraces more than environmental sustainability, although this is the context in which the word is often used. It includes the concepts of economic, financial and operational sustainability as well as environmental sustainability. The issue of financially sustainability is particularly relevant to the financing of the Romanian railways.

1.1.14 In summary, the Master Plan will identify the projects and policies which will best meet Romania's National transport needs over the next 5-15 years, for all modes of transport, and providing a sound, analytical basis for the choice of those policies and projects.[3]

[3] *Ibid Chapter 7 for details of the project and programme appraisal criteria.*

Methodology

2 Methodology

2.1 Overall Methodology

2.1.1 The overall process for developing the Master Plan is set out in Figure 2.1 below:

Figure 2.1 Overall Process for Developing the Romanian Transport Master Plan

1. •**Define Strategic Objectives** - Terms of Reference, EU and National Policy
2. •**Problem Definition -** Identification of Underlying Causes
3. •**Operational Objectives** - Specific Objectives based on Problem Analysis
4. •**Project Generation** - Interventions Generated from Problems and Objectives
5. •**Appraisal** - Screening/Shortlisting/Preliminary Appraisal (CBA & MCA)
6. •**Develop Master Plan Scenarios** – Economy & Economy + Environment

o **Step 1: the Strategic Objectives** are those which are defined at a Government, or Ministerial Level, and apply at a high level, as overall goals of the Government, and the Ministry of Transport. For the Master Plan, these were defined using the objectives from the Terms of Reference, various statements from the Ministry of Transport, and the European Commission's White Paper on Transport.

o **Step 2: Problem Definition** is the outcome of a diagnostic of the Transport System. We have identified the underlying causes which are responsible for the manifestation of problems, as well as identifying the problems at a spatial level so that specific objectives and interventions can be identified.

o **Step 3: Operational Objectives**: these are objectives that relate to the specific problems which have been identified, and are a subset of the Strategic Objectives.

o **Step 4: Project Generation**: these are the specific interventions which will address the operational objectives, and the problems.

o **Step 5: Project Appraisal and Prioritisation**: A systemised project appraisal process is required for two main reasons. First, there may be more than one project which addresses an operational objective, so selection is required. Secondly, a project may address the problem but may offer poor value for money. In a situation like Romania's, where the funds available for transport are much less than the needs, financial resources must be allocated in an economically efficient way. A fair, independent way of appraising projects must be used for this purpose. A multi-criteriate analysis (MCA) has been undertaken for this purpose.

o **Step 6: Develop Master Plan Scenarios**: the Terms of Reference require that two scenarios are developed, an "Economically Sustainable" Scenario, and an Economically and Environmentally Sustainable" Scenario. Each project was scored in the MCA according to how well it met the defined appraisal criteria. Using different weights for the scores, each projects was given two scores, applying to each scenario, which gave a different set of priority projects for each scenario

2.1.2 The Romanian National Transport Master Plan is, as its name implies, a National Plan. There is therefore an issue of scale in the projects, policies and programmes that the Master Plan will contain. The high-level objectives will therefore be met by policies, programmes and projects of sufficient scale to which will make a difference at a National Level. These include interventions such as:

- Large infrastructure projects
- National Maintenance Programmes
- New Rolling Stock and Locomotives
- Large Scale Rehabilitation projects
- National Policies such as Rail Reform

2.2 Objective setting

2.2.1 Establishing objectives is fundamental to the development of any strategy or project. The objectives focus the appraisal and the outcome of the study. Furthermore, the objectives are central to the monitoring and evaluation required during the implementation stage.

2.2.2 The "strategic" objectives will provide clear and concise goals that the strategy will aim to deliver. They encapsulate the underlying purpose of Transport Policy, Projects and Interventions, and represent the overall aims and objectives of the Ministry of Transport, and indeed the Romanian Government, as far as transport is concerned.

2.2.3 It is important to stress that the Master Plan is a long term Strategy for all of Romania, not just the areas of the country that are located on European corridors. The determining factor for projects and policies in the Master Plan will be National need; clearly the availability of funding will be an important determinant of prioritisation and programming.

2.2.4 The concept of high-level and operational objectives, which are defined following the thorough assessment of problems, provides a hierarchy of objectives. This structure clarifies the logic of the intervention and provides a framework for future appraisal and evaluation. The appraisal process for the Master Plan contains a two level hierarchy which consists of:

- **High level or strategic objectives** – For a strategy, this may be to aid economic development of the country or, at project level, to aid the development of the Trans-European Transport Network. These are generally objectives to which transport contributes, but not always in a direct manner. Furthermore these objectives may already be predefined, for example in EU or national policy documents; and

- **Operational objectives** – These are derived from the detailed examination of problems, and the underlying causes of these problems. They are therefore specific to a corridor, route, or transport node (such as port or airport), and allow the interventions to be designed in a precise way to meet the objectives.

2.2.5 It is also important to note that setting objectives implies a commitment to follow them through in actions and projects. There may be legitimate reasons for slower than desired or planned progress in implementation, but the underlying driver of transport projects in the Master Plan must be the achievement of the objectives.

2.2.6 Lastly, the Master Plan strategic objectives are not mode-specific: the actions and projects, for which we use the term "interventions" which follow from the objectives should, of course, relate to specific modes which are best-suited to achieve the objectives.

The High-Level Objectives

2.2.7 The documents relevant to setting the strategic objectives are as follows:

- The objectives in the Terms of Reference (ToR)
- Mission: Minister's Statement in the Forward to the Strategic Plan of the Ministry of Transport and Infrastructure
- EU White Paper on Transport 2011
- Romanian Government Statement on Transport Policy Document-2012-20-12-1358430-0 programme-guvenare 2013-2016 transport
- Partnership Agreement 2014 – 2020 (see pages 176-177)
- AECOM Existing Conditions Report
- National Spatial Plan Section 1 Transport Networks
- EU Core Networks for Road and Rail

2.2.8 The key objectives for the Transport Master Plan, as set out in the Terms of Reference, relate to

- Economic Efficiency: that is the transport sector must contribute to the national economy and the economic benefits it generates must exceed its costs;
- Sustainability: the transport system should be energy efficient, and leave a legacy for future generations;
- Safety: the transport system should be safe;
- Economic Development: the transport system should facilitate national economic development;
- Financial: the Master Plan should enable increased absorption of EU funds.

2.2.9 The Ministry of Transport's Mission as set out in the Minister's Forward to the Draft Strategic Plan for the Ministry emphasises the following points:

- Economic Efficiency: a transport system that generates benefits that are greater than its costs;
- Equity: the costs and benefits of the transport system should be distributed fairly among citizens, industries and geographic areas;
- Safety: the transport infrastructure and services should be provided in a manner that protects people from death and injury;
- Integration: the transport system should enable people to travel conveniently and reliably using a combination of different modes of transport, and to minimise the costs of transporting goods;
- Environment: the transport system should protect the environment and by so doing should support social and economic development for the benefit of today's and future generations.

2.2.10 Romania relies on the EU Cohesion Funds and Economic Regional Development Funds for the majority of its funding for new transport infrastructure, and the Terms of Reference recognise this. Therefore, the Romanian transport objectives must pay due regard for to the current policies of the EU.

2.2.11 The Transport White Paper published in 2011 sets out in Annex I a list of initiatives, which are really actions, under several headings which may be regarded as objectives. These are:

1. *An efficient and integrated Mobility System*

- A single European Transport Area
- Promoting quality jobs and working conditions
- Secure transport
- Service quality and reliability

2. *Innovating for the Future: Technology and Behaviour*

- A European Transport and Research and Innovation Policy
- Promoting more sustainable behaviour
- Integrated urban mobility

3. *Modern Infrastructure and Smart Funding*

- Transport Infrastructure: territorial cohesion and economic growth
- A coherent funding framework
- Getting prices right and avoiding distortions

4. *The External Dimension:* this area refers predominantly to actions at an EU rather than a National level.

2.2.12 The 2014-2020 Partnership Agreement has the following Thematic Objectives (TO 7) with regard to transport, which are relevant to the Master Plan:

o Improving the accessibility of Romania and its Regions and their connectivity with markets, thereby significantly reducing the obstacles to their development and diversification in the context of the GTMP; improving the governance of the transport sector; and

o Improving the sustainability of Romania's transport mix and the attractiveness of alternatives to road-based transport.

2.2.13 The AECOM Existing Conditions Report analyses the transport system by mode, but certain common themes emerge:

o Economic: The level of service offered by all modes of transport is generally poor, and this means both freight and passenger transport is slow and inefficient. The topography of Romania means that many main routes cross the Carpathian Mountains, but journey times by road and rail are slow, high capacity roads are few in number, and the rail network has provided progressively slower speeds and greater unreliability on unimproved routes.

o Sustainable Modes: intermodal freight transport is very poorly developed, and road-based passenger transport competes rather than complements rail transport. Rail freight and passenger travel has declined in recent years so reversing this trend will require a variety of interventions, some involving policy as well infrastructural. The River Danube is a valuable resource for low-energy transport, but the river through Romanian section is not managed and there are many points where the depth frequently fall below the minimum desirable (2.5m) and the fairway is below the desirable width (180m.).

o Environment: road transport of both passengers and freight has been increasing in recent years. There is a conflict between desirable transport improvements from an emissions point of view but which have serious environmental impacts. Thus there is often a conflict in Romania between the environmental objective, and the economic objective. A classic example of this conflict is the River Danube, where the river banks are part of Natura 2000 sites, and dredging operations disturb the hydrology of the river and some fish and other river mammals.

o Funding: all transport modes are under-funded, in terms of the infrastructure that the vehicles and services use, the maintenance of that infrastructure, and the services and vehicles themselves. This leads to unnecessarily costly operations and a low-level of service to the end-users.

2.2.14 There are some common themes which emerge from these various sources. These are:

- Economic: the transport system should be economically efficient as far as transport operations and users themselves are concerned. Specifically, the transport system benefits should exceed its costs. In addition, the transport system should be configured to enable economic development both nationally and regionally. The investment should also favour equity as far as Romanian citizens are concerned.
- Environment: the transport system should not impact negatively on the environment. Transport investment should minimise negative impact on the physical environment.
- Sustainability: the so-called sustainable modes of transport which are more energy efficient and have lower emissions should be developed as a priority;
- Safety: investment in transport should produce a safer transport system; and
- Funding: there is a substantial shortfall in funding for transport in Romania.

2.2.15 Bearing in mind the common themes in the above documents, the following high-level objectives were established for the Master Plan strategy.

- Economic Efficiency: the transport system should be economically efficient as far as transport operations and users themselves are concerned. Specifically, the benefits of investments in transport should exceed the cost of that investment. This objective measures the benefit to the users and providers of the transport system, and its quantitative measures are the Benefit:Cost Ratio (BCR), Net Present Value (NPV) and Economic Internal Rate of Return (EIRR).
- Sustainability: this concept includes financial, economic, as well as environmental sustainability. The so-called sustainable modes of transport – rail, bus and waterways - which are more energy efficient and have lower emissions should be developed as a priority. Monetary values are assigned to operating costs and emissions in the economic evaluation, but making Sustainability a separate objective respects not only the intentions of the Romanian Government and the EU, but the concerns of future generations.
- Safety: investment in transport should produce a safer transport system. The economic cost of accidents is monetised in the economic evaluation, but since the goals of the Government, the EU and the ToR are clearly a reduction in transport-related accidents, safety must remain as a separate objective.
- Environmental Impact: Transport investment should minimise negative impact on the physical environment. Agreed methods for monetising physical impacts are not yet available, and therefore the impact on the physical environment is not included in the economic evaluation. Most infrastructure projects by their nature impact negatively on the natural environment, and therefore the objective is to select projects and options which minimise the extent of the negative impact.
- Economic Development. The transport system should be configured to enable economic development both nationally and regionally. The investment should also favour equity as far as Romanian citizens are concerned. Efficient transport is not an end in itself, but one important way of contributing to overall economic development. A “pure” economic objective will tend to favour projects where demand is highest and where the existing economy is already strong (generally around Bucharest and the major cities). This objective recognises first, that transport investment has a role to play in the development of less-advanced regions in economic terms,

and secondly, that transport should provide services which are available to all citizens, regardless of social status, income or where they live.

- Funding: there is a substantial shortfall in funding for transport in Romania. Policies which produce more efficient pricing for transport, such as road-user charging, particularly for HGV, should be examined. At a project level, availability of EC funding from the Structural Funds (CF and ERDF, Connecting Europe Facility (CEF)) and PPP will affect "buildability" and therefore the prioritisation of projects. The overall programme will have to be within a realistic estimate of national and other funds over the plan period.

The High-Level Objectives for the Master Plan are summarised below:

Master Plan High-Level Objectives
Economic Efficiency: the transport system should be economically efficient as far as transport operations and users themselves are concerned. Specifically, the benefits of investments in transport should exceed the cost of that investment.
Sustainability: the transport system must economically, financially and environmentally sustainable. The so-called sustainable modes of transport – rail, bus and waterways - which are more energy efficient and have lower emissions should be developed as a priority.
Safety: investment in transport should produce a safer transport system. The economic cost of accidents is monetised in the economic evaluation, but since the goals of the Government, the EU and the ToR are clearly a reduction in transport-related accidents, safety must remain as a separate objective.
Environmental Impact: Transport investment should minimise negative impact on the physical environment.
Balanced Economic Development. The transport system should be configured to enable economic development both nationally and regionally. The investment should also favour equity as far as Romanian citizens are concerned.
Funding: Availability of EC funding from the Structural Funds (CF and ERDF, Connecting Europe Facility (CEF)) and PPP will affect "buildability" and therefore the prioritisation of projects. The overall programme will have to be within a realistic estimate of national and other funds over the plan period.

Operational Objectives

2.2.16 Operational objectives are a subset of the high-level objectives. They are derived from the problem analysis and, unlike the high-level objectives are specific to each mode, and, in many cases, are also location-specific. They enable the interventions to be designed in such a way to meet these objectives. This is best illustrated by specific examples.

2.2.17 For the rail sector, a particular issue is the lack of a regular interval train service on the main routes, which, combined with slow travel times, creates inconvenience for passengers and contributes to the decline in passenger numbers. An operational objective which corresponds to this problem would be:

Improve the competitiveness of passengers rail services on the route between Bucharest and Hungary via Brasov, Teius / Cluj.

The specific problem which was identified on this corridor was:

- Infrequent services: headway 180 minutes

- o Slow average speed
- o Slow rail travel times compared to road.

2.2.18 The specific interventions for this route are:

- o Introduction of regular interval services with trains every 2 hours
- o Infrastructure upgrade, particularly between Predeal and Brasov. Review the potential options to upgrade different proportions of the line to 160kph. Other infrastructure schemes include Dej to Coslariu via Apahide and F039 Brasov to Simeria (assumes Brasov to Sigishoara is upgraded to 160kph)
- o Introduction of tilting trains to help increase running speeds

2.2.19 The problem, operational objective and interventions relate directly to the Economic Efficiency, and Sustainability high-level objectives, and indirectly to the safety objective since some passengers would transfer to rail, which is a safer mode.

2.2.20 For the roads sector, road safety is a major issue - Romania has 259 fatalities per 10 billion pkm (against an EU average of 61) and 466 fatalities per million passenger cars (against an EU average of 126) – and it is the worst performing EU country for both indices. The corresponding operational objective is:

- o Decrease by half the accident rates by 2020 and down to EU average by 2030.

2.2.21 In fact, in this case there are seven further operational objectives designed to meet this target, each with an appropriate intervention. These come under the “safety” high-level objective.

2.2.22 The above outputs from the Problem Definition Report provided the essential "operational objectives" which guide Project Identification Phase. These were brought together in working documents (the Problems/Objectives/Interventions (POI) reports), which set out in detail the problems, objectives and interventions in a logical and consistent manner. These were agreed with the MT and JASPERS.

Environmental Objectives

The general environmental objective of the GTMP

- o OM1: The development of a modern transport infrastructure, considering the environmental impact.

Specific environmental objectives of the GTMP

- o OM1-1 Promoting projects with investments in transport that contribute in achieving a sustainable transport system, with measures to avoid and reduce adverse effects, such as emissions of pollutants into the atmosphere, noise pollution in urban areas and on roads with heavy traffic, water and soil pollution due to diffuse sources, the impact on landscape and cultural heritage;
- o OM1-2 Reduction of greenhouse gas emissions from the transport sector;
- o OM1-3 Protection of public health by improving environmental and safety conditions of transport;
- o OM1-4 Reducing the impact on biodiversity by providing measures to protect and conserve biodiversity and ensure consistency of the national network of natural protected areas.

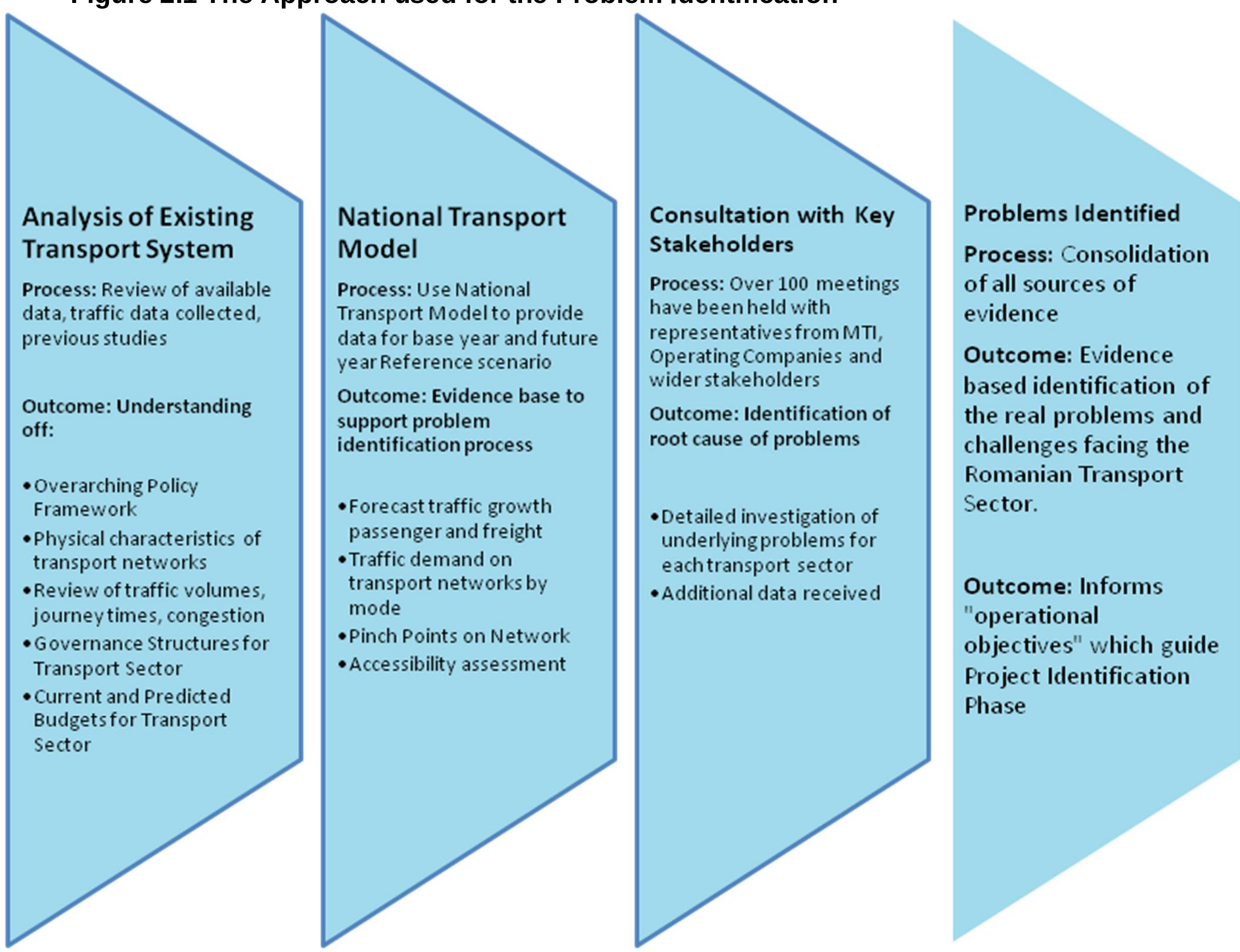
2.3 Identifying the Problems and Defining the Interventions

2.3.1 The Problem Identification stage in the development of any plan or strategy is a key procedure, as it identifies and confirms the underlying problems of the transport system rather than merely describing the symptoms. Problem identification also provides a basis for developing operational objectives which in turn form a framework for the appraisal of measures for improving the current transport system.

2.3.2 This step in the process is designed to provide an understanding of the need for a transport intervention and to provide strong input into the setting of objectives through identifying existing and potential transport problems, opportunities and constraints. AECOM's Existing Conditions Report describes the current challenges on a modal basis. There is an existing identified need for improvements to transport infrastructure and services, and there is a large "backlog" of projects already identified by project sponsors. This particularly applies to maintenance of the road and rail networks.

2.3.3 It is crucial that the causes of the problems are investigated before solutions are generated. Focusing on problems (rather than underlying causes) as the stimulus for option development may result in solutions which address the symptoms without solving the real underlying problems.

Figure 2.1 The Approach used for the Problem Identification



2.3.4 Several sources of information have been used to support problem analysis, including:

- o Statistical data on current network operations;
- o Modelling of current transport network performance;
- o Forecasting of future year transport demand and network performance; and
- o Consultations with key stakeholders.

2.3.5 The National Transport Model (NTM) provided a core component of current problem analysis, and provides forecasts for the future year "Reference Case" scenario, enabling analysis of the future year transport networks to be undertaken, identifying which problems may be exacerbated in the future.

2.3.6 The NTM contains a representation of the transport system, in the supply side in the form of the networks, capacities and services, and the demand side, in terms of travel between origins and destinations for each mode. The outputs are flows on each link in the network, together with statistics such as passenger and vehicle kms, freight tonnes kms, and travel times and costs by mode.

2.3.7 Consultations with key stakeholders have provided key information covering current transport policies and operational issues. The key stakeholders consulted include:

- o CFR Infrastructure
- o CFR Calatori
- o CFR Marfa
- o MT Railways Directorate
- o CNADNR
- o MT Naval Directorate,
- o the Civil Aviation Authority,
- o the Ports and River Authorities, including APDM Galați, APDF Giurgiu, ACN Constanța și APM Constanța,
- o TAROM,
- o Henri Coanda Airport management,
- o private companies such as DHL, and
- o representative bodies such as UNTRR.

2.3.8 Full details of the review of existing conditions are provided in the Romania GTMP Existing Conditions Report (ECR) and problem identification process in the Problem Definition Report (PDR).

2.3.9 The appraisal of a transport intervention involves the comparison of the 'with intervention' situation against the situation which would be obtained without the intervention in place. The 'without intervention' scenario needs careful consideration and will involve specifying a Reference Scenario which has a very high probability of occurring. This is very important as it will affect both the identification of the need for the intervention and the assessment of the costs and benefits of the proposal.

2.3.10 The Reference Scenario provides a realistic view of what is likely to happen in the absence of the intervention proposals. It is based on the continuation of existing maintenance regimes plus any transport improvement commitments that have policy and funding approval and from which it would be difficult to withdraw. It corresponds to maintaining present transport facilities and implementing those aspects of national and county transport strategies that are certain. It takes into account forecast changes in demographics (population, employment and households) and car ownership factors, from European and national datasets, together with changes in land use.

Problems and Opportunities

2.3.11 The identification of transport problems, constraints and opportunities which affect an area and its aspirations for the future, ensures transport interventions are forward-facing and not simply reacting to current issues. Thus, both the transport problems affecting an area and the aspirations for the future – which are often broader than transport – must be the drivers of the proposals for a transport intervention.

2.3.12 The Master Plan is intended for the development and appraisal of proposals which either contribute to objectives relating to transport, or where the underlying opportunities are transport opportunities. This is because if transport proposals are being considered to help meet an objective that could be met by other means (rather than transport), poor decisions could easily result.

Current and Future Transport Related Problems

2.3.13 Problems were identified in a number of ways, including:

- Perceptions of the problems from users, both those that they encounter when travelling and those which result from other people travelling;
- Through discussions with representatives of stakeholders to gain an understanding of the transport and planning professional's perceptions of problems with the transport system;
- Conducting audits of specific elements of the transport system in order to gain a deeper understanding of the roles performed and to analyse the extent to which the expected aims are not met;
- Analysing outputs from the National Transport Model, or analysing existing data sets, to determine the extent to which local, county and national transport and wider policy objectives are being met; and
- Benchmarking the local performance against similar situations elsewhere.

2.3.14 Future problems were analysed from the future travel demands and changes in the transport supply in the Reference Scenario.

Problem Definition Report

2.3.15 The formal Problem Definition Report (PDR) identified the problems for each sector of the transport system, supported by an analysis of the performance of each sector and taking into account consultation with operators and providers, and users of the transport system.

2.3.16 The PDR is built up from the following processes:

- Analysis of Existing Transport System containing a review of available data, new data collected, existing analyses;
- Use of the National Transport Model to provide data for base year and future year Reference scenario to provide an evidence base to support the problem identification process;
- The results of consultation with key stakeholders in order to identify the root cause of problems; and

o Concise statements of the problems identified, following consolidation of all sources of evidence, which will provide an evidence-based identification of the real problems and challenges facing the Romanian Transport Sector.

2.3.17 The above outputs from the PDR provided the essential "operational objectives" which guide Project Identification Phase. These were brought together in working documents (the Problems/Objectives/Interventions (POI) reports) which were agreed with the MT and JASPERS.

2.4 The National Transport Model

Overview

2.4.1 A transport model is a computer-based representation of the movement of people, goods (trips), and vehicles around the transport system. It is intended to provide an indication of how travel behaviour, travel patterns and demands will respond, over time, to changes in policy, infrastructure or services.

2.4.2 A major benefit of using a transport model is that it ensures that schemes, or scheme options, are considered on a consistent basis both within and between studies. An objective of these guidelines is to ensure that all scheme evaluations follow the principles discussed herein and therefore enable the assessing organisation to compare schemes on a like for like basis.

2.4.3 There are certain terms and concepts which have specific meanings when used in transport modelling. These are:

o **Base Year**: this is the year for which a Model is calibrated (or fitted to the data). It is the most recent year for which good, accurate travel and demographic data (relevant to the project) is available. The Base Year of the National Model is 2011.

o **Forecast years**: these are the years for which travel forecasts are made by the model. At least two forecast years should be modelled: the assumed opening year of the project which is being analysed, and 15 years after that. This is because first, typically projects design years are normally 15 years after opening, and secondly, the economic evaluation of a project assumes a 30 year "life" for the project. Forecasting for 15 years after the opening year is an accepted compromise between the uncertainty of long term forecasts, and excessive extrapolation of the economic evaluation. The forecast years for the National Model are 2015, 2020, 2030 and 2040[4].

o **Zones:** in transport models, the area in which the project is located is divided into geographical areas called zones. Within the model, traffic is assumed to enter and leave the transport networks at these zones. Of course, in reality traffic enters and leaves the transport system at individual addresses, and businesses, but it is impossible to obtain the necessary detail of each individual journey, so trips are modelled as zone to zone movements. In other words, zones represent the origins and destinations of trips. In the National Model there are 1160 zones within Romania, and 150 zones outside of Romania.

o **Modes**: in transport modelling, "modes" is shorthand for the modes of transport people and goods use to travel between zones. These can include "non-mechanised" modes of transport such as walking and cycling, and "mechanised" modes such as private car, bus, tram, train, metro, air and waterways and sea transport. "Single mode" models represent travel by one mode only, and "multi-modal" models represent travel by more than one mode. The National

[4] This is an additional year which AECOM added to ensure a better forecast of economic benefits.

Model is a multi-modal model, with all the mechanised modes of travel included, and intermodal freight transport as well.

o **Networks**: In transport models, networks are a computerised representation of the transportation networks. In most models these include the road network, and the public transport networks: bus, tram, metro and heavy rail networks. The public transport networks also include details of routes, frequencies and fares.

o **Trip Matrices**: these are tables of trips between zones. They may contain numbers of vehicles, or the number of persons, for a particular journey purpose, or for a particular time of day, or for a particular mode. These are commonly referred to as Origin – Destination (“O-D”) matrices.

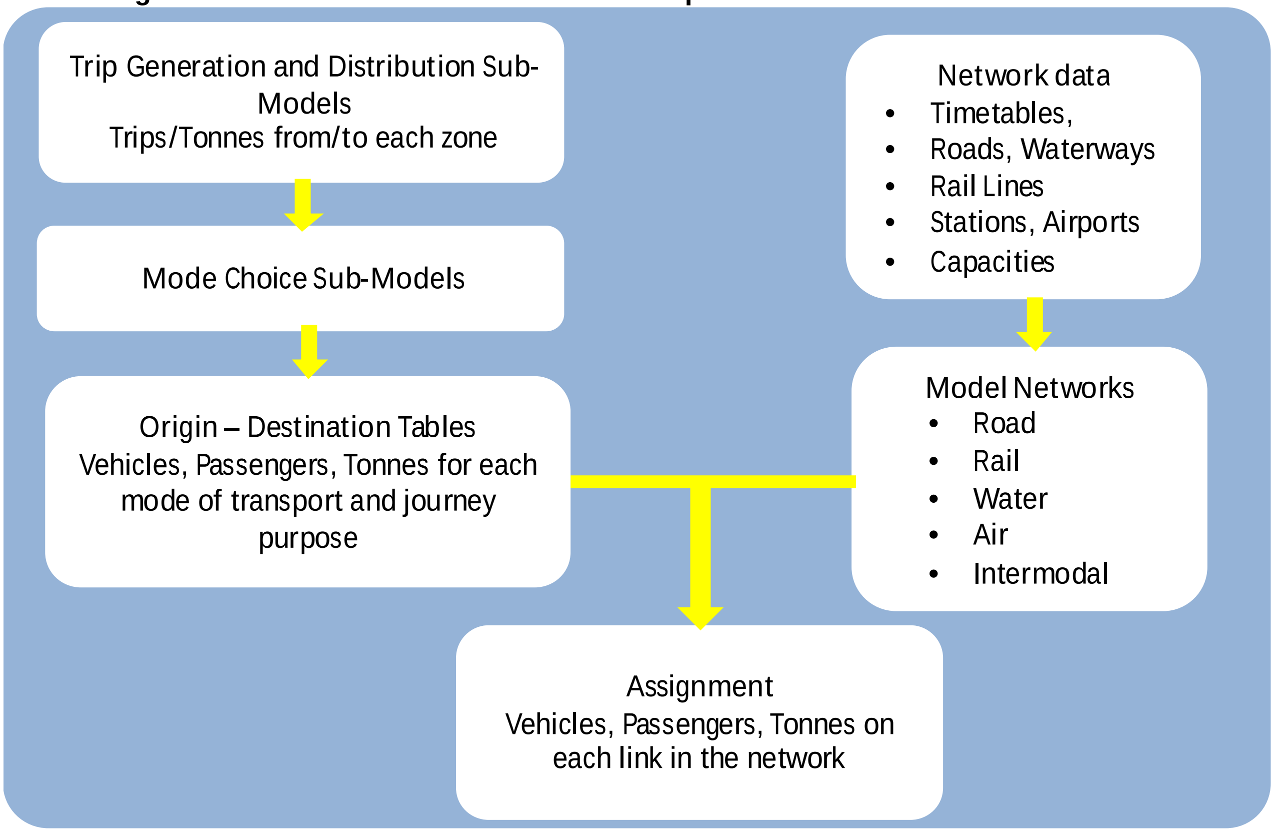
o **Assignment**: During Assignment, the model calculates the least cost route through the network for each O-D pair in the trip matrices, and accumulates the flows on each link in the netowork. Between most origins and destinations there is more than one possible route, so the model repeats this procedure many times until the network is in equilibrium. Each calculation of the paths is called an iteration. The National Model has a total of 1310 zones so the model calculates 1.7m different paths in every iteration.

o **Calibration and Validation**: Calibration is the process of fitting the model and its relationship to the data, while validation is the process of comparing model outputs with independent data. There are internationally-recognised standards for assessing the “goodness-of-fit” for models, depending on the size and scope of the model in question.

o **Modelling Software**. Simple transport models can be built using EXCEL, but there are limitations using this approach. For most modelling applications, there are bespoke packages available and we recommend that these should be used. The National Model is built using EMME, which is a well-known and widely-used suite, which has the necessary flexibility to meet the required scope.

2.4.4 The basic structure of the model is shown on Figure 2.3 below:

Figure 2.3 Basic Structure of National Transport Model



2.4.5 Further details of these processes are given in subsequent sections.

2.4.6 Specific interventions that the National Transport Model (NTM) is capable of modelling include:

- The impact of economic (GDP, income, car ownership) and social (population levels and distribution) changes on travel demand;
- Infrastructure changes;
- New PT services;
- Policy measures including:
- Differential pricing for rail and air;
- Internalisation of external transport costs; and
- Climate change policies (subsidy of low emission modes)
- Implementation of road tax; and
- Car ownership and its linkage to level of taxation

2.4.7 NTM modelled demands are responsive to changes in costs and time for all aspects of travel. The most common interventions in Romania for the Master Plan are improvements to infrastructure, such as motorways and expressways, re-habilitation of railways, more frequent train services, and improved freight terminals at ports and intermodal centres. But the model is also designed to evaluate "policy" interventions, including road user charges, fuel duty increases, or the additional costs of car ownership through registration/tax measures. For example road user charges for heavy vehicles will lead to higher operating costs and this will result in shorter distance HGV trips, transfer to other modes, particularly rail, or suppression of some trips altogether. The developed model structure includes all of these responses. Increasing registration or tax fees on car ownership will moderate car ownership growth through the responses in the car ownership model.

Study Area

2.4.8 The NTM includes:

- o Journeys made wholly within Romania, mainly inter-urban movements. The NTM does not examine urban travel patterns and demands in detail and the data collection and model development was structured accordingly ;
- o International journeys with either an origin or destination in Romania; and
- o International journeys with both their origin and destination outside Romania

2.4.9 A key requirement was to understand the inter-urban and international travel patterns, recognising at the same time that local travel congestion affects parts of the strategic network. Therefore, the study needed good quality data for inter-urban travel, with local urban area travel data deemed less important. These requirements applied equally to the passenger transport and freight markets. However, it is important to recognise that there are important differences between them, particularly in relation to the choice of transport modes.

2.4.10 The NTM, therefore, provides a detailed representation of all transport modes in Romania and their connectivity to the wider European TEN-T transport corridors by mode. The main focus of the model is on inter-urban travel and as such the treatment of urban travel is at a simplified level of detail.

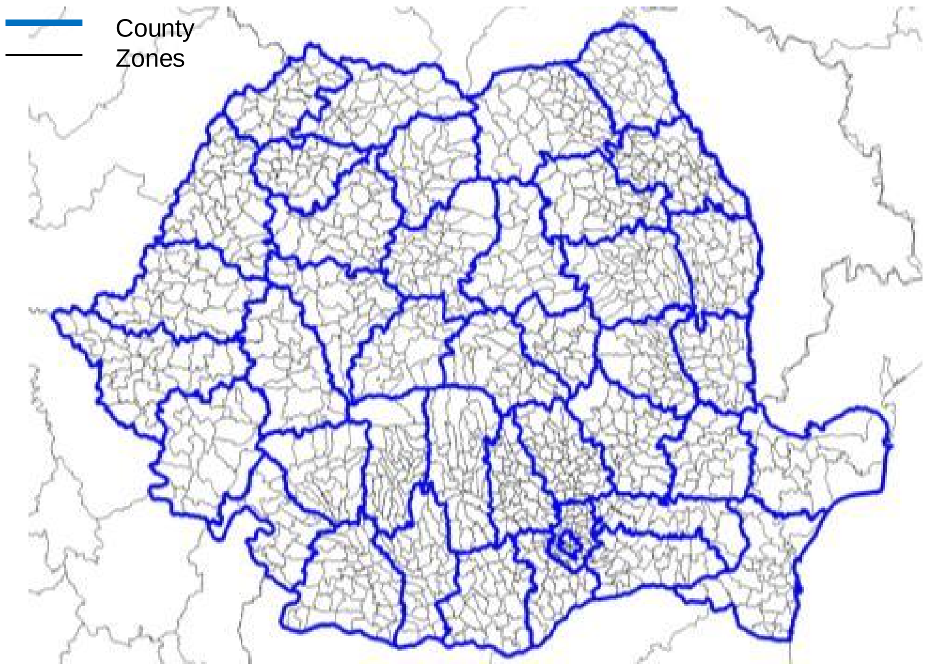
Zoning System

2.4.11 The zoning structure is at a level of spatial detail that meets the objectives of the NTM. The principles adopted in developing the zone system were to ensure that:

- o adequate spatial detail was provided in terms of access to the extensive rail system;
- o zones contained no more than one main town as far as practical;
- o zones outside of the main cities and towns were limited in area so that very large zones were avoided, except in the mountains, where the average population per zone was kept below 15,000;
- o zones followed natural boundaries;
- o zonal boundaries were aggregations of administrative boundaries so that compatibility with planning inputs, and socio-economic datasets could be guaranteed;
- o access to the highway network as properly represented in terms of loading points on key roads;
- o account was taken of special land uses such as Constanta Port; and
- o the zonal structure took account of future development proposals.

2.4.12 Figure 2.4 shows the internal zone system and the model is populated with zonal data on population, jobs, active population, GDP by sector, and car ownership all of which are used in the model forecasting routines.

Figure 2.4 NTM Internal Zone System



2.4.13 This is supplemented by the external zones being specified at the relevant NUTS level as indicated in the study brief. The external zone detail is compatible with Trans-Tool zoning through either aggregation, or disaggregation, of the Trans-Tool zones. Figure 2.5 shows the external zone system.

Figure 2.5 NTM External Zone system

NTM Model Segmentation and Transport Networks

2.4.14 The NTM considers demand at the following levels of segmentation:

- o Passenger Demand (Domestic and International) by:
- o Car availability (CA/NCA);
- o Trip purpose: Business, Commuting, Personal and Vacation/Leisure; and
- o Mode of travel: Car, Rail, Bus, Air and Ferry where available
- o Freight demand by:
- o Commodity (16 separate commodities);
- o Container and general freight; and
- o Mode: Road, Rail, Water and air for international movements

2.4.15 The NTM includes representations of the following transport networks for carriage of passengers and freight:

- o Highway network – passenger cars, passenger bus services, light and heavy goods vehicles;
- o Rail network – rail passenger services (region, interregio and intercity) and rail freight services;
- o Air network – air passenger services and air freight services;
- o Waterway network – freight; and
- o Intermodal facilities.

2.4.16 The NTM highway network, Figure 2.6, contains all motorways and National Roads in Romania, the more heavily used county roads and some local roads to ensure connectivity from zones to the highway network. The rail network, Figure 2.7, includes all stations and rail links on which passenger rail services operate. Finally the waterway network, Figure 2.8, is comprised of the Danube and the channels between Constanta and the Danube, and all the ports along the Danube both in Romania and other countries through which it travels.

Figure 2.6 NTM Internal Highway Network

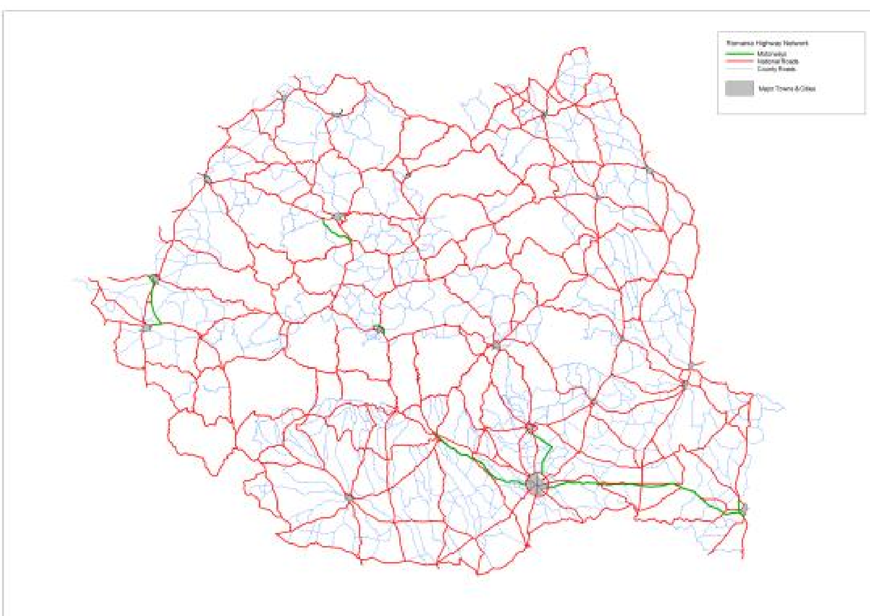


Figure 2.7 NTM Internal Rail Network

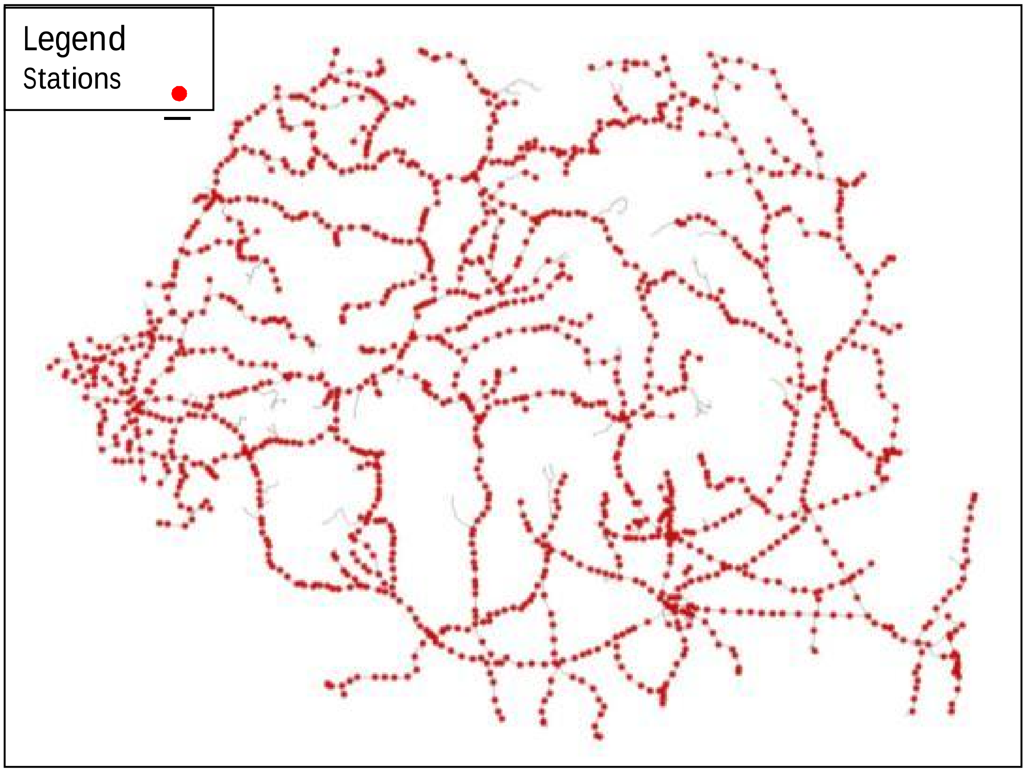
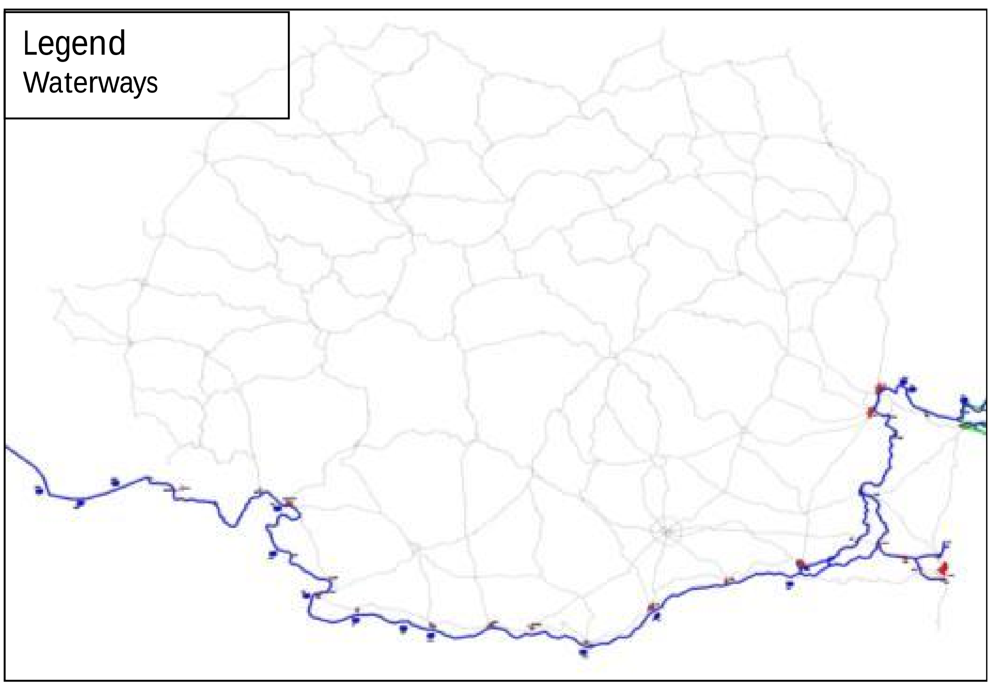


Figure 2.8 NTM Waterway Network

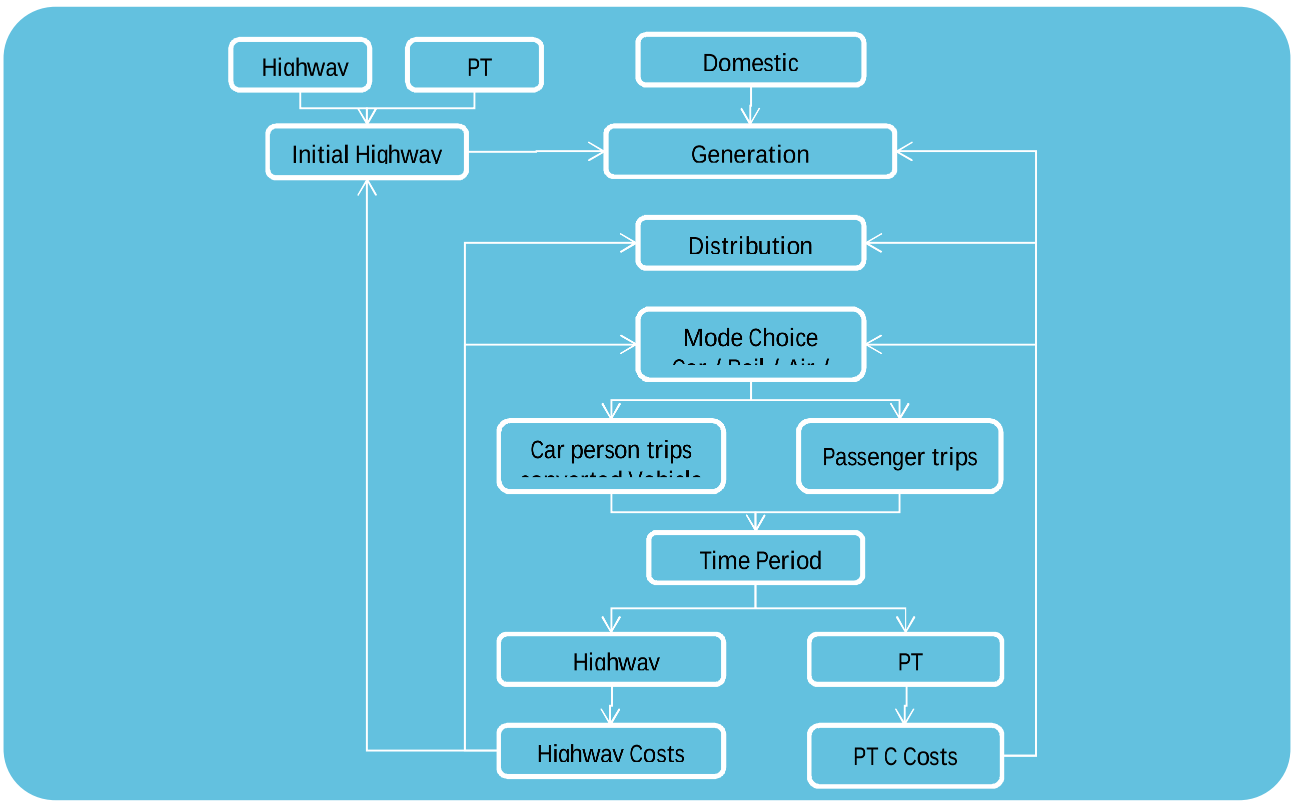


2.4.17 The NTM also includes a representation of air travel through a network comprised of all airports in Romania and links representing all flights from each airport in Romania to all destinations served by direct flights.

NTM Structure

2.4.18 Figures 2.9 and 2.10 show the main components of the model. These are the domestic and international passenger demand model, and the freight demand model (domestic/international). The domestic and international passenger models use the same structure but the coefficients for the demand models are different and reflect the differing characteristics of the travellers making each type of trip.

Figure 2.9 Passenger Model Structure



2.4.19 The main modules contained in the above passenger model structure are:

- o Highway and public transport network definitions:
- o Road(car, bus, and freight);
- o Interurban bus and minibus services;
- o Rail network, intermodal terminals, and rail services;
- o Waterways; and
- o Air
- o Domestic passenger demand model
- o Car ownership model as a function of income growth and car ownership costs;

o Trip generation/attraction growth based on demographic (population and employment) and socio-economic changes (GDP);

o Distribution – calibrated functions by trip purpose including responsiveness to cost changes ; and

o Mode choice

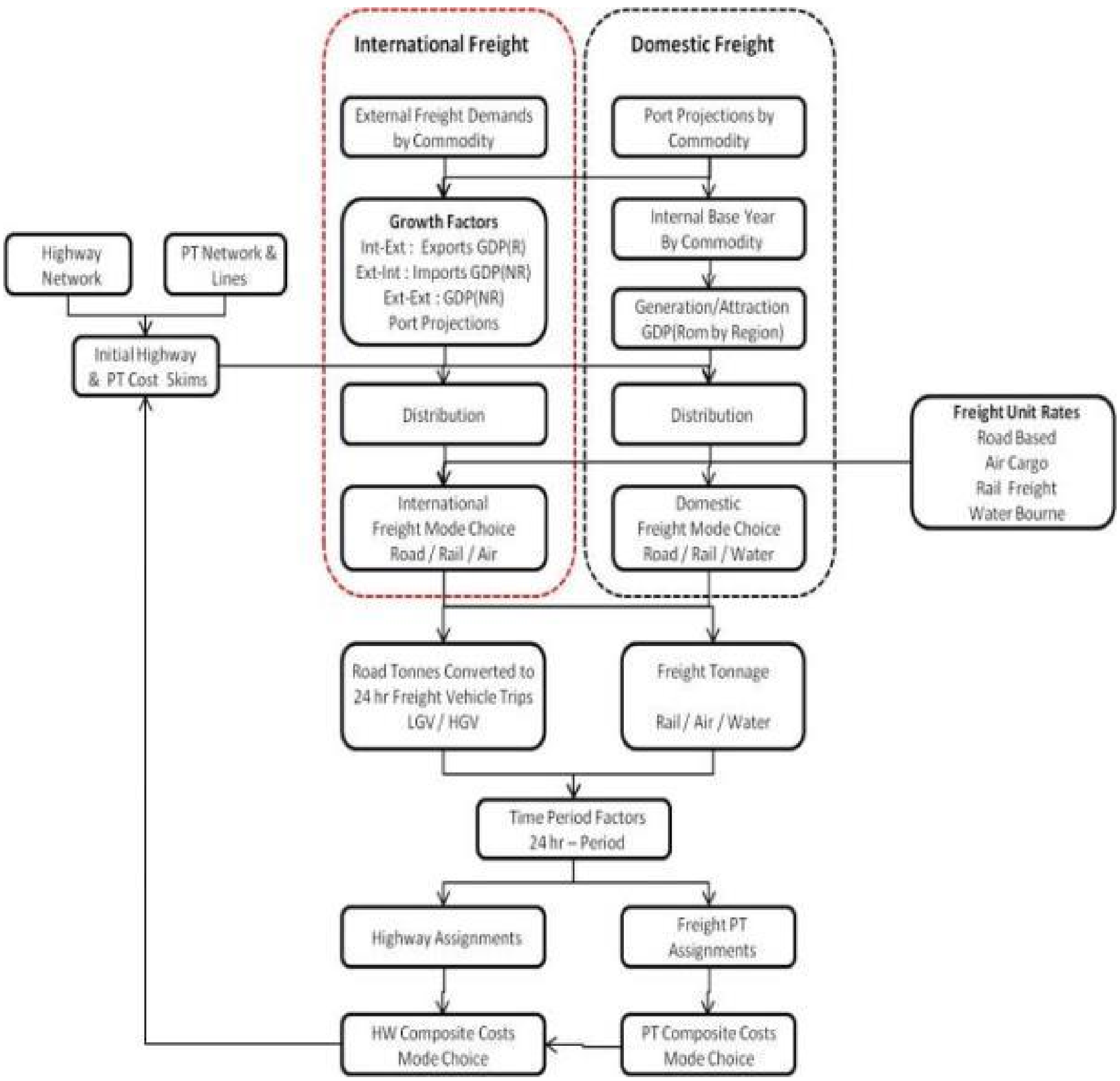
o International passenger demand model

o Direct demand model based on GDP, population and car ownership changes;

o Distribution based on changes in trip ends and generalised costs; and

o Mode choice

Figure 2.10 Domestic and International Freight Model



2.4.20 The main modules contained the above freight model structure are:

o Highway and public transport network definitions:

- o Road(freight);
- o Rail network, intermodal terminals, and rail services;
- o Waterways; and
- o Air
- o Freight model for international and domestic freight demand by commodity in tonnes and vehicle movements
- o Growth factors based on GDP for international and for domestic combination of GDP and population changes;
- o Distribution;
- o Mode choice and intermodal modelling; and
- o Conversion from tonne to vehicles for highway assignment (LGV/HGV)
- o Network assignment models and generalised cost derivation
- o Demand split into four time periods (AM peak, Off-peak, PM Peak, night time); and
- o Generalised costs combined across time periods, modes and destinations for use in demand models

Trip Generation

2.4.21 The NTM contains a set of calibrated base year demands that are used as the basis from which to derive future year forecasts of travel demand by mode based on changes in the main drivers of travel demand. The main drivers of demand used in the model are population, car ownership, employment, and GDP by sector. Separate approaches are taken to the development of future trip ends depending on the nature of the movement being modelled.

2.4.22 Changes in travel demand are typically driven by changes in the socio-economic indicators of the population making the trips. These include indicators related to the size of the potential trip-making group, for example changes in active population dictates the number of commuting trips, and changes in the level of economic activity, given by GDP, impact on the number of freight trips made. Indicators related to the wealth of the trip makers, such as GDP/head, increase rates of trip making as people have greater disposal income and increase their rates of car ownership.

2.4.23 A series of economic factors for Romania and other key countries and regions are used in the model to determine the growth in traffic demand between base and future years. The table below provides a summary on the economic factors used by the model.

Table 2.1 Economic Factors Required by NTM Growth Model

Factor / Geography	**Romania** (at regional level)	**Other key countries & regions** (at national level)
GDP growth	✓	✓
GDP by Economic Activity growth	✓	✓
Total Population growth	✓	✓
Economically Active Population growth	✓	
Employment growth	✓	
Car Ownership growth	✓	✓

2.4.24 Future year forecasts for each of the factors identified in the table above have been derived with the exception of car ownership, which is derived from changes in GDP through a car ownership model calibrated to fit historic ownership trends.

Trip Distribution

2.4.25 The NTM trip distribution model links the estimated trips produced from each zone with trips attracted to other zones. The model considers the balance between the location of these trip ends and the cost of travel (generalised in terms of time, distance, parking charges, and fares) between them, for all locations within Romania, to/from Romania and through Romania.

2.4.26 The number of trips between two zones is estimated to be directly proportional to the number of trip productions in the production zone and attractions in the attraction zone, and inversely proportional to the cost of travel between the zones. The output of the distribution model is a set of travel demand matrices that detail the number of trips from each zone to all other zones for various trip purposes for an average weekday.

2.4.27 The trip distribution models in NTM have the following form:

$$T_{ij} = A_i * P_i * B_j * D_j * IMP_{ij}$$

Where:

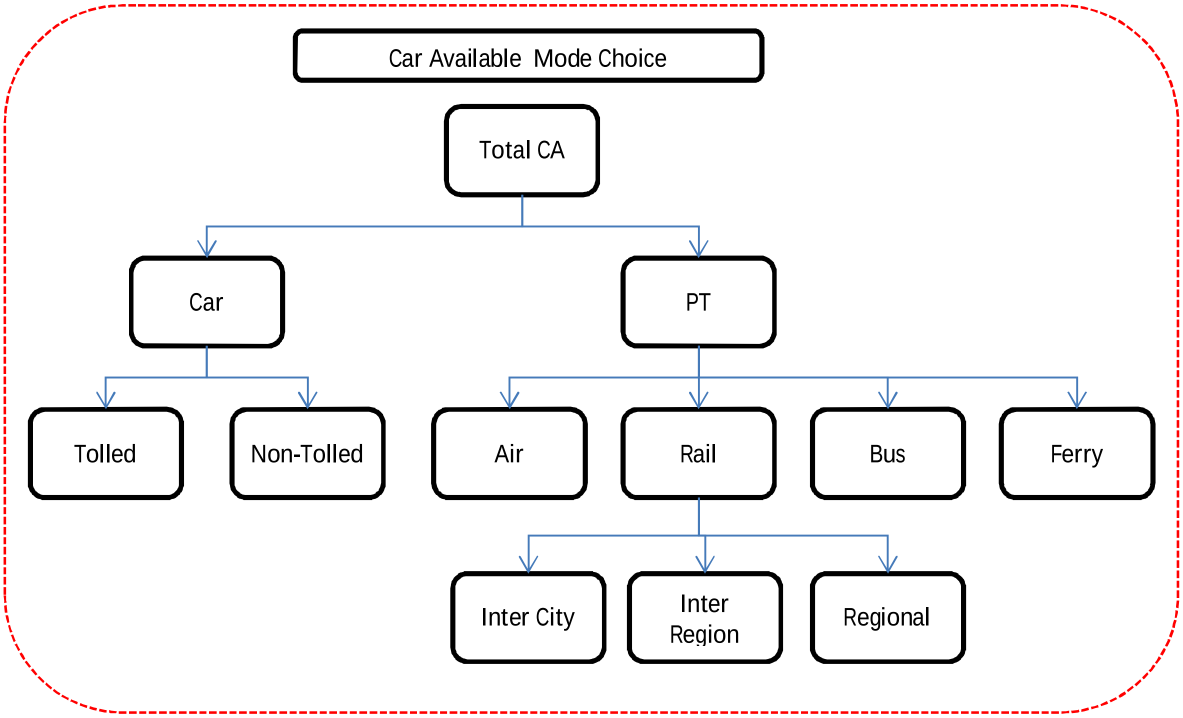
T_{ij} = *predicted trips;*
P_i = *production total;*
D_j = *attraction total;*
IMP_{ij} *is impedance between production and attraction zone pair; and*
A_i **and** B_j *are adjustment factors.*

2.4.28 The impedance functions calibrated in NTM are specific to each purpose and car availability type combination. Therefore a different set of x_0, x_1 and x_2 parameters has been derived for each demand segment within NTM.

Mode Choice Models

2.4.29 Each of the demand models in the study adopts a hierarchical model formulation for the mode choice but in each case, there are specific differences that reflect the domestic and international passenger and freight markets. Figure 1.8 shows the structure of the car available mode choice model as an example of the hierarchical form.

Figure 2.11 NTM Mode Choice Model Hierarchy



Highway Assignment

2.4.30 The highway assignments in NTM are undertaken using a link based capacity restraint process with the speed/flow relationships reflecting the effect of volume, HGV composition, road type, lanes, frontage type, gradient, and road condition on achievable travel speeds. Three highway assignments are undertaken to represent peak, inter-peak and night time travel so that appropriate costs by time of day are generated for use in the model. The three time period assignments are aggregated to create 24 hour flows on the highway network.

2.4.31 The key difference between the assignment periods is the magnitude and pattern of travel demand and trip purpose composition. However, there are also variations in network restrictions, e.g. truck bans for certain times of the day. Public transport service patterns and frequency may also differ by time of day. These differences are applicable both in the base year and in future years.

2.4.32 The transport networks represented in the NTM include:

o Road – including all expressways and National roads, plus the main county roads in traffic terms along with other county roads required for zone connectivity;

o All rail routes and services;

o Long distance bus services;

o Airports and internal domestic air services; and

o Waterways including River Danube and the existing, and proposed linkages to Constanta Port.

Public Transport Assignment

2.4.33 Public transport assignments are undertaken separately by mode of travel. The rail assignment is done in three parts to represent the three main train service types in Romania, each of which has a different fare scale. Separate assignments are then undertaken for inter urban bus passengers and air passengers.

2.4.34 The public transport system is described in terms of the following components:

- The physical network:
- Nodes;
- Links; and
- Interchanges.
- The public transport services:
- Public transport modes;
- Representation of public transport routes (time table information);
- Routeing;
- Service frequency;
- Dwell time; and
- Stopping pattern

Public transport fares.

2.4.35 Bus stops, and rail stations, are represented as nodes in the transport network. In the rail network the station nodes are coded with a boarding time factor in minutes which in the base case is taken to represent an element of rail reliability (average train delay), preference for using the station (ease of interchange), and station quality and range of services. In testing the effect of rail proposals the base year boarding penalty can be adjusted to reflect:

- Improved reliability which is modelled by reducing the element of the boarding penalty that relates to average lateness; and/or
- Improvements to a station which result in rail becoming a more attractive option and which can be modelled by reducing the element of the boarding penalty that reflects station attractiveness.

2.4.36 Rail stations are separately identified and are connected to the adjacent road network by a walk link. All rail stations in Romania have been included in the rail network model definition.

2.4.37 Airports are defined as separate nodes that link to the network of air routes and also to the highway network to enable representation of access by car/taxi or bus, and the rail network where a rail exists to the airport.

2.4.38 Ports on the River Danube are individually represented and have links to the adjacent highway network as well as the waterway network.

NTM Capabilities

2.4.39 This section summarises the type of transport operations and specific interventions that the NTM is capable of representing, which are set out in Table 2.2. Where there are areas that cannot be fully modelled in the NTM, such as new/modernised airports, and passenger ferry services separate bespoke demand models have been constructed.

Table 2.2 NTM Capabilities

Intervention		Treatment in Model				
		Modelled	Frequency	Distribution	Mode Choice	Assignment
Road Improvements	New Infrastructure	Yes	*	**	**	****
	Change in speed limits	Yes	*	*	*	***
	Heavy vehicle restrictions	Yes			*	****
	Road User Charges	Yes	*	**	**	****
	Road Closures	Yes			*	****
	Rehabilitation	Yes	*	*	*	**
	Driver Information Systems	No				
Railway Projects	New Lines, conventional and high speed.	Yes	*	**	***	**
	Electrification	Yes	*	*	***	**
	Improvements to Existing Lines, including reconstruction	Yes		*	***	**
	New services, higher frequencies and new connections	Yes		*	**	*
	Changes in Fares	Yes	**	**	****	**
	New Rolling Stock: carriages	Yes			**	
	New Rolling Stock: Locomotives	Yes			**	
	Rehabilitation of Bridges and Tunnels	Yes		*	**	**
	Signalling systems / Advanced Telematics	No				
	Modernisation of stations	Yes	*		***	
Improvements to Inter-City Bus Services	Improvements to roads which will affect existing Services	Yes	*	**	***	*
	New services, higher frequencies and new connections	Yes	*	**	***	*
	Changes in Fares	Yes	*	**	***	
	New buses	Yes			**	
	New bus stations	Yes			**	
	Modernisation of existing bus stations	Yes			**	
	Integration of bus and rail services	Yes		*	***	**

Intervention		Treatment in Model				
Air Transport	New services	Yes	**	**	***	
	Changes in Fares	Yes	**	**	***	
	New aeroplanes / Airport Modernisation / Air Traffic Control Systems	No				
	Integration of internal air and rail services	Yes		*	***	*
Freight Transport	Improvements to existing roads, and new roads.	Yes			**	****
	Changes in Rates, including infrastructure charges on CFR	Yes			***	
	Road User Charges for HGV	Yes			***	****
	Restrictions on HGV movements, e.g. at weekends, or weight limits	Yes			*	****
	Improvements to the River Danube and Channels	Yes			***	
	Modernisation of Danube ports	Yes			**	
Intermodal Transport	New or improved intermodal terminals, including logistics centres	Yes			***	**
	New container services by rail	Yes			***	
	New or improved rail stations	Yes			***	*
	New or improved bus stations	Yes			***	*
	Integration of bus and rail	Yes	*	*	***	*

Dimensions of the NTM

2.4.40 The main physical dimensions of the NTM transport system base year representations are shown in Table 2.3. The NTM contains a detailed representation of the inter-urban transport networks and the services that operate on it.

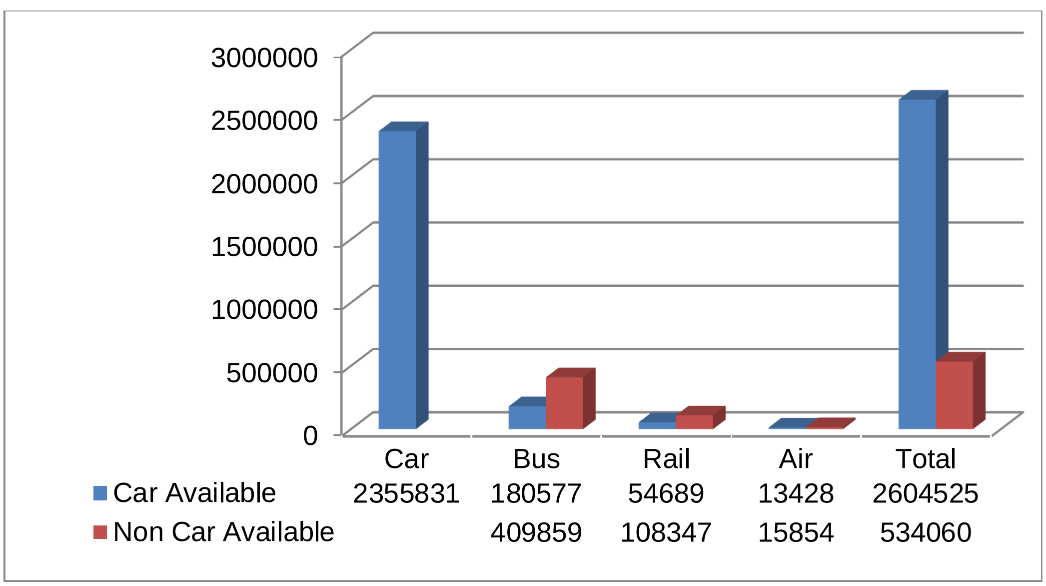
Table 2.3 NTM Base Year Model Dimensions (Internal Network)

<table>
<tr><th>Variable</th><th>Mode</th><th colspan="2">Total</th></tr>
<tr><td>Zones</td><td>All</td><td colspan="2">1,169 (134 external)</td></tr>
<tr><td colspan="2"></td><td>Nodes</td><td>Links</td></tr>
<tr><td rowspan="4">Transport Networks</td><td>Road</td><td>9,430</td><td>20,882</td></tr>
<tr><td>Rail</td><td>2,466</td><td>5,028</td></tr>
<tr><td>Water</td><td>66</td><td>132</td></tr>
<tr><td>Air</td><td>15</td><td>30</td></tr>
<tr><td rowspan="3">Transport Services (All)</td><td>Rail</td><td colspan="2">2,240</td></tr>
<tr><td>Bus</td><td colspan="2">4,155</td></tr>
<tr><td>Air</td><td colspan="2">469</td></tr>
</table>

Source: AECOM NTM

Base Year – Overall Indicators

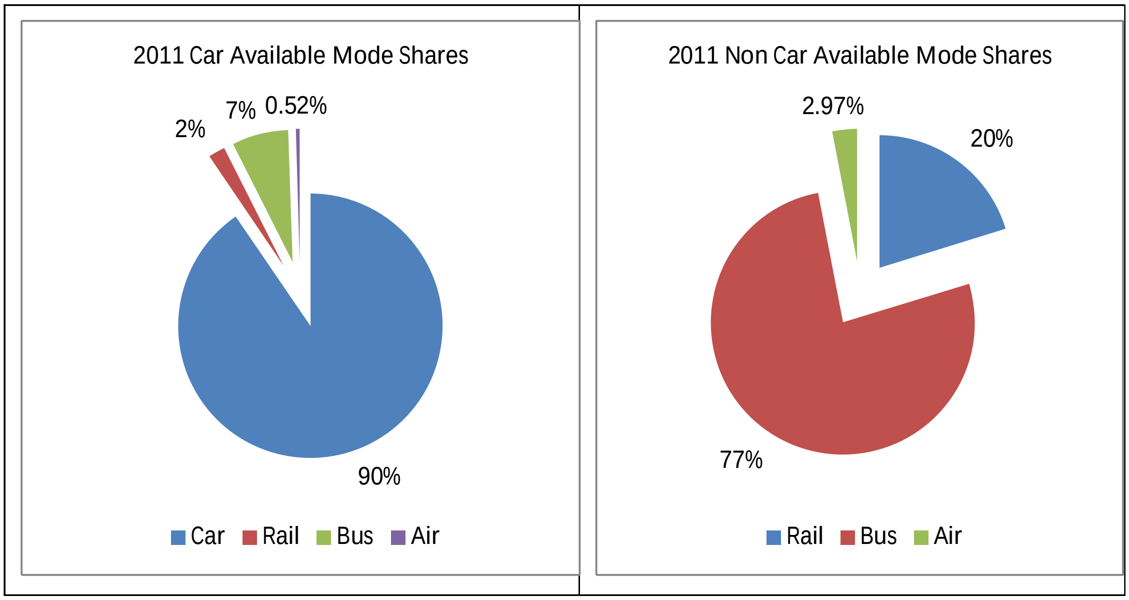
2.4.41 The base year passenger travel demands in the NTM are derived from comprehensive surveys undertaken with car, bus, rail and air passengers. This data was combined with ticket sales data for rail and air movements to produce passenger travel demands by mode as shown in Figure 3.12. Over three million inter-urban passenger trips were made on an average day in the base year.



Source: AECOM NTM

Figure 2.12 NTM Base Passenger Trips

2.4.42 The passenger mode shares in the base year are shown in Figure 3.13 for car available and non-car available travellers respectively. As expected only a relatively small proportion of car available travellers opt to use public transport, 10%. In the non-car available market the main mode is bus, 77% , followed by rail, 20%. Overall 77% of passenger travel is by car, 18% by bus, and only 5% by rail and air.



Source: AECOM NTM

Figure 2.13 NTM Base Year Passenger Mode Shares

2.4.43 The base year freight demands in the NTM are derived from comprehensive surveys undertaken with road hauliers, individual consignment data for rail freight, and port and airport details of freight handled by commodity. The split of freight traffic between the main modes is as follows:

- o Road freight tonne kms 53.3%
- o Rail freight tonne kms 24.2%
- o Waterways tonne kms 22.5%

Source: INS

NTM Reference Case Scenario (2020)

Travel Demand Growth

2.4.44 The NTM uses economic and demographic factors for Romania and neighbouring countries, together with the transport network structure and conditions as inputs to its forecasts. The main drivers of forecast demand are GDP, population, employment, economically active population, and car ownership.

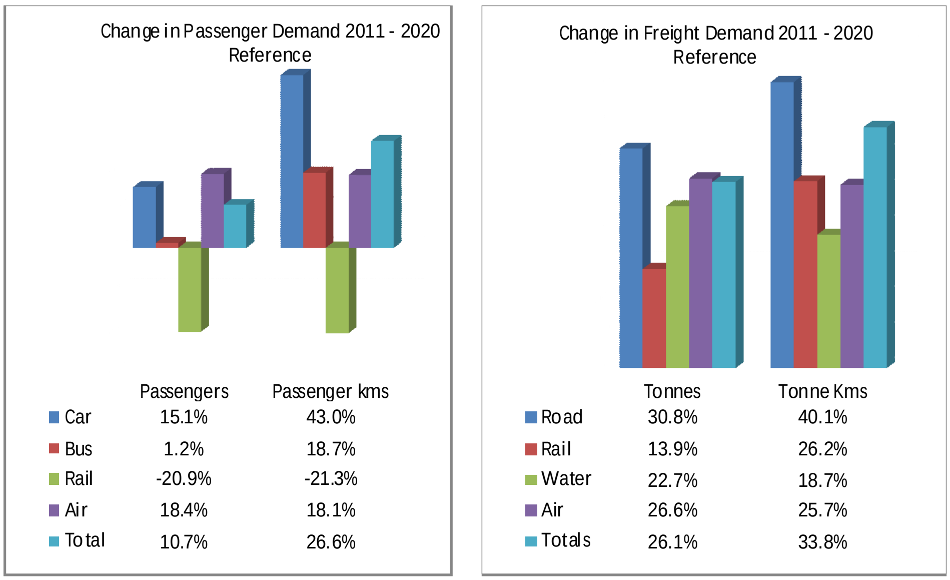
2.4.45 Between 2011 and 2020 the current predicted change in the drivers of travel demand is:

- o GDP increases by 26.4%;
- o Population decreases by 1.8%;
- o Employment increases by 3.6%;

- o Economically active population decreases by -3.4%; and
- o Car ownership increases by 29%.

Source: National Committee of Prognosis, EIU, IMF, OECD

2.4.46 The NTM model outputs are the absolute travel demands, and changes between the base situation and future years. Figure 3.14 shows the forecast changes in passenger and freight demands by mode between the model base year 2011 and the reference case in 2020, both in terms of trips made and kilometres travelled/transported.

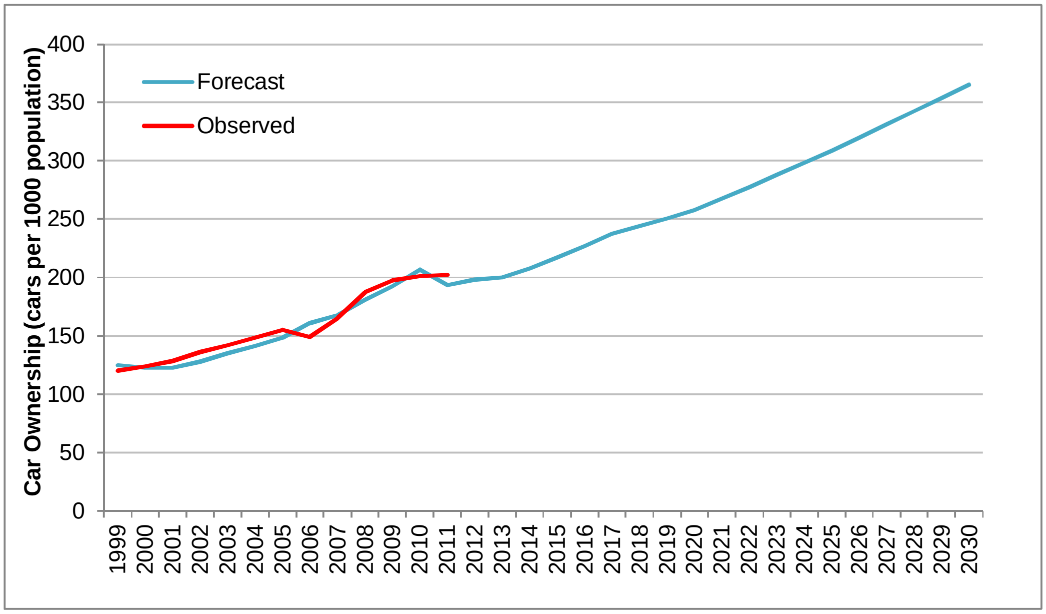


Source: AECOM NTM

Figure 2.14 Change in Passenger and Freight Demand 2011 – 2020 Reference Case

2.4.47 The total increase in daily passenger trips in the 2020 Reference Case is forecast to be 10.7% with a 26.6% increase in total passenger km. Freight demands experience similar patterns of growth with tonnes up by 26% and tonne km by 34%.

2.4.48 Car ownership levels in Romania are still at relatively low levels which means that car ownership is forecast to grow strongly, 19.3% of population have a car available in 2011 rising to 24.9% by 2020. As car ownership rises, the proportion of the population that is “captive” to public transport declines. This reduction in the captive market, changes the dynamics of the public transport sector, with an increasing need to compete with road for people who now have a car available.



Source: AECOM NTM

Figure 2.15 Car Ownership Growth, 2011 - 2020

2.4.49 The 2020 Reference Scenario contains a number of committed highway schemes, but in comparison relatively little investment in rail. The 20.9% reduction in rail trips is mainly driven by the growth in car ownership levels, and committed investment in the highway network, which makes car travel more attractive. Bus travel is forecast to increase slightly by 1.2%. Like rail, the bus sector will be adversely affected by the growth in car ownership, but will benefit from the highway investment projects which provide faster journey times. Car trips are forecast to increase by 15.1%, reflecting of the increase in car ownership, and the committed investments in the highway network.

2.4.50 The forecast increase in total passenger km (of 26.6%) is due to a number of factors, including:

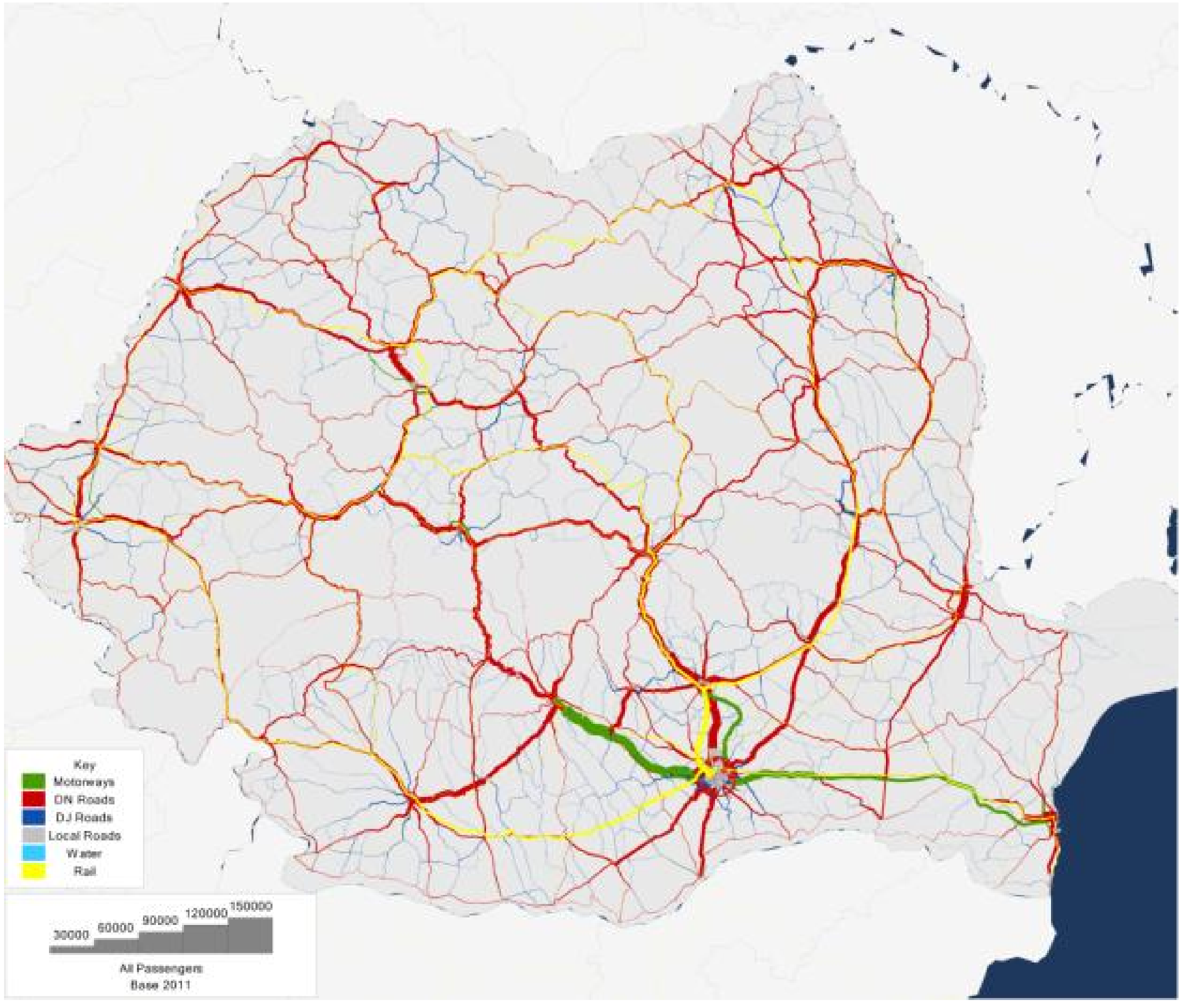
o Significantly increased speeds on a number of corridors due to the almost doubling of the motorway network by 2020 (from 550kms to 993kms), which encourages greater interaction between major cities and leads to an increase in journey distances; and

o Growth in household incomes of 29% and therefore lower cost of operating a car, which leads to a propensity for individuals to make longer distance trips.

Passenger and Freight Flows

2.4.51 The following sections provide an overview of the situation in 2011 and 2020 with respect to the passenger and freight flows on the road, rail, and waterways networks.

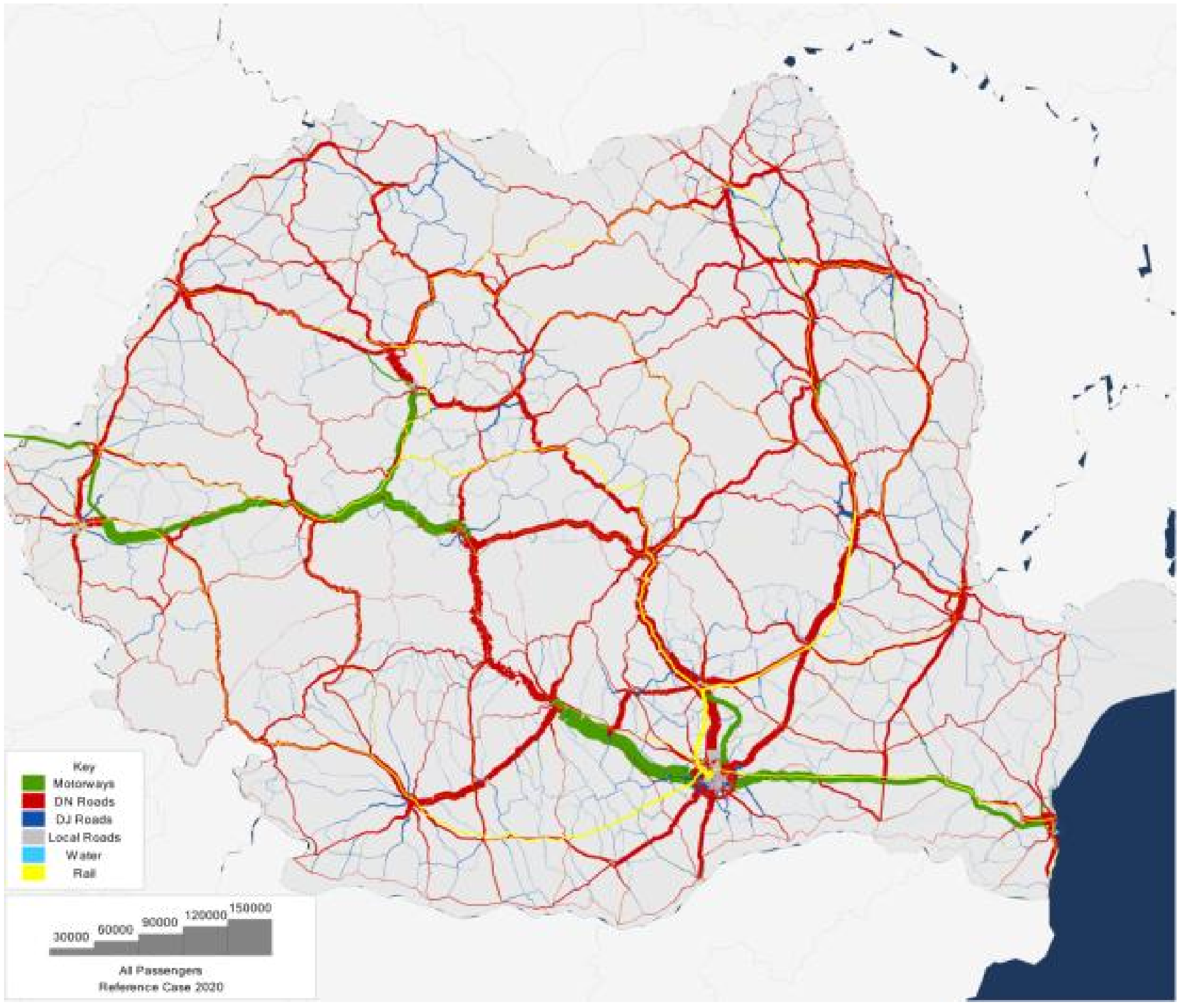
2.4.52 The current dominant position of road transport for passenger trips is clear to see in 2011 with significant rail shares only on the radial routes from Bucharest.



Source: AECOM NTM

Figure 2.16 Daily Passenger Trip Volumes in Romania, by Mode, 2011

2.4.53 By 2020 the contribution made by rail to passenger trip volumes has declined further and passenger trip volumes are dominated by road trips. This is the forecast situation without the interventions proposed by the Master Plan, with only the current committed projects in place. Essentially it rerpresents a “business-as-usual” scenario.

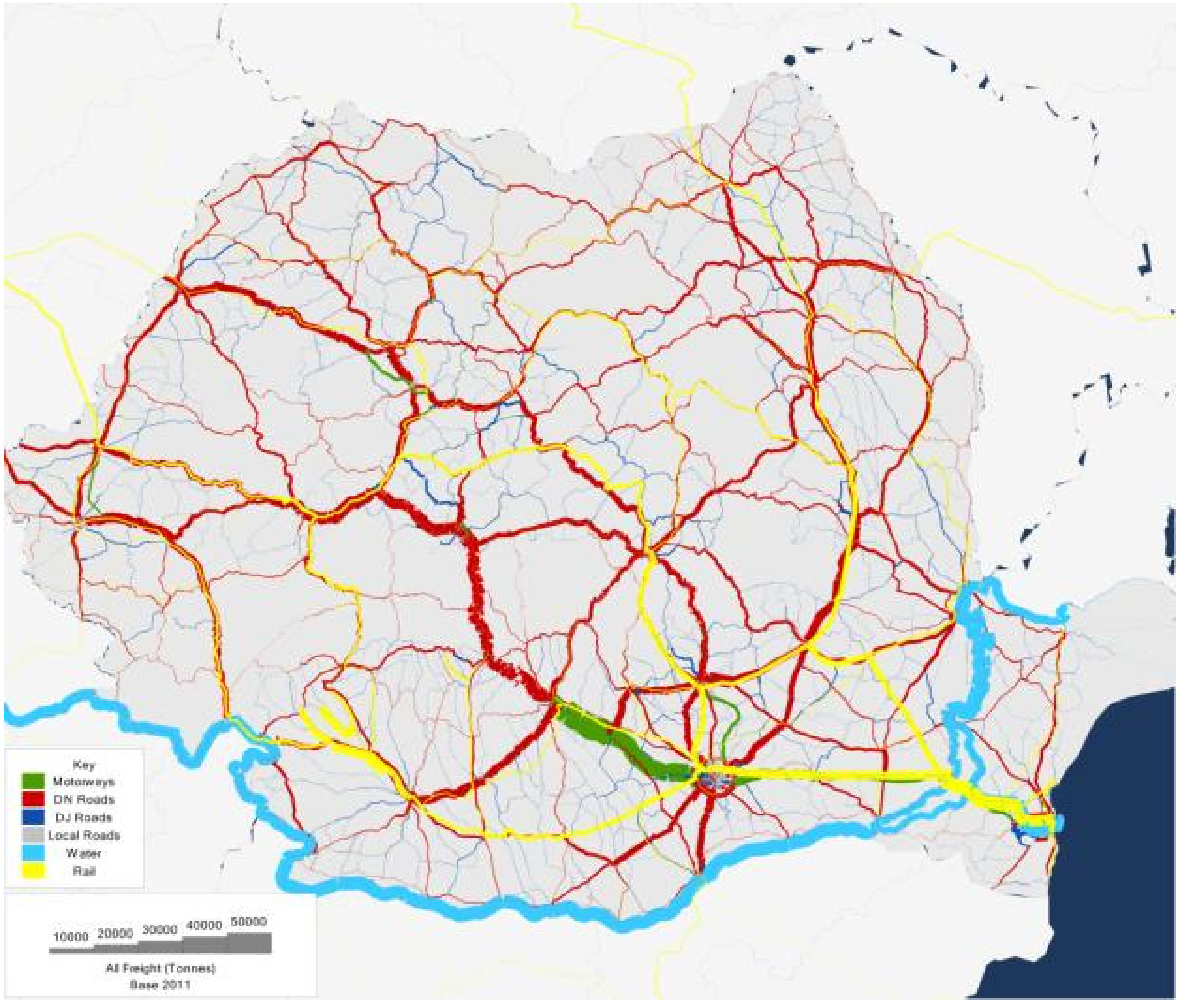


Source: AECOM NTM

Figure 2.17 Daily Passenger Trip Volumes in Romania, by Mode, 2020

2.4.54 There is a much larger share of non-road freight than non-road passenger movements. The main freight movements by road are into Bucharest, and by rail into Constanta port. The role of the River Danube as a freight artery is clearly illustrated. Corridor IV (N) is an important road corridor, as well as flows between industrial centres as Craiova and Pitesti. There is also a strong road freight movement in the Pitesti-Ploiesti-Buzau-Bacau corridor.

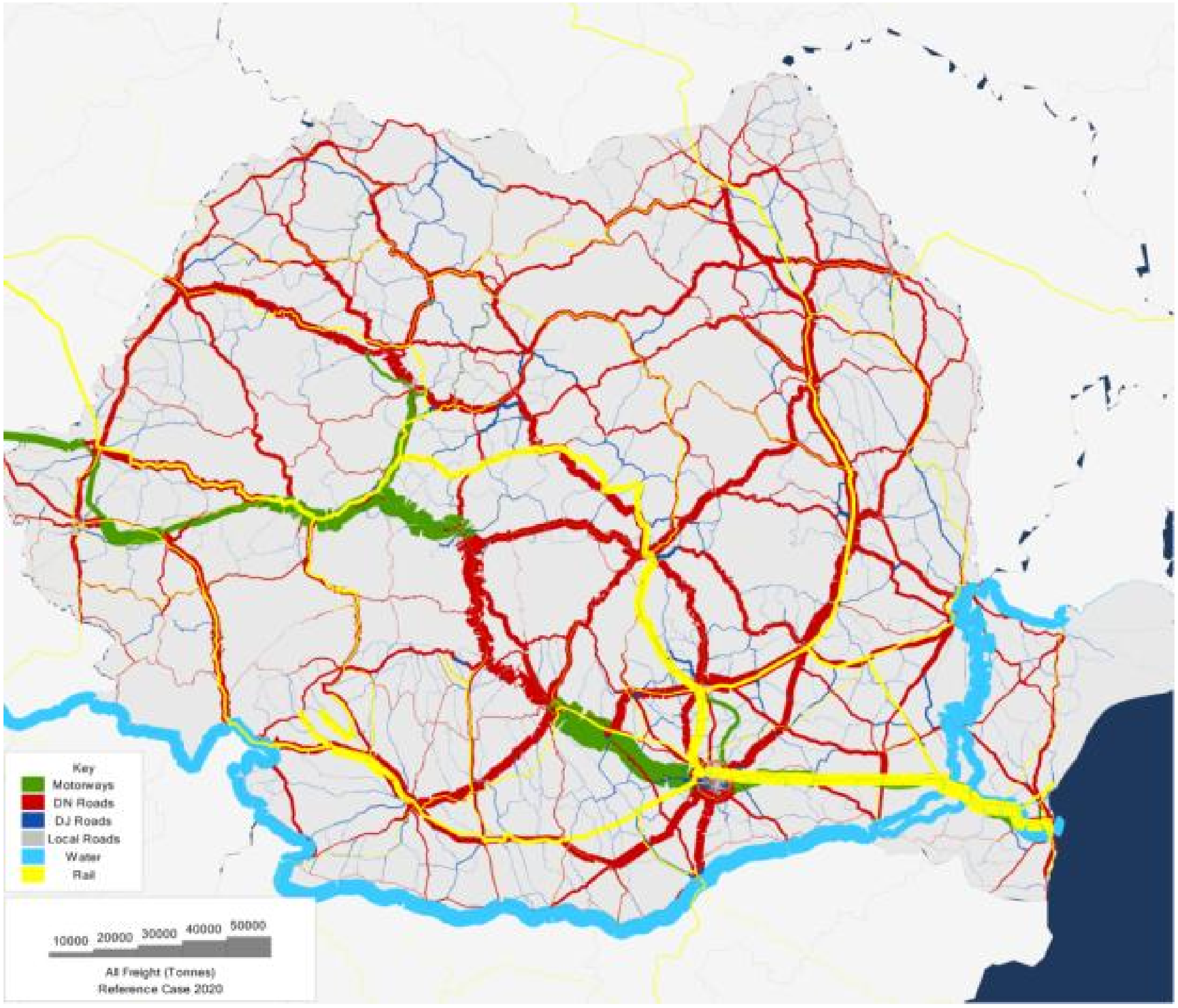
2.4.55 The major cross-border flows are to Bulgaria at Giurgiu and the Hungarian border. For rail, the border crossing with the Ukraine at Siret and Moldova at Ungheni are also of some importance. The largest cross border flows in terms of tonnes is on the Danube at Iron Gates.



Source: AECOM NTM

Figure 2.18 Daily Freight Volumes (Tonnes) in Romania by Mode, 2011

2.4.56 By 2020, the increase in freight tonne km is more closely aligned with the change in tonnes carried than was observed for passenger growth. This is because reducing the journey time and cost of freight transport will not, in itself, necessarily lead to longer journeys. For freight the average distance moved is also dependant on changes in the distribution of economic activities, that is where goods are produced, or imported, and consumed or exported.



Source: AECOM NTM

Figure 2.19 Daily Freight Volume (Tonnes) in Romania by Mode, 2020

2.4.57 This section has presented an overview of the National Model with some key statistics. The Model, in conjunction with the CBA tool, was subsequently used to test, and evaluate, a large number of potential interventions. These tests and the results are described in Chapters 5-10 of this Report.

2.5 Cost-Benefit Analysis

2.5.1 Cost Benefit Analysis (CBA) is a standard method used to assess the performance of a project or intervention in terms of measuring the return on investment.

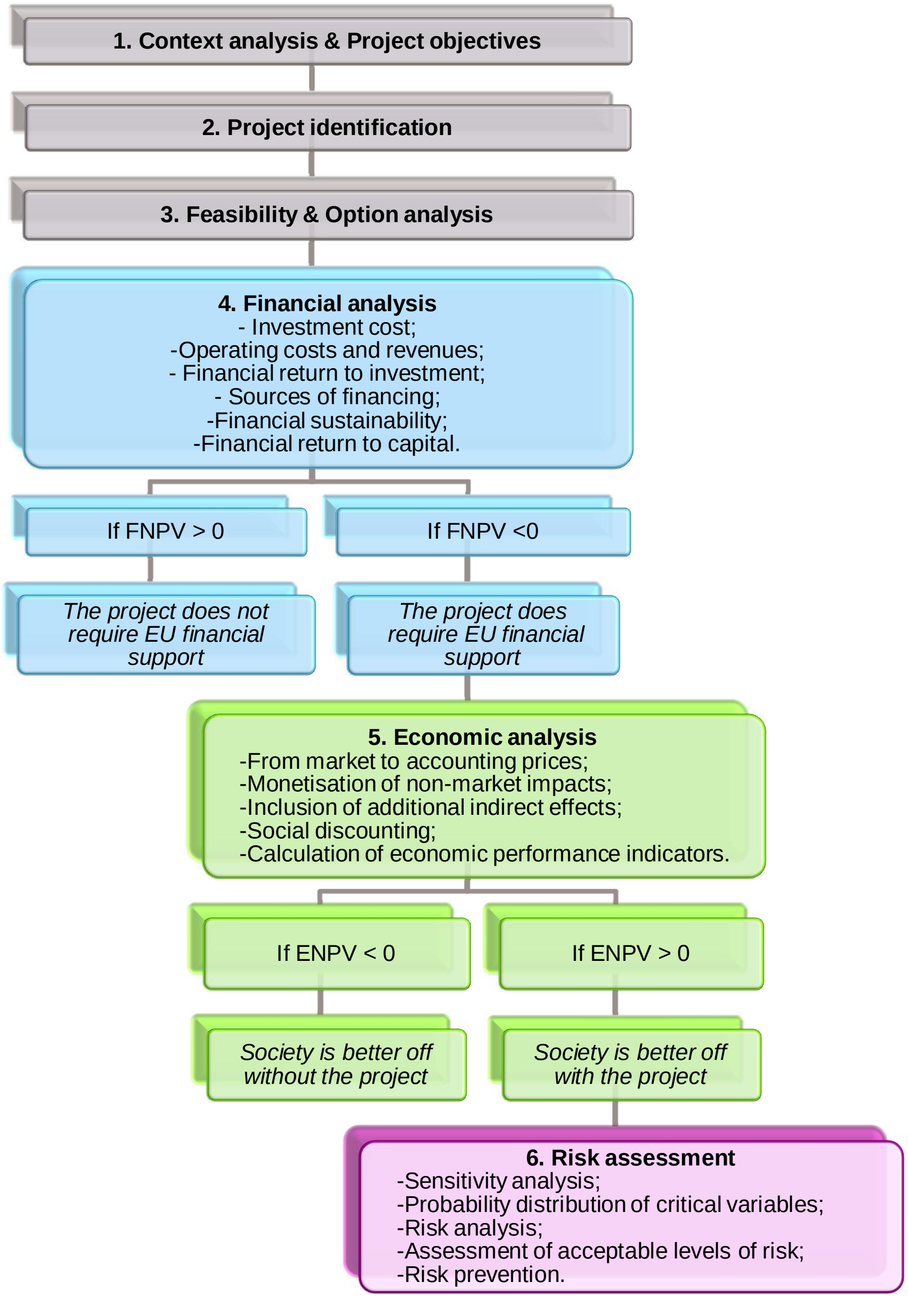
2.5.2 The approach that should be adopted in undertaking CBA is set out in the National Assessment Guidelines for Transport Projects, Vol 2 Part C developed as part of the Masterplan study. The guidance has been developed to meet the requirements set out in the 'General Guidelines for Cost Benefit Analysis of Projects to be supported by the Structural Instruments' published by the Ministry of Economy and Finance, Authority for Coordination of Structural Instruments.

2.5.3 The following documents have also informed the advice contained in this guidance:

- Developing Harmonised European Approaches for Transport Costing and Project Assessment (HEATCO), 'HEATCO Deliverable 5. Proposal for Harmonised Guidelines', 2006;
- European Commission (EC), 'Guidance on the Methodology for Carrying out Cost-Benefit Analysis: Working Document 4', 2006;
- Internalisation Measures and Policies for All external Cost of Transport (IMPACT), 'Handbook on estimation of external costs in the transport sector', 2008;
- Ministry of Economy and Finance – Authority for the Coordination of Structural Instruments, 'Cost Benefit Analysis of Transport Projects to be supported by the Cohesion Fund and the European Regional Development Fund in 2007-2013', 2008
- New Energy Externalities Developments for Sustainability (NEEDS), 'NEEDS Deliverable 2.1. Value Transfer Techniques and Expected Uncertainties', 2009;
- Unification of accounts for and marginal costs for Transport Efficiency (UNITE), 'Valuation Conversions for UNITE', 2001.
- UK Department for Transport (UK DfT), 'Web-based Transport Appraisal Guidance (WebTAG)', 2002, 2010.
- Government of Romania, 'Government Decision No28 on the approval of general framework contents of the technical-economic documentations for public investments and the methodology for developing general cost estimates for investment objectives and works', 2008

2.5.4 There are three stages to Cost Benefit Analysis, economic analysis, financial analysis and risk analysis. As outlined in the National Assessment Guidelines for Transport Projects at a strategy stage only economic analysis is required as this indicates which projects provide the greatest total benefit to society for the cost invested. Financial and risk analysis follows at the more detailed scheme appraisal stage.

2.5.5 The flow chart for the CBA process is shown below:



Purpose of Economic Cost Benefit Analysis

2.5.6 The main purpose of the economic analysis is to assess whether the project's benefits exceed its costs and whether it is therefore worthwhile to progress in a strict economic sense. Other factors are considered using Multi-Criteriate Analysis (MCA), see the following paragraph. The analysis is conducted from the view point of the whole of society, not just the project owners.

2.5.7 To capture the range of economic impacts the analysis includes both elements with direct monetary value, such as construction and maintenance costs and vehicle operating cost savings; as well as elements without direct market value such as time savings, accident reduction and environmental impacts. In order to allow consistent comparison of costs and benefits across a project all impacts are monetised (i.e. attached a monetary value) and then aggregated to determine the net benefits of the project. From this it can be determined whether the project is desirable and worth implementing. However it is important to recognise that not all project impacts can be monetised and it is therefore important to consider the results of the CBA in conjunction with the wider Multi-Criteria Appraisal (MCA), which considers these non-monetised impacts.

Purpose of Financial Cost Benefit Analysis

2.5.8 The main purpose of the financial analysis is to assess the financial profitability and sustainability of the project from the viewpoint of the project owners. This is done by considering the financial cash flow for the project; this includes both outflows in terms of investment, maintenance and operating costs; and inflows in terms of funding sources and user revenues/charges. Simplistically this analysis shows whether the project will generate a positive net cash flow over the appraisal period (profitability) and whether the cumulative net cash flow since project inception is never less than zero (sustainability).

2.5.9 The analysis initially considers the project's financial profitability without EU funding to assess whether EU funding is needed. For projects seeking EU funding this is required to demonstrate that the project is eligible for EU funding.

2.5.10 For a project to be viable the financial analysis needs to demonstrate that the funding sources (including, if relevant an EU grant) and revenue generated by the project are sufficient to offset the project costs, and that the funding and revenue are appropriately profiled across the appraisal period to ensure that in any year the project will not require any additional external bridging funding.

Purpose of Risk Assessment

2.5.11 Project appraisal is a forecasting process and as such has inherent uncertainties. These uncertainties come from both data limitations in the existing situation, and uncertainties as to how aspects, such as demand for travel, costs for infrastructure etc will change over time. The risk assessment considers these uncertainties and their impact on the outcomes of both the economic and financial appraisal.

Cost Benefit Analysis within Masterplan study

2.5.12 Economic Cost Benefit Appraisal has been undertaken for schemes as part of the Masterplan selection and prioritisation process. To assist in this a CBA Tool has been developed by AECOM that interfaces with the National Transport Model to undertake multi-modal CBA analysis of projects.

2.5.13 The CBA Tool is an Excel based program for estimating the economic impact of a project or a scenario (consisting of more than one projects), building on the theoretical background of welfare economics. The CBA Tool uses data automatically extracted from the National Transport model, along with scheme cost estimates to calculate the economic impact of a project in a manner consistent with requirements of the National Assessment Guidelines for Transport Projects.

2.5.14 The main functions of the CBA Tool are:

- to import the outputs of the National Transport Model;
- to use appropriate values to express anticipated benefits in monetary terms;
- to analyse the value of the anticipated benefits, by discounting and applying conversion factors where applicable;

- o to produce key economic indicators, by comparing anticipated benefits to estimated costs.

2.5.15 Costs elements considered in the multi-modal analysis include:

- o Investment costs,
- o Changes in maintenance cost,
- o Changes in operating costs (for operating new infrastructure/services).

2.5.16 Benefits considered in the multi-modal analysis include:

- o Vehicle operating cost changes for users (Freight and road passengers)
- o Time savings for users,
- o Variations in external costs:

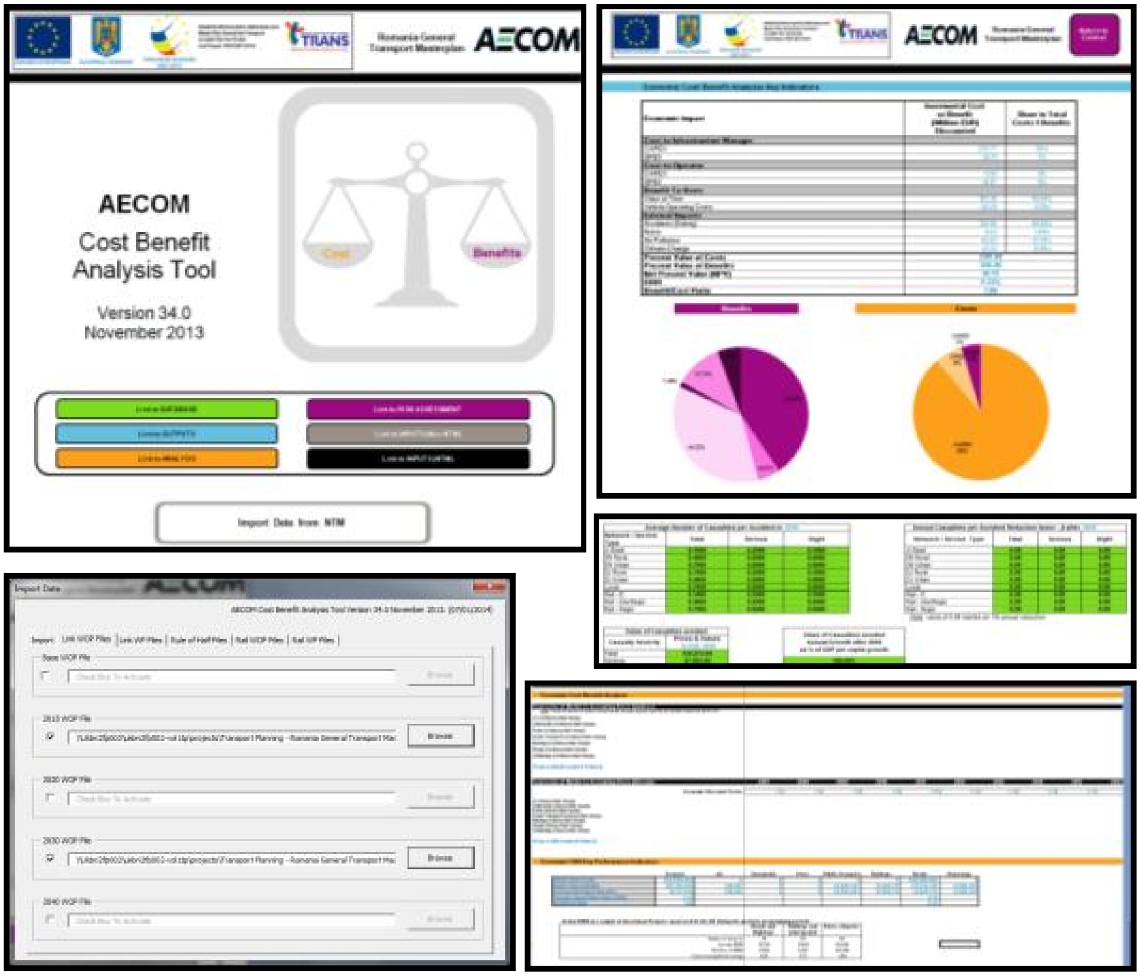
- Emissions (greenhouse gas and local pollution),
- Noise,
- Accidents,
- Congestion costs.

2.5.17 Costs and benefits can be positive or negative depending upon the nature of the project being assessed.

2.5.18 Key indicators from the analysis are:

- o Present Value of Benefits (PVB) – total discounted benefits during the appraisal period
- o Present Value of Costs (PVC) – total discounted economic costs incurred during the appraisal period
- o Economic Net Present value (ENPV) –the absolute size of the project net benefits.
- o Benefit to Cost Ratio (BCR) – the ratio between total benefit and costs. This gives the relative size of the project net benefits but is independent of project size
- o Economic Internal Rate of Return (EIRR) – Similar to BCR it is independent of project size and gives an indication of the scale of benefits relative to the investment cost.

2.5.19 The tool is fully described in Volume 2, Appendix A of the Appraisal Guidance. It produces a wide range of outputs, describing all the various inputs and outputs for all modes. Some of the screens are reproduced below:



2.6 Prioritisation of Projects

Overview

2.6.1 Projects prioritisation forms a critical step in producing the Master Plan programme of investments as the investment needs identified are far greater than the available financial allocations. This implies the necessity of ranking projects considering a set of predefined evaluation criteria, which will assure a fair and neutral project prioritisation. Adding the funding restrictions to the list of ranked projects leads to obtaining of the implementation calendar.

2.6.2 The first phase appraisal for a strategy is aimed at discarding the projects having a low economic performance, having in view one of the high-level objectives of the Master Plan, which is “Economic Efficiency”. The projects which emerge from this will be strong candidates for inclusion in one or both of the development scenarios based on “Economic Sustainability” – termed “ES” - or “Economic and Environmental Sustainability” – termed “EES”.

2.6.3 This requires a broad, but robust, appraisal of projects. The appraisal was undertaken using a Cost Benefit Analysis (CBA) and a summary Multi Criteria Analysis (MCA).

2.6.4 The overall process of project appraisal is illustrated in Figure 2.20 below.

Figure 2.20 Project and Scenario Appraisal Process

2.6.5 The process of generating projects based on the problem analysis and identification of the interventions that best address the specific problems has been described in Sections 2.2-2.4. Sections 2.5 and 2.6 described the main evaluation tools used in the project appraisal stage, which are the National Transport Model and the Cost-Benefit Analysis.

2.6.6 The following sections describe how projects were appraised individually and then incorporated into the two "Do Something" Scenarios, the Economic Sustainability Scenario ("ES") and the Economic and Environmental Sustainability Scenario ("EES").

2.6.7 Individual projects have been tested before assembly into the "ES" and "EES" scenarios. This is because it is a firm requirement of the EU that each of projects in the Master Plan must be justified in economic terms, before consolidation into scenarios. If the scenarios were assembled first there is danger that a form of "cross-subsidization" would occur, that is, while the scenario as a whole might produce economic benefits, which might disguise the fact that the economic benefits from some projects might offset disbenefits from others.

2.6.8 Therefore, the initial list of projects has been processed using the economic value as the sole criterion. All projects for consideration in the Master Plan will have to meet this criterion (EIRR > 3%) and this is consistent with EU requirements. This minimum value for EIRR was defined considering the uncertainty margin inherent to the high level of analysis, having in mind that the economic discount rate is 5% for the next EU programming period.

2.6.9 The projects which pass the economic criterion have been combined into the ES and EES Scenario.

Selection of Projects for the ES and EES Scenarios

2.6.10 The output from the project appraisal is a list of projects with scores out of 100 for each Scenario. A critical step was then to determine which projects should then have priority and for this the approach is to assign weights to each score for each criterion to give an overall project score.

2.6.11 The weighting of the projects and their score depends on the characteristics of the two scenarios. For the ES Scenario, projects have a higher weighting for the economic criteria than for the EES Scenario. The weighting system, based on past consultations with MT and JASPERS, are presented in Table 2.21.

Table 2.21 Criteria and Weights for ES and EES Scenarios

Criteria	ES	EES
Economic Efficiency	70%	50%
Trans-European Integration/TEN-T Policy	30%	20%
Environmental Impact	-	20%
Sustainability	Not scored but dealt with the distribution of funds by mode	
Balanced Economic Development	-	10%

Source: AECOM / MT / Jaspers

2.6.12 Each project was scored for each scenario using the above weights. A ranking of projects within each scenario was then be made.

2.6.13 Based on the results of the project appraisal, there are identified projects which are strong candidates for inclusion in the two development scenarios “economic sustainability” and “economic and environmental sustainability”. Typically:

- Projects that have limited economic benefits and significant environmental disbenefits were dropped;
- Projects which have high economic benefits and significant environmental disbenefits were included in the “economic sustainability” scenario;
- Projects that have limited economic benefits but positive environmental benefits were included in the “economic and environmental sustainability” scenario; and
- Projects which have high economic benefits and are neutral or positive in environmental terms were included in both scenarios.

Appraisal of the ES and EES Scenarios: Application of Multi Criteria Analysis

2.6.14 The Master Plan represents the direction of the country’s transport for the next 15-20 years. It is therefore important that a broad appraisal is made at the strategic level so that the overall impact of the Master Plan is known and assessed. This assessment will be made using the following criteria.

- Economic Impacts
    - EIRR
- Transport Policy
    - On TEN-T Core/Comprehensive
- Environmental Impacts
    - Impact on Natura 2000 sites
- Sustainability
    - Transfer of Traffic to Sustainable Modes
- Balanced Economic Development
    - Accessibility of less accessible regions

2.6.15 The weighting and scoring systems for the ES and EES scenarios are presented in Tables 2.22 and 2.23. These have been agreed with the Ministry of Transport and reflect the high-level objectives of the Master Plan as defined in the Terms of Reference.

Table 2.22 Economic Sustainability Scenario

No.	Master Plan High-Level Objective	Criteria	Indicator/ Reference	Weight	Scoring criteria	Scoring (points)
A	Economic Efficiency	Economic Performance	EIRR	70%	5%	0
					Maximum EIRR	100
					> 5% < highest EIRR%	Proportionally from 100 = highest EIRR
B	Trans-European Integration	Relation with TEN-T network	TEN-T Regulation	30%	Core TEN-T link	100
					Comprehensive TEN-T link	30
					Other links	0
C	Sustainability	Contribution to cleaner transport modes policy	White Paper	Not scored under MCA but dealt with via pre-allocation of funding per sectors: this scenario assumes 51% roads, 44% for rail and 5% for Ports, IWT, Intermodal and Aviation		

Source: AECOM / MT / Jaspers

Table 2.23 Economic and Environmental Sustainability Scenario

No.	Master Plan High-Level Objective	Criteria	Indicator/ Reference	Weight	Scoring criteria	Scoring (points)
A	Economic Efficiency	Economic Performance	EIRR	50%	5%	0
					Maximum EIRR	100
					> 5% < highest EIRR%	Proportionally from 100 = highest EIRR
B	Trans-European Integration	Relation with TEN-T network	TEN-T Regulation	20%	Core TEN-T link	100
					Comprehensive TEN-T link	50
					Secondary connectivity with TEN-T	10
					Other links	0
C	Environmental Impact	Potential environmental impact (in particular on NATURA 2000 sites)	SEA	20%	Very high	-100
					High	-80
					Moderate	-50
					Low	-30
					None	0
D	Sustainability	Contribution	White	Not scored under MCA but dealt with via		

No.	Master Plan High-Level Objective	Criteria	Indicator/ Reference	Weight	Scoring criteria	Scoring (points)
		to cleaner transport modes policy	Paper	pre-allocation of funding per sectors: this scenario assumes 51% roads, 44% for rail and 5% for Ports, IWT, Intermodal and Aviation		
E	Balanced Economic Development	Improving the accessibility of less accessible regions	GTMP accessibility maps	10%	Improving link to an area with low accessibility both to foreign and domestic markets	100
					Improving link to an area with low accessibility to foreign markets	70
					Improving link to an area with low accessibility to domestic markets	50
					Links to areas with good accessibility	0

Source: AECOM / MT / Jaspers

Description of the Evaluation Criteria

A. Economic Efficiency

2.6.16 The Transport Economic Impacts criterion relates to the direct economic impacts of the project on the efficiency of the transport system, evaluated by the EIRR (Economic Internal Rate of Return).

B. Trans-European Integration

2.6.17 On TEN-T Core or Comprehensive: this sub criterion reflects the fact that it is both Romania's and the EU's policy to improve the quality of the most important routes within and across the country. In addition, the routes selected for the core TEN-T have already been the subject of careful analysis and evaluation, so it is logical that the Master Plan should favour projects which improve these routes. The inclusion of a National Network criterion acknowledges the fact that the TEN-T network is not comprehensive geographically and there are many large and medium sized cities which are connected only by national roads, and lines designated "core" on the railway network.

2.6.18 Maps of the TEN-T network in Romania are provided in Appendix B.

C. Environmental Impact

2.6.19 ***Natura 2000*** relates to the Natura 2000 network of sites that contain the most important habitats across Europe. Natura 2000 sites have EU legislation to protect them. This sub-objective should appraise the extent, if any, to which the strategy, or the major projects within a strategy, is likely to impact on these sites in terms of numbers and magnitude. The habitat and species in these locations are protected, so any impact from a project is likely to be seen as significant.

2.6.20 The assessment is also considering the extent, if any, the project is likely to impact on biodiversity features outside Natura 2000 sites, rating the importance of these features and any inter-relationships, as well as providing a description of the impact on biodiversity, including the effects on its distinctive quality and local diversity.

D. Transfer of Traffic to Sustainable Modes

2.6.21 Sustainability includes the transfer of traffic to sustainable modes of transport and reflects both national and EU policy towards “sustainable” modes of transport. These are those modes, which, in the long term, have lower emissions and energy consumption per passenger km, and which have better safety records. In practice this means rail and water transport, and to some extent long distance bus. The National Model provides a means of quantifying the transfer of passengers and freight to these sustainable modes of transport, as a basis for assessing the impact of each scenario.

E. Balanced Economic Development

2.6.22 It comprised the improvements towards areas with low accessibility both to foreign and domestic markets. A comprehensive analysis on the accessibility was produced using the National Transport Model and its results were then used to quantify this criterion.

Selection of the Preferred Scenario

2.6.23 At the end of appraisal stage, the optimised strategies for the development of Romania’s transport system have been developed based on “economic sustainability” and “economic and environmental sustainability” respectively. The final stage of the process was to determine an overall recommended strategy.

2.6.24 The recommended strategy seeks to synthesise the two scenario strategies by combining the strongest elements of both scenarios, within the likely funding available. Given that both scenarios refer to economic sustainability it is likely that there will be substantial overlap between them. Projects that are advocated under both scenarios are likely to be included in the final recommended strategy, plus some projects which are included in one but not the other.

2.6.25 Outputs from the CBA and MCA provide a succinct and objective assessment of the main impacts of each scenario. This allows the appraisers to consider the benefits and disbenefits of each scenario, based on a consistent, transparent and auditable approach.

2.6.26 Chapter 12 includes the results of the prioritisation process and the recommendations of the preferred scenario.

2.7 Ex-Ante Conditionalities

2.7.1 The document "Guidance on Ex ante Conditionalities for the European Structural and Investment Funds PART II" [5] states that the Thematic Objective transport objective for transport is:

Promoting sustainable transport and removing bottlenecks in key network infrastructures (referred to in Article 9(7))

2.7.2 The corresponding ex-ante conditionality is:

The existence of a comprehensive plan or plans or framework or frameworks for transport investment in accordance with the Member States' institutional set-up (including public transport at regional and local level) which supports infrastructure development and improves connectivity to the TEN-T comprehensive and core networks.

2.7.3 The Master Plan is a comprehensive plan for all modes of transport, developed using quantified measures for the economic contribution of projects, their contribution to the Core TEN-T, and their contribution to national and regional development. The key assessment tools are the National Transport Model, which assesses the demand for travel based on observed data and mode choice relationships, and takes into account the level of service offered and travel times and costs for the different modes of transport. It provides an integrated, neutral, and holistic for assessing transport interventions. The CBA procedure, developed especially for the Master Plan, uses EC-recommended procedures to evaluate the economic benefits of an intervention taking into account the benefits to existing travellers and freight, diverted and traffic from other routes and modes, and newly-generated traffic. It values travellers time, costs, vehicle operating costs, and environmental impacts such as vehicle emissions and noise, using accepted values, and compares these with the investment and operating costs. The outputs are produced in the EC-approved format for Funding Applications to the Structural Funds.

2.7.4 Table 2.24 shows the ex-ante conditionalities and the way the Master Plan follows them.

[5] EUROPEAN COMMISSION, Directorate-General- Regional and Urban Policy, DRAFT **-"Guidance on Ex ante Conditionality for the European Structural and Investment Funds", PART II, "Criteria for fulfilment"**

Table 2.24 Ex-ante conditionalities

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	**Elements of non-fulfilment**
The existence of a comprehensive transport plan or plans or framework or frameworks for transport investment which:		
• The relevant operational programme and where appropriate, the Partnership Agreement contains a reference to the name of the plan or framework and provides a hyperlink to the documents(s).	NO	Master Plan not yet approved
– complies with legal requirements for strategic environmental assessment :		
• An environmental report has been prepared in which the likely significant effects on the environement of the implementation of the plan or framework and reasonable alternatives taking into account the objectives and the geographical scope of the comprehensive transport plan or framework, are identified, described and evaluated.	YES	
• The draft plan or framework and the environmental report have been made available to the public and the authorities with specific environmental responsibilities designated by the Member States who are likely to be concerned by the environemental effects of the implementing plans.	NO	The draft plan has been made available to the public and the authorities on October 2012 and October 2013 . Each chapter from Environmental Report have been presented in the working group. The final Environmental Report will be make available after Appropriate Assessment will be approved by MECC. The final Environmental Report must include the conclusion of Appropriate Assessment.
• In case of possible significant transboundary effects, the draft plan or framework and the environmental report have been forwarded to the relevant/affected Member States.	NO	In case of possible significant transboundary effects the Final Environmental Report and Master Plan will be forwarded to the relevant/affected Member States. Responsibility to inform the relevant/affected Member States lies the central public authority promoting the plan (in this case the Ministry of Transport), on the recommendation of the Ministry of Environment and Climate Change. It is recommended that the establishment of States which are notified to be performed by the central public authority promotes plan with the Ministry of Environment and Climate Change. In according with GD 1076/2004 Art. 22 (2) din HG 1076/2004 menţionează că *„În cazul în care implementarea planului sau programului poate*

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	Elements of non-fulfilment
		avea efecte semnificative transfrontieră, titularul, prin intermediul autorităţii publice centrale care promovează planul sau programul, este obligat să transmită proiectul de plan sau de program şi raportul de mediu elaborat pentru acesta, în limba engleză, autorităţilor centrale de mediu din statele posibil afectate, în termen de maximum 20 de zile calendaristice de la finalizarea raportului de mediu, conform art. 21 alin. (3)".
• The environmental report and the opinions expressed in the relevant consultations (including as appropriate transboundary ones) have been duly taken into account during the preparation of the comprehensive transport plan or framework.	NO	See previous.
• When the plan or framework has been adopted, the authorities with environmental responsibilities, the public and any Member State consulted, are informed and the following items have been made available to them: the plan or framework as adopted, the statement referred to in Article 9(1) of the SEA Directive and the measures concerning monitoring referred to in Article 10 of the SEA Directive.	NO	See previous.
– sets out the contribution to the single European Transport Area consistent with Article 10 of Regulation (EU) No1315/2013 of the European Parliament and of the Council, including priorities for investments in the core TEN-T network and the comprehensive network where investment from the ERDF and CF is envisaged; and secondary connectivity.	**YES**	
• The investment priorities included in the comprehensive transport plan or framework connect the identified main nodes (see the list in annex) and provide for connections with neighbouring countries' transport infrastructure networks. The Member State shall also demonstrate how its investments in secondary connectivity will contribute to the single European Transport Area[57].	YES	
• The comprehensive transport plan or framework includes measures that are necessary for:		
ensuring enhanced accessibility and connectivity for all regions of the Union while taking into consideration the specific case of islands, isolated networks and sparsely populated, remote and outermost regions;	YES	
ensuring optimal integration of the transport modes and interoperability within transport modes;	YES	
bridging missing links and removing bottlenecks, in particular in cross-border	YES	

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	Elements of non-fulfilment
sections;		
promoting the efficient and sustainable use of the infrastructure and, where necessary, increase the capacity;	YES	
improving or maintaining the quality of infrastructure in terms of safety, security, efficiency, climate and where appropriate disaster resilience, environmental performances, social conditions, accessibility for all users, including elderly people, persons with reduced mobility and disabled passengers, as well as the quality of services and continuity of traffic flows;	YES	
implementing and deploying telematic applications as well as promoting innovative technological development;	YES	
• Particular consideration shall also be given in the comprehensive transport plan or framework to measures that are necessary for:		
ensuring fuel security through increased energy efficiency and promoting the use of alternative and in particular low or zero carbon energy sources and propulsion systems;	YES	
mitigating exposure of urban areas to negative effects of transiting rail and road transport;	YES	
removing administrative and technical barriers, in particular to the interoperability of the trans-European transport network and to competition.	YES	
- ***sets out a realistic and mature pipeline for projects envisaged for support from the ERDF and CF***		
- The plan or framework for transport investments includes a table containing :		
a list of prioritised projects (studies, upgrading or works) that the Member State envisages launching over the period and asking for support from the ERDF and CF.	NO	To be included in separate Strategy Report containing Implementation Plan
the name of the authorities and stakeholders involved in the lead of these projects, the foreseen expenditures and a financing plan,	NO	To be included in separate Strategy Report containing Implementation Plan
a realistic timetable for delivery of the projects identified indicating dates for feasibility studies, a Cost Benefit Analysis, EIA procedure58, an implementation timetable including procurement and permission procedures, and for potential state aid notification (per phase for bigger projects).	NO	To be included in separate Strategy Report containing Implementation Plan
- ***Measures to ensure the capacity of intermediary bodies and beneficiaries to deliver the project pipeline.***		
- The Member State has provided an adequate description of the measures already in place to ensure the capacity of intermediary bodies and beneficiaries to deliver the project pipeline:		

Criteria for fulfilment	Criteria fulfilled?	
	YES / NO	Elements of non-fulfilment
These measures are based on the analysis of both the bottlenecks and of the weaknesses of intermediary bodies and beneficiaries to deliver timely the project pipeline, as regards:		
o tendering (including tenders without competition, irregularities)	NO	To be included in the Final version of the Master Plan
o implementing environmental requirements,	NO	To be included in the Final version of the Master Plan
o developing and prioritising a mature project pipeline,	YES	
o financial project management,	NO	To be included in the Final version of the Master Plan
o funding for maintenance and operations,	YES	
o administrative burden and red tape,	NO	To be included in the Final version of the Master Plan
o managing complex systems (ITS such as ETCS-ERTMS, VTMIS, RIS, emaritime services and air traffic management system).	YES	
They include training and appropriate internal procedures to monitor and identifiy potential delays and to ensure a smooth and effective procurement;	NO	MT are still in the process of establishing new organizational structures
A early warning system is in place to identify and solve any difficulties rising from intermediary bodies and beneficiairies when delivering the project pipeline;	NO	MT are still in the process of establishing new organizational structures
Adequate assistance schemes are in place to help beneficiaries during procedure and implementation to be able to replace projects quickly when implementation is blocked.	NO	MT are still in the process of establishing new organizational structures

Existing Situation and Recent Transport Trends in Romania and Europe

3 Existing Situation and Recent Transport Trends in Romania and Europe

3.1 GTMP Relation with the Relevant EU Transport Policy Documents

3.1.1 Any national or regional economic growth is strengthened by a competitive and progressive transportation system, that is geared to the needs of customers and operated as a sustainable network offering high quality and affordable services.

3.1.2 To achieve such a system, policies of all levels have to be coordinated and harmonised. This harmonisation supports not only the economic development and trade but also avoids extra costs to the transport system, and improves the capital and labour productivity within the European Union.

3.1.3 The EU's responsibility for policy-making varies enormously across its range of policy interests. In some spheres arrangements are well established, and effective policy instruments – legal and financial – are usually available. In other spheres, EU involvement is marginal, policy processes may be confined to little more than occasional exchanges of ideas and information.

3.1.4 The main aim of all EU policies is to create an integrated market, not only to dismantle internal barriers and provide conditions for fair trade, but also to give it many of the characteristics of an economic and monetary union.

3.1.5 The EU's main policy responsibilities could be divided into five major groups:

- establishing the Single European Market;
- macroeconomic and financial policies;
- functional policies;
- sectorial policies; and
- external policies.

3.1.6 Functional policies have a well-defined functional purpose and more specific nature than the macroeconomic policies. The best known functional policies are the justice and home affairs, cohesion, and research and technological development. Other policies are directed towards specific economic sectors – covering coal and steel, atomic energy, agriculture and transport. These sectoral policies were explicitly provided for in the Founding Treaties.

3.1.7 The EU transport policy is a component of this integration process. It does have a regulatory emphasis in the areas of working conditions and the environmental protection because of market implications. It also develops a framework for an integrated transport market not just finding solutions to internal barriers. rriers. In the transport sector, the extent of the EU policy involvement can be seen as responsibility shared between the EU and the member states

3.1.8 From the multitude of plans, strategies European programs related to the transport sector there have been considered the major plans programs, strategies, policies and existing conventions order to identify problems, issues and aspects that may influence the General Transport Master Plan.

3.1.9 As a result of this analysis the following conclusions were drawn:

- The main national transport objectives are common with those of GTMP and follow these:
  - Ensuring economic development: transport sector should contribute to the development of the national economy and the economic benefits should exceed its costs;

- Sustainable development: transport system must be efficient in terms of energy consumption, providing reserves for future generations;
- Safety: transportation system must provide security;
- Providing funding: Master Plan should be able to absorb EU funds.

o GTMP takes account of necessary measures to adapt to climate change;

o Based on the strategies / plans aimed particularly to environmental protection and on the existing environmental issues at national level related to the transport sector, for GTMP there have been proposed a number of relevant environmental objectives which take into account the targets set at national and European level for the environment protection (see also Section 2.3 – Objective Setting).

3.1.10 A series of national and European policty documents were analyzed, with respect to the relation with the Master Plan, among wich the most relevant ones were:

o European and National Policies

- **TEN-T Regulations**[6]
- **EU White Paper on Transport 2011)**[7]
- Government programs 2013-2016 - transport policy proposed by the Romanian Government [8]
- Strategic Plan Integrated for Transport and Infrastructure - June 2009 (Ministry of Transport Policy)[9]

o Partnership Agreements

- Partnership Agreement proposed by Romania for the programming period 2014-2020 (Ministry of European Funds)[10]

o European and National Programs

- Integrated European action program for inland owaterway - NAIADES I and II [11]
- Sectoral Operational Programme Transport (POST) 2007-2013, Revision 2[12]
- Strategic development program of airport infrastructure Bucharest Otopeni International Airport (1999-2015) – Law220/2002 (Gazette no 288/29.04.2002) approving the government ordinance no. 64/1999 (Gazette no. 405/26.08.1999)
- Strategic development program of airport infrastructure at SN International Airport Constanta SA between 2002-2015 - GD. 623/2002 (Gazette. No. 458 / 27.06.2002)
- Strategic development program of airport infrastructure at SN International Airport SA between 2002-2015 - GD. 60/2003 (Gazette. No. 76 / 06.02.2003) amending GD 615/2002 (Gazette. 488 / 08.07.2002)

o National Plans

- National Action Plan for Energy Efficiency (NAPEF) - developed in 2007, under review
- National Spatial Plan (NSP) - Section 1 transport network. Key rail and road networks (Law 363/2006)

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[6] http://ec.europa.eu/transport/themes/infrastructure/revision-t_en.htm
[7] http://ec.europa.eu/transport/themes/strategies/2011_white_paper_en.htm
[8] http://www.drp.gov.ro/download.php?6b3a2e12faf92184a320aeeaa3f853cf
[9] http://www.mt.ro/strategie/plan_strategic/planul%20strategic%20integrat%20revizuit%202009.pdf
[10]http://www.fonduri-ue.ro/res/filepicker_users/cd25a597fd-62/2014-2020/acord-parteneriat/Acord_de_parteneriat_01.10.2013.pdf
[11] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0006:FIN:EN:PDF
[12] Programul Operațional Sectorial deTransport 2007 – 2013 (revizia 2 - aprobat la 26.07.2013) Ministerul transporturilor și infrastructurii. http://www.ampost.ro/fisiere/pagini_fisiere/RO-POST_revizia_2.pdf

- LAW. 203 of 16 May 2003 on the implementation, development and modernization of the national and European transport
- Management Plan for the National portion of the Danube River International Basin - Synthesis of the management plans at basin / catchment areas level.

o European and National Strategies

- **Europe 2020 Strategy** [13]
- **EU Strategy for the Danube Region** [14]
- **EU strategy on climate change adaptation (2013)**[15]
- Marine environment Strategy (Directive 2008/56 / EC of the European Parliament and of the Council of 17 June 2008 establishing a community action framework in the field of marine environmental policy)[16]
- **Strategy for the sustainable transport for the period 2007-2013 and 2020, 2030**[17]
- Romanian intermodal transport strategy – 2020[18]
- Romanian National Strategy on climate changes 2013 – 2020[19]
- National Strategy for the sustainable development of Romania -Horizons 2013 – 2020 – 2030
- National Strategy and Action Plan for the biodiversity conservation 2010 -2020[20]
- National Road Safety Strategy 2011-2020[21] - consultative version
- National Waste Management Strategy 2014-2020, approved by Government Decision no. 870/2013

o Conventions

- Law 98/1992 ratifying the Convention on the Protection of the Black Sea against pollution, signed in Bucharest on 21 April 1992 (known as the "Bucharest Convention")
- **Convention regarding the regime of navigation on the Danube (Belgrade, 1948) ratified by Decree no. 298 of 30 October 1948 Additional Protocol of 26 March 1998 to the Convention of 18 August 1948 regarding the regime of navigation on the Danube*)**
- Law 14/1995 for the ratification of the Convention for the Protection of the Danube River

o Other Documents

- Preliminary report on the Transportation developed within the project: The operationalization of the national strategy and development component of the Operational Programs 2014-2020 Climate "project of the MECC (Ministry of Environment and Climate Changes)
- Working Document of the European Commission - "Adapting Infrastructure to Climate Change" [22]
- Joint Declaration on the principles guiding the development of navigation and environmental protection in the Danube River Basin (Joint Statement on Guiding

[13] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:RO:PDF
[14] http://ec.europa.eu/regional_policy/sources/docgener/panorama/pdf/mag37/mag37_ro.pdf
[15] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0216:FIN:RO:PDF
[16] http://europa.eu/legislation_summaries/maritime_affairs_and_fisheries/fisheries_resources_and_environment/l28164_ro.htm
[17] http://www.mt.ro/strategie/strategii%20sectoriale_acte%20normative/strategie%20dezvoltare%20durabila%20noua%20ultima%20forma.pdf
[18] http://www.mt.ro/nou/_img/documente/strategie_de_transport_intermodal_text.pdf
[19] http://www.mmediu.ro/beta/wp-content/uploads/2012/10/2012-10-05-Strategia_NR-SC.pdf
[20] http://biodiversitate.mmediu.ro/implementation/legislaie/politici/strategia-nationala-si-planul-de-actiune-pentru-conservarea-biodiversitatii/anexa-strategia-nationala-si-planul-de-actiune-pentru-conservarea/snpacb.pdf/download
[21] http://www.mt.ro/transparenta/2012/ianuarie/1_17%20Anexa1.pdf
[22] http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_137_en.pdf

Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin)”[23].

3.1.11 Table 3.1 includes a brief description of the contents of the most relevant EU Policy documents, the reference period for the actions to be undertaken and also the relation with the Master Plan.

Table 3.1 Relationship of General Transport Master Plan with the most relevant EU Transport Policy documents

Strategy/Plan/ Program relevant to GTMP	Summary description of document	Reference period	Relation to General Transport Master Plan
TEN-T Regulations	The TEN-T network consists of two layers: a **core network** intended to be completed by 2030 and a **comprehensive network** feeding into this, intended to be completed by 2050. The comprehensive network will ensure full coverage of the EU and accessibility of all regions. The core network will prioritize the most important links and nodes of the TEN-T, to be fully functional until 2030. Both layers include all transport modes: road, rail, air, inland waterways and maritime transport, as well as intermodal platforms. The TEN-T guidelines set common requirements for the TEN-T infrastructure – with tougher requirements for the core network. This will ensure fluent transport operations throughout the network. The policy also fosters the implementation of traffic management systems which will allow optimising the use of infrastructure and by increasing efficiency, to reduce CO2 emissions. Intelligent transport systems include the traffic management systems for road, rail, air and waterborne transport as well as the positioning and navigation systems.	2030	The relation with the EU TEN-T policy consists of one the evaluation criteria in the project prioritisation process. This reflects the fact that it is both Romania’s and the EU’s policy to improve the quality of the most important routes within and across the country. In addition, the routes selected for the core TEN-T have already been the subject of careful analysis and evaluation, so it is logical that the Master Plan should favour projects which improve these routes. The TEN-T concept includes the connection of major nodes (cities with a population of 1 million or more) via multi-modal corridors. The assessment of network improvements used in the Master Plan implicitly takes into account the travel demand from these and other major centres. Maps of TEN-T Network in Romania are provided in Appendix B.

[23] www.icpdr.org

Strategy/Plan/ Program relevant to GTMP	Summary description of document	Reference period	Relation to General Transport Master Plan
White Paper on Community Transport Policy (2011)	The White Paper of Transport is a Roadmap to a single European space of transport to a competitive and efficient transportation system. Examines developments in the transport sector, future challenges and policy initiatives that should be considered globally. The document presents both the European Commission vision on transport as well as the key measures to allow the vision implementation. The vision for a **sustainable** and **competitive transport system** refers to: - Increasing transport and supporting mobility while reaching the goal of reducing emissions of greenhouse gases by 60%. This can be achieved by: • *Developing and implementing sustainable fuels and propulsion systems* • *Optimizing performance of multimodal logistic chains, including wider use of more efficient modes of transport in terms of energy* • *Increasing the efficiency of transport and infrastructure use with information systems and market-based incentives* - An efficient core network for transport and long-distance journeys - Multimodal. - Global fair transport conditions for long distance journeys and for intercontinental freight transport. - Clean urban and commuting transport Achieving this vision involves the following: • Creating a single European transport space: by developing rail services, including the quality of air service development and airport capacity, further transformation of European maritime transport space, optimizing the internal market for inland waterway transport, improvement of road freight creating the necessary framework for multimodal transport of goods • Promoting employment and quality working conditions • Transport safety • Quality and reliability of services • Innovation and implementation strategy • Promoting a more sustainable behaviour • Modern infrastructures and smart financing	2020-2050	The General Transport Master Plan objectives are based on the provisions of the White Paper and are focused on ensuring sustainable transport, ensuring funding sources, transport safety, economic development and environmental protection. GTMP will help create an efficient transport system in terms of supporting economic competitiveness but also encourage the most efficient use of resources, reduce negative impacts that the transportation system has on the environment respectively on water, soil, air populations and natural ecosystems GTMP proposes to develop transportation infrastructure by creating new transport corridors (development of highways, bypasses, road), rehabilitation of railway lines to achieve high speeds, improving navigation on the Danube and modernization of port infrastructure, modernize airports.
Europe 2020	Europe 2020 Strategy proposes three mutually	2020	GTMP includes

Strategy/Plan/ Program relevant to GTMP	Summary description of document	Reference period	Relation to General Transport Master Plan
Strategy – An European strategy for a smart, sustainable and inclusive development	reinforcing priorities: – smart growth: developing an economy based on knowledge and innovation; –sustainable growth: promoting a more efficient economy in terms of resource use, greener and more competitive; –inclusive growth: promoting an economy with a high rate of employment, ensuring social and territorial cohesion. To ensure that each Member State tailors the Europe 2020 strategy to its particular situation, the Commission proposes that EU goals are translated into targets and trajectories. Romania proposes for the Energy Sector and transport the following: • Based on the current situation, namely that Romania has a low degree of competitiveness and energy efficiency in the transport is considered necessary to ensure the liberalization of gas and electricity prices, strengthen corporate governance and state regulatory bodies and to complete cross-border connections. In terms of infrastructure for broadband connections, now it is the least developed in the EU, which should be corrected. In the transport sector is necessary a long-term comprehensive plan.		Romanian strategy for the transport sector in the short, medium and long term and include integrated transport development projects that may be proposed for funding in the next phase of funding by 2014-2020 Through its proposals in the transport sector, GTMP will contribute to effective and sustainable economic development of Romania, the creation of environmentally friendly transport systems and low greenhouse gas emissions, ensuring mobility and improve connections between different modes of transport.
EU Strategy for the Danube region	This strategy has been elaborated by the European Commission (EC), through the General Directorate for Regional Policies (REGIO). The strategy focuses on these: Danube region interconnectivity (improving transport infrastructure, encouraging sustainable energies, culture and tourism promotion), environment protection (achieving the environment objectives included in the Danube management plan, nutrient pollution reduction, implementation of protection plans against floods, protection against floods risks, reduction of the areas affected by erosion and biodiversity protection), consolidation of the Danube region (institutional cooperation, security), increasing prosperity in the Danube region (socio-economic development, research, employment development, improving education). The objectives of this strategy in terms of the transport sector are the following: - 20% increase compared to 2010 of the freight transport on the river, 2020; - removing bottlenecks to navigation on the river, until 2052, to use the VIb type vessels throughout the year;	2010-2020	General Transport Master Plan proposes a series of investments to improve waterways in the Romanian Danube, modernization of port infrastructure, development of intermodal freight transport.

Strategy/Plan/ Program relevant to GTMP	Summary description of document	Reference period	Relation to General Transport Master Plan
	- improved travel times for competitive rail connections between major cities; - implementing the 4 rail freight corridors crossing the Danube, as planned, within 3 or 5 years; - Development, by 2020, of efficient multimodal terminals at Danube River ports to connect inland waterways with rail and road transport.		
European Union (EU) Strategy on adaptation to climate changes (2013)	The overall aim of the EU strategy on adaptation to climate change is to contribute to a more resilient Europe to climate change, thereby increasing the preparedness and capacity to respond to climate change impacts at local, regional and national levels as well as EU level, developing a consistent approach and improving coordination. The recommended tool globally in the context of the UN Framework Convention on Climate Change is the national adaptation strategies.	2014-2020	It is necessary to apply climate change adaptation measures in key vulnerable sectors such as the transport sector is. Thus, planning and prioritizing investments included in the Master Plan of Transportation has considered the climate component. It is expected that the projects proposed in the Master Plan of Transportation to lead to the reduction of greenhouse gas.
Sustainable transport strategy	Sets the priority projects in transport identified by Romania together with EU which should be achieved by 2015. The overall objective is to develop balanced national transportation system to provide infrastructure and transport services, sustainable development of economy and quality of life. The specific objectives envisaged for the overall objective are the following: - modernization and development of the transport network of European and national interest; - increase the safety and quality of services; - liberalization of internal transport; - stimulate economic development and competitiveness; - strengthening social and territorial cohesion at regional and national; - Compatibility with the environment.	2007-2013, 2020, 2030	General Transport Master Plan will propose a list of priority investments selected by specific selection criteria taking into account the provisions of sustainable transport strategy. Proposed investments by GTMP consider the following: - development of transportation infrastructure - improvement and efficient rail infrastructure - development of intermodal transport - improvement of air transport infrastructure

Strategy/Plan/ Program relevant to GTMP	Summary description of document	Reference period	Relation to General Transport Master Plan
Convention regarding the regime of navigation on the Danube (Belgrade, 1948), ratified by Decree no. 298 of October 30, 1948 **Additional Protocol of 26 March 1998 to the Convention** of 18 August 1948 **regarding the regime of navigation of the Danube*)**	It is an international legal instrument governing navigation on the Danube. - Navigation on the Danube shall be free and open to trade and cargo ships of all states on an equal footing in terms of port rights and duties of navigation, as well as the conditions which is subject to Merchant Shipping - All countries of the Danube will provide the necessary work to improve navigation conditions without hindering or impeding navigation on the Danube waterways Convention is coordinated by a "commission" which includes representatives of the Member States.	Starting with the date the convention was ratified	Romania must comply with the Convention regarding the regime of navigation on the Danube. The Danube Fairway must meet the internationally accepted standards as set by the Danube Commission GTMP implementation will contribute to the improvement of navigation and refurbished port infrastructure.

3.1.12 Sections 3.2.-3.7 describe the headline figures and historical trends for transport in Romania, on all modes and at an integrated European level.

3.2 Road Transport Trends in European Context

3.2.1 An efficient, safe and reliable road network is of fundamental importance to the success of the Romanian economy and, ultimately, to recognising the potential for growth.

3.2.2 The highway network in Romania is classified into five categories:

- Motorways (Autostrăzi) - A;
- National and European Roads (Dumuri Naționale si Europene) – DN/E;
- National Roads (Dumuri Naționale) – DN;
- County Roads (Dumuri Județene) – DJ; and
- Communal Roads (Dumuri Comunale) – DC.

3.2.3 The motorway and national road network accounts for just 20% of the entire network as summarised in Table 3.2.

Table 3.2 Length of Road Network by Category

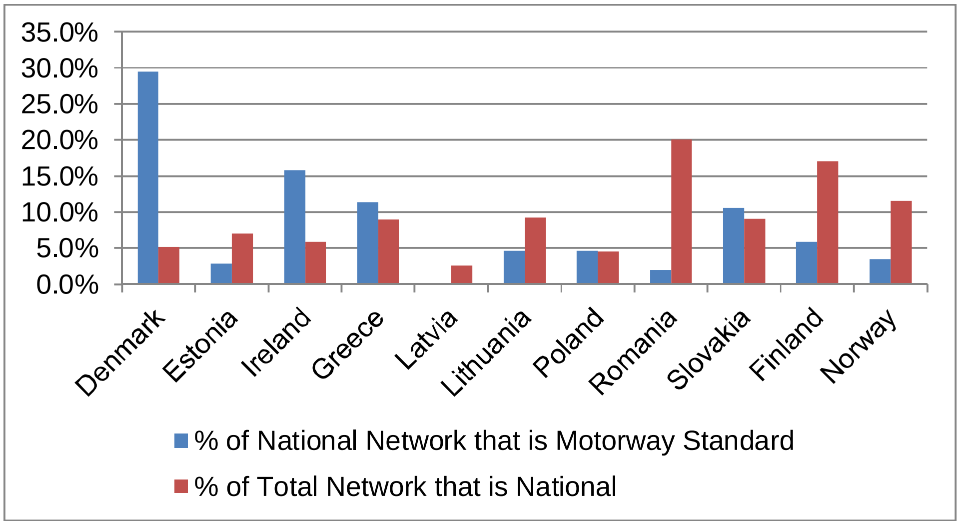
Road Type	Kilometres	Proportion
Motorway	362.6	0.5%
National European	5,697.7	7.1%
Other National	9,930.9	12.4%
County	36,009.8	45.1%
Commune	27,780.8	34.8%
Total	79,781.7	-

Source: AECOM analysis of individual DRDP data

3.2.4 Standard of Network Provision and Function: Almost 90% of the national network is single carriageway standard, this impacts upon both travel time and safety. Some national roads utilise a single carriageway with a hard shoulder but this is typically of sub-standard width. This is not sufficient to accommodate overtaking of local agricultural vehicles, which commonly make use of the network, nor heavy goods vehicles which are prevalent on any national network and need to be accommodated safely.

3.2.5 Compared to the rest of Europe, the level of motorway provision is very low. Recent European statistics comparing the level of motorway provision to that of all national / main roads, places Romania 30th out of 31 (for those countries with relevant data available). This has an impact upon the reliability of the road network for business and the economy.

3.2.6 It is also worth noting that the same data source identifies that Romania is 7th out of 33 countries in terms of the proportion of the total network that is classified as “national”. This shows that the proportional extent of the national network is higher than most EU countries. Figure 3.1 shows the percentage of the overall road network which is categorised as being part of the National Network and the percentage of that network which is Motorway standard for countries with comparable total road network lengths as Romania.



Source: EUROSTAT

Figure 3.1 Percentage of Road Networks Classified as "National"

3.2.7 CESTRIN have provided data to AECOM on the state of the national network as at 1st January 2012. The data provided includes information on the type of surfacing, an assessment of the quality of that surfacing (based on IRR surface roughness values) and also the type of topography through which the road section runs. We have not been able to obtain equivalent data for the non-national network.

3.2.8 Table 3.3 shows the proportion of the network that is considered good, average or poor broken down by surface type and topography.

Table 3.3 National Road Network - Surface Condition

		Asphalt	Concrete	Paved	Light Bituminous Pavement	Stone	Earth	Total	
Hill	Good	19.2%	0.8%	0.0%	0.3%	0.0%	0.0%	20.4%	40.6%
	Average	11.5%	1.4%	0.1%	1.4%	0.3%	0.0%	14.6%	
	Poor	3.8%	0.9%	0.0%	0.8%	0.1%	0.0%	5.6%	
Mountain	Good	10.3%	0.4%	0.0%	0.1%	0.0%	0.0%	10.8%	18.3%
	Average	4.0%	0.2%	0.0%	0.2%	0.1%	0.0%	4.5%	
	Poor	1.2%	0.3%	0.0%	0.5%	0.9%	0.0%	2.9%	
Plains	Good	19.9%	1.0%	0.1%	0.7%	0.0%	0.0%	21.7%	41.2%
	Average	10.4%	0.5%	0.0%	0.7%	0.1%	0.0%	11.7%	
	Poor	5.5%	0.6%	0.1%	1.4%	0.1%	0.1%	7.7%	
Total		85.7%	6.3%	0.2%	6.0%	1.6%	0.1%	100.0%	100.0%

Source: AECOM analysis of CESTRIN Viabilitate data

3.2.9 The notable point from this is that only just over 50% of the national network is classified as good with a further 30% average and 20% poor. The expectation is that the national network should be at the top end of the standard for any country.

3.2.10 **Safety:** Romania has a significant road accident problem as evidenced by comparisons with the EU. The EC use three separate indicators as follows:

- Fatalities per million inhabitants;

- o Fatalities per 10 billion pkm; and
- o Fatalities per million passenger cars.

3.2.11 In this order, Romania's score and ranking is as follows:

- o 24th out of 28 – 94 versus EU average of 60;
- o 28th out of 28 – 259 versus EU average of 61; and
- o 28th out of 28 – 466 versus EU average of 126.

3.2.12 From these data, it is fair to conclude that Romania has the worst road fatality accident rate in Europe.

3.2.13 It is also important to recognise that whilst the national network accounts for around 30% of all accidents in Romania, it accounts for well over 50% of all fatal accidents.

3.2.14 The overall pedestrian accident rate for Romania is the worst in Europe and significantly above the EU average – see Table 3.4.

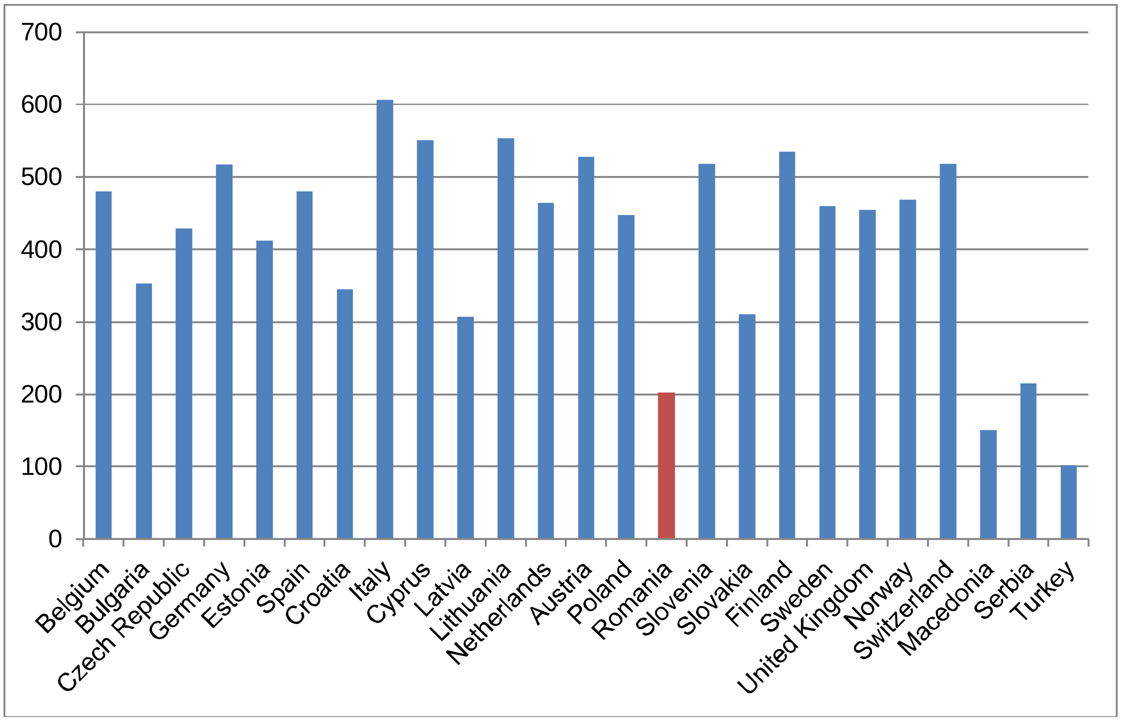
Table 3.4 EU Comparative Statistics on Pedestrian Fatality Rates

Country	No. of Fatalities	Population [million]	Pedestrian fatalities by million inhabitants
BE	106	10.8	9.8
CZ	168	10.5	16.0
DK	44	5.5	8.0
DE	476	82.0	5.8
EE	23	1.3	17.7
IE	44	4.4	10.0
EL	179	11.3	15.8
ES	471	45.8	10.3
FR	485	64.4	7.5
IT	614	60.0	10.2
LV	79	2.3	34.3
LU	1	0.5	2.0
HU	192	10.0	19.2
MT	2	0.4	5.0
NL	63	16.5	3.8
AT	98	8.4	11.7
PL	1,236	38.1	32.4
PT	195	10.6	18.4
RO	868	21.5	40.4
SI	26	2.0	13.0
SK	126	5.4	23.3
FI	35	5.3	6.6
SE	44	9.2	4.8
UK	429	61.6	7.0
EU-24	6,004	487.8	12.3

Source: EU DaCoTA - Pedestrian fatalities per million inhabitants by country, EU-24, 2010 Pedestrian fatalities*

3.2.15 **Car Ownership Levels:** There has been a steady growth in car ownership levels in Romania with the long term trend averaging around 5% per annum.

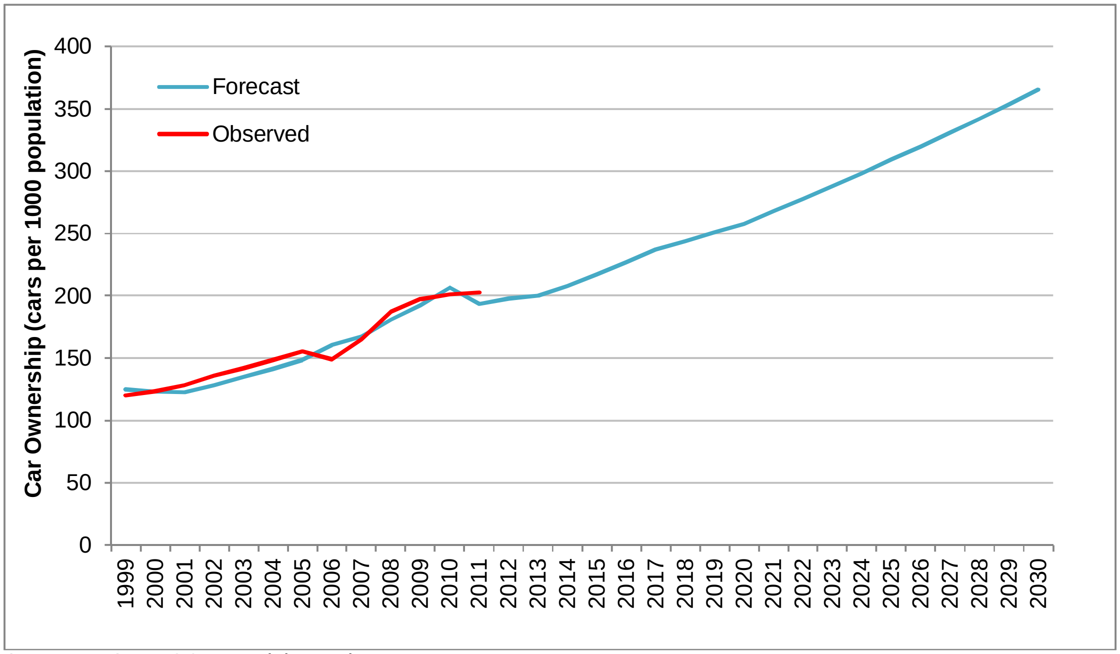
3.2.16 This needs to be seen in context however with car ownership levels in the rest of Europe. The comparison is provided in Figure 3.2 with the values for Romania highlighted in red.



Source: Eurostat

Figure 3.2 Comparison of EU Car Ownership Levels (2010)

3.2.17 Clearly car ownership levels are lagging some way behind the rest of Europe. Car ownership is forecast to grow strongly in Romania, as shown in Figure 3.3. 19.3% of population have a car available in 2011 rising to 24.9% by 2020. This will have a direct impact on the likelihood of road becoming the mode of choice for even more passenger journeys than presently is the case.



Source: INS, AECOM Model Development Report

Figure 3.3 Forecast of Car Ownership in Romania

3.2.18 By 2020 however car ownership will still be well below the current national average across the rest of Europe.

3.3 Rail Transport Trends in European Context

3.3.1 **Rail Network Characteristics**: Total Romanian route network length stands at 10,818 km. Table 3.4 sets out some of the key statistics associated with the network.

Table 3.5 Rail Infrastructure Statistics

Length of rail network	**10,818 km**	**Number of level crossings (number of which are automatic)**	**5,119 (1,082)**
Double track	2,909 (27%)	Number of points/switches	20,868
Single track	7,771 (72%)	Train control (signalling) infrastructure:	
Electrified (overhead 25 Kv)	4,002 (37%)	Electronic interlocking systems	28
Non-electrified	6,816 (63%)	Relay interlocking systems	618
Number of stations	965	Installations without interlocking	354
Number of tunnels	177	Automatic line block:	
Length of tunnels	6,809	Number of installations	577
Number of bridges	4,216		
Number of culverts	13,961		

Source: CFR SA: CFR Network Statement

3.3.2 A significant proportion (72%) of the rail network is single track – the EU27 average is 59%. The 37% of the network that is electrified compares to the EU27 average of 52%.

3.3.3 In terms of the density of the network, Table 3.6 compares Romania to some other European and neighbouring countries.

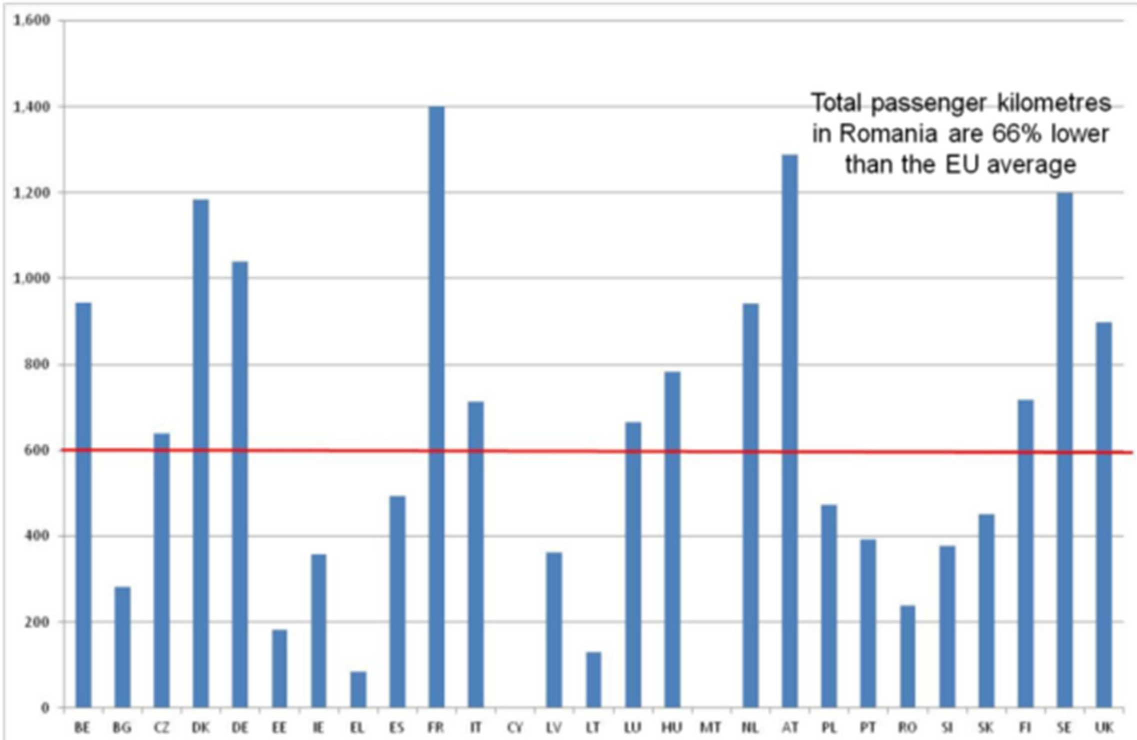
Table 3.6 Rail Network Density

Country	**Km of railway per 1000km^2**	**Km of railway per million population**
EU27	50.0	430.8
UK	65.3	256.2
Germany	105.5	460.6
Hungary	79.5	738.0
Bulgaria	36.9	541.8
ROMANIA	45.4	504.1

source: Eurostats

3.3.4 Romania is above the average in terms of density per population (but not as high as in neighbouring countries), but lower than average in terms of spatial density.

3.3.5 **Rail Passenger Demand**: Figure 3.4 provides a comparison between Romanian rail passenger kilometres with those of other EU countries.

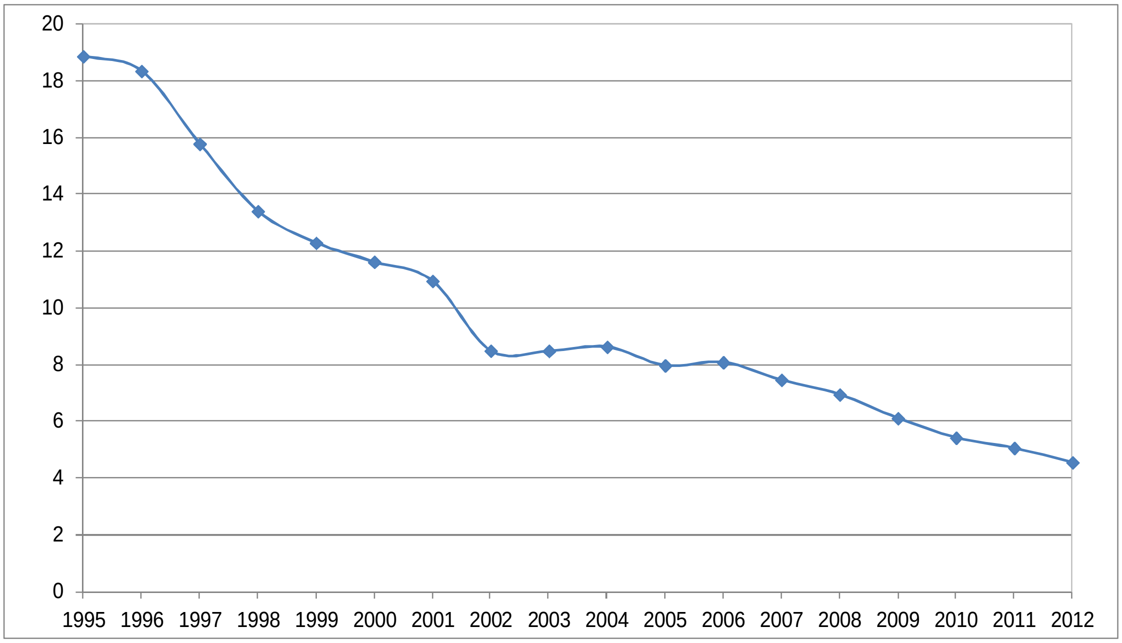


Source: http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2013_en.htm

Figure 3.4 Comparison of Rail Passenger Kilometres – Romania versus other EU Countries

3.3.6 Compared with those countries with a similar level of rail network provision per head of population, the rate of railway use in Romania is low. Rail demand in Romania, as measured by kms travelled per person is two to three times lower than in these countries, and this failure to capture the potential rail market results in reduced revenue. The EU27 average is 650km per passenger per year, as shown in Figure 3.4, while the equivalent figure for Romania is 66% lower.

3.3.7 Figure 3.5 illustrates the number of journeys declined between 2004 and 2012 from about 100m per annum to 58m. The 28% decline in patronage experienced in Romania between 2004 and 2009 is the largest decrease across all the EU Member states.



Source: AECOM analysis of CFR Calatori data

Figure 3.5 Number of Rail Passenger Journeys per annum in Romania (2004-2012)

3.3.8 The relationship between passenger kilometres per person has also been benchmarked for Romania against other EU countries. The ratio for Romania (239 passenger kilometres / person) is lower than other EU countries except Estonia (172), Greece (118), Turkey (74) and Lithuania (34). The results for Romania are lower than Bulgaria (270 passenger kilometres / person) or Hungary (731). These statistics indicate rail is capturing a good percentage of the total trips, albeit recognising the actual trip rate per person is significantly lower. The comparison of passenger kilometres per person for Romania against other EU countries indicates there is significant scope to grow the market if service improvements were delivered.

3.3.9 **Freight Usage:** With about 28% of goods moved by rail, Romania is ranked 6th compared with other countries. This proportion was about 10% higher compared with the EU27 average of 18.4%.

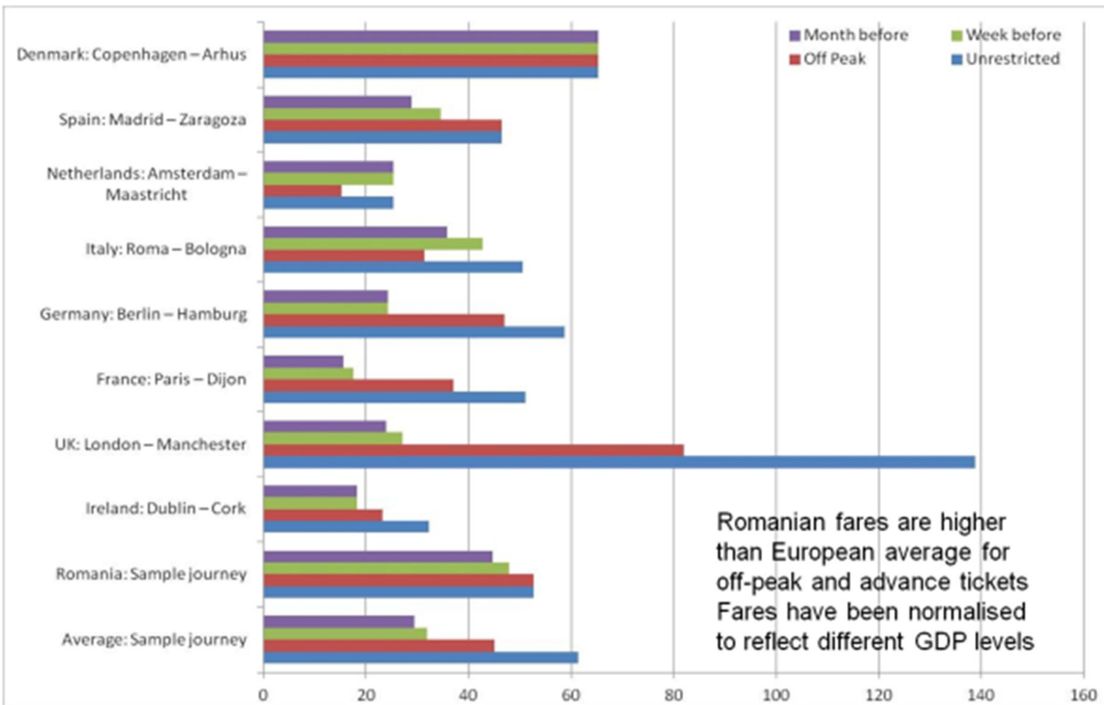
Table 3.7 Proportion of Goods Transported by Rail

Country	% of goods transported by rail (tonne km)	Rank
Latvia	63.8	1
Estonia	51.0	2
Lithuania	41.2	3
Austria	39.9	4
Sweden	38.2	5
Romania	28.0	6
EU27 Average	18.4	

Proportion of goods transported by rail in the Transport model year 2011 by tonne km (Source Eurostat)

3.3.10 Similar to the passenger market, the rail freight market has also contracted, with many traditional heavy industries such as coal mining and metal smelting, which provided the core rail freight demand, having declined. Coal fired power stations for electricity generation are gradually being replaced by renewable energy sources such as wind farms where Romania is the 5th largest producer in the EU. Tonnage moved by rail has declined steadily since 2004 (from 72m tonnes in 2008 to 56m tonnes in 2012). This is against a background of growth in road freight - in 2012, road freight grew by 4% and rail freight declined by 4% and 2012 saw a significant downward trend in market share in tonne kms from 28% to 21% in just one year.

3.3.11 **Passenger Ticket Prices:** A benchmarking exercise indicates that Romanian rail fares are relatively high compared with other countries when they are normalised to take account of comparative spending power of other European economies. This is particularly relevant for advance purchase tickets. The high fares restrict the opportunities to attract new passengers and reduces the net economic benefit of the railway system, as shown in Figure 3.6.



Source: AECOM analysis of a selection of fares for a 100km journey. Fares are adjusted to take account of differences in GDP

Figure 3.6: Comparison of Romanian Fares with Selected EU Examples

3.3.12 **Track Access Charges:** In line with EU legislation, the MTI administers a non-discriminatory track access charge for passenger and freight operations. The basis for the charge, whether passenger or freight, is a combination of train tonnage, line categorisation (essentially line speed) and whether the line is electrified or not. Figure 3.7 below demonstrates that Romania has some of the highest track access charges in the EU.

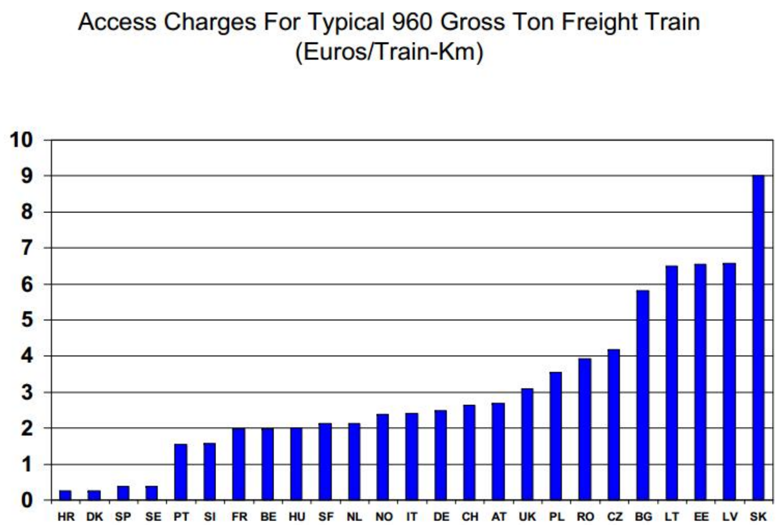
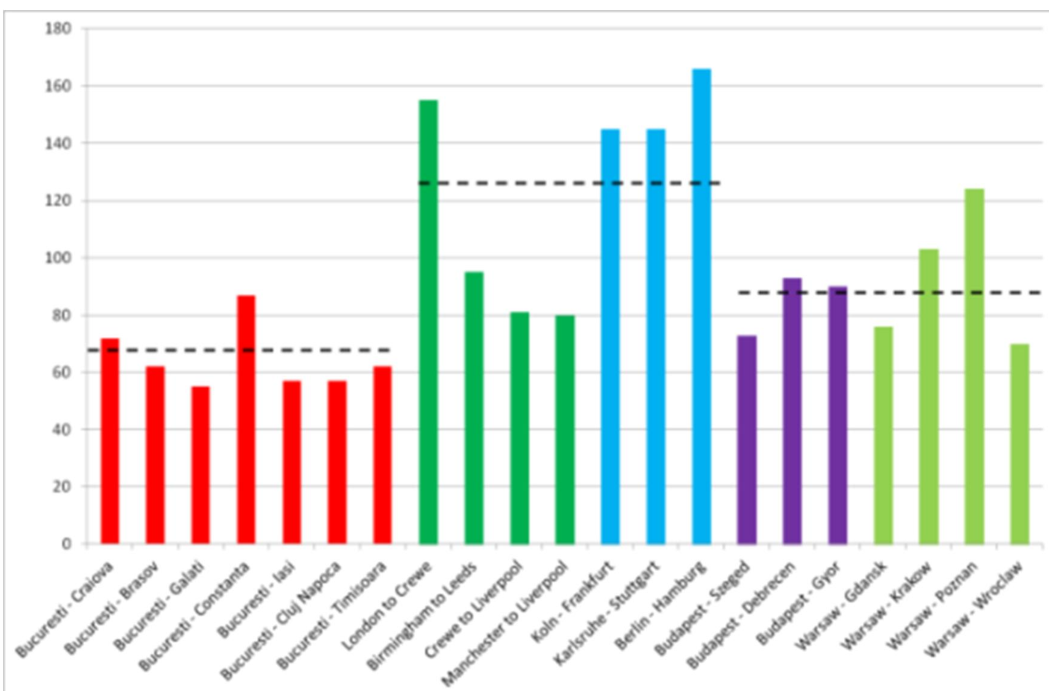


Figure 3.7 Access Charges for Typical Frieght Train

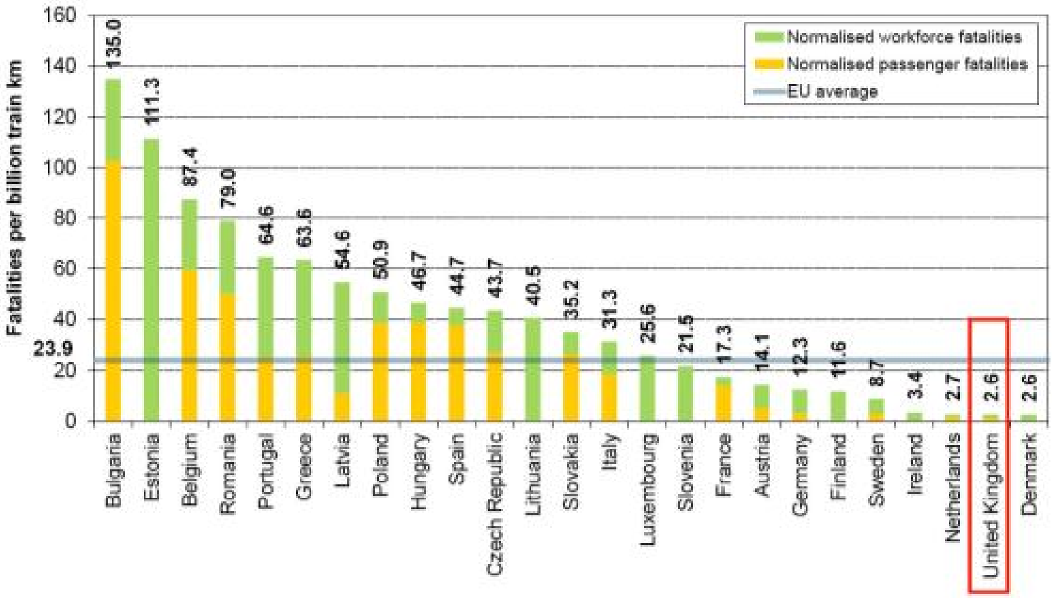
3.3.13 **Passenger Rail Journey Speeds:** Selected rail journey speeds in Romania have been compared with a sample of European services as shown in Figure 3.8. For example, the average speeds in Romania are about 65-70km/h, yet a comparison with the UK and Germany indicates rail journey speeds in Romania are about twice as slow as the examples. Furthermore, timings in Romania are 40% slower compared with Hungary and Poland. The topography in Romania is a partial factor for some journeys, for example, the hilly terrain between Bucharest and Cluj, but there are other contributory factors including the numerous intermediate stops, lengthy dwell times and various technical factors



Source: AECOM analysis of CFR Calatori timetables and DB website

Figure 3.8 Comparison of Rail Journey Times – Romanian versus European Examples (km/h)

3.3.14 **Rail Safety:** The the number of fatalities involving passengers or railway employees is relatively low when expressed in terms of numbers per billion passenger kilometres, but there are still a relatively high number of deaths due to suicides and other incidents at level crossings. There were 79 rail-related fatalities (all deaths occurring on railway property) per billion train kilometres between 2007 and 2011. This is almost four times higher than the EU average, and the 4th highest rate overall, as demonstrated in Figure 3.9.



Source: European Union information, printed in the Guardian 13 May 2013

Figure 3.9: Comparative Number of Fatalities (per billion train kilometres)

3.4 Ports and Waterways Trends in European Context

3.4.1 The proportion of total inland freight in Romania moved by water is the second highest in the EU. This is due to Romania's position relative to the Danube. However Romania compares unfavourably to Holland, which has a similar position relative to the Rhine and the key difference between the countries is the lack of modern facilities in Romania. The vast majority of the goods transported by water in Romania are bulk goods. The Danube carries 3 types of traffic, domestic, transit, and import/export.

Table 3.8 Percentage in total inland freight tonne-km 2011

Country	%	Rank
Holland	36.7	1
Romania	21.7	2
Belgium	18.5	3
Bulgaria	15	4
Germany	11.2	5
Croatia	5.7	6
EU27	6.2	

Source: Eurostat

3.4.2 **Compliance with International Standards for Waterway Draught:** The UN defines the Danube as an international waterway and the draught required for such status is 2.5m, although 2.8m is preferable. Several sections of the Danube regularly fall below 2.5m draught and navigation was very difficult on the lower river for more than 38 days in September and October 2011 because of insufficient water levels.

3.4.3 A convoy comprises either one motor cargo vessel (a ship with its own cargo hold) or a pusher and one or more barges rigidly coupled to the freighter or pusher.

Table 3.9 Barge operation comparison between the Danube and Rhine

Pushed Convoy with four barges		
	Danube	*Rhine*
Length	193 m	193 m
Width	22 m	22.80 m
Draught	2.70 m	3.70 m
Total deadweight (all told)	7,000t	11,000t

Source VNF: Voies navigable de France

3.4.4 The table above provides a basic comparison between the Danube and the Rhine that shows whilst a Danube convoy can be the equivalent of 280 HGVs, a Rhine convoy can be the equivalent of 440 HGVs. The reason a Rhine convoy can handle 57% more than a Danube convoy is because of the additional 0.80m in width and the extra 1m in draught. This allows the barges to hold more deadweight. The increased dimensions are incremental (extra 4% width and

37% draught), but add up to a significant increase in capacity (57%), the sum being greater than the parts.

3.4.5 The operational speed upstream on the Romanian Danube is 10-12kph for a convoy and the operational speed downstream is 16-18kph. These figures are similar on the Danube-Black Sea canal. From Braila out to sea there is no speed limit. However on the Sulina navigation the speed is limited by regulation based on type and size of vessel and this typically is 15-20kph.

3.4.6 Romania currently spends €17m on maintaining the Danube. This compares to €1m that Bulgaria spends and €80m that Austria spends. Taking into account the length of the Danube these countries must maintain gives the following maintenance budgets.

Table 3.10 – Maintenance budgets on the River Danube for selected countries

Country	Danube Maintenance Budget	Length of Danube Responsible for	Budget per km
Romania	€17m	1,500km	€11,333/km
Austria	€80m	320km	€250,000/km
Bulgaria	€1m	470km	€2,128/km

Source: AFDJ Giurgiu

3.4.7 Austria spends significantly more than Romania or Bulgaria, this is despite it having by far the shorter stretch to maintain. Bulgaria’s Danube maintenance budget is minimal, especially when considered alongside Romania’s Danube maintenance budget. What is unclear from the figures is why the countries have allocated the budget that they have, particularly with regards to the maintenance issues that they must contend with.

3.4.8 Romania’s major sea port is at Constanta, located on Romania’s Black Sea coast. Constanta is now home to the largest container port in the Black Sea and is strategically situated to feed freight into the heartland of Central and Eastern Europe.

3.4.9 It is a major regional container port. Constanta is not amongst the top 20 container ports (by volume) in Europe as it handled 684,000 TEU (Twenty foot equivalent units) in 2012, but it was back in 2007 when the port handled 1.41 million TEU. Constanta is used as a hub by the shipping lines with a number of containers being transited.

3.4.10 The modal share of containers leaving Constanta (excluding transiting) has been estimated as currently:

- Road – 56%
- Rail – 41%
- Barge – 3%

3.4.11 It is possible to compare Constanta’s modal split of containers with other major European container ports:

Table 3.11 Modal Split of Containers for some Major European Ports

Modal Split	Road	Rail	Barge
Constanta	56%	41%	3%
Antwerp	56%	44% (combined)	
Amsterdam	55%	45% (combined)	
Rotterdam	54%	11%	35%
Hamburg	62%	36%	2%
Bremen	50%	46%	4%
Felixstowe	69%	28%	3% (coastal)

3.4.12 Many of these ports have their own future plans about modal split in an attempt to move containers from road to more sustainable modes of transport. In some cases this is for environmental reasons, in others it is because it allows the port to make better use of limited space and have a greater hinterland (some of these ports cannot develop much more at their current site) to react to increased demand.

Table 3.13 Planned Future Modal Split of Containers for some Major European Ports by 2020

Planned Future Modal Split	Road	Rail	Barge
Antwerp	42%	15%	43%
Amsterdam	40%	60% (combined)	
Rotterdam	40%	15%	45%
Hamburg	45%	53%	1%

3.4.13 Some of these ports intend to increase the modal split of containers leaving the port by rail and barge. Constanta is well placed to do the same and could learn from the practices and operations at some of these ports. It is considered that Constanta could expand the use of both modes of transport and particular barge traffic when looking at planned percentages at Antwerp and Rotterdam.

3.5 Aviation Trends in European Context

3.5.1 In 2011, a total of 10.8 million passengers travelled through all Romanian airports. Of this total, over 50% of passengers travelled through Bucharest's Henri Coanda International Airport – showing the strong capital-centric nature of the country's air transport system.

3.5.2 A total of 21 airfields are listed in Romania's Aeronautical Information Publication (AIP), and seven of the country's airports are not currently served by scheduled flights. The development of the Romania air transport infrastructure aims to provide regional centres with a means of fast transport to Bucharest, the capital, along with other regional centres. Air transport is also relied upon to provide international connectivity. As the country's highway network remains in development, and even the fastest section of the rail network (currently between Bucharest and Constanta) are subject to speed restrictions, air travel is a preferred choice for domestic transport where fast journey times are a critical factor.

3.5.3 The construction of the new Brasov-Ghimbav International Airport has also commenced. The new runway, destined to receive medium-haul aircraft, will be 2,820 metres long and 45 metres wide. The opening of the airport is likely to increase the investment potential of the area, mainly in the tourism industry, as well as new development opportunities for small and medium-sized companies. The airport is scheduled to open at the end of 2014/beginning of 2015.

3.5.4 For the purposes of benchmarking, the air transport market of Romania has been compared to the market in the Czech Republic which joined the EU only three years earlier. Table 3.14 below compares the two countries in terms of a small number of key socio-economic and political indicators.

Table 3.14 Socio-economic and political comparison between Romania and the Czech Republic

2011 statistic	Romania	Czech Republic
GDP per capita	€6,100	€14,800
Area	238,391km^2	78,866km^2
Population	21,413,815	10,486,731
Population density	93/km^2	135.5/km^2
Post-Communist revolution	1989	1989
EU accession	2007	2004
Key industry sectors	Construction, automotive, machinery, chemicals	Machinery, chemicals, foods, telecommunications

Source:Eurostat

3.5.5 While Romania is a larger and more populous country than the Czech Republic, the latter state is significantly wealthier, despite having entered the EU only three years earlier. As a smaller country, it would be expected that the domestic air market in the Czech Republic was smaller, and Table 3.* shows this to be correct. Nevertheless, in 2011 the Czech Republic saw 19% more air passengers in total than Romania, although the domestic market was significantly smaller as expected. The larger international market could be explained by the country's higher wealth, giving Czechs a higher propensity and ability to travel abroad, and a higher level of international business activity is likely to encourage business from abroad.

3.5.6 The Czech air freight market in 2011 was more than 2.6 times larger than that in Romania; perhaps reflecting a larger manufacturing base in the country or different industry sectors may trigger greater levels of air freight activity, such as foods or telecommunications.

3.5.7 In terms of the penetration of low-cost carriers, the Romanian market ranks more favourably than the Czech Republic. This factor may in part be explained by the lower wealth of Romania; those travelling from Romania may be attracted to the lower fares of low-cost carriers, rather than 'full-service' airlines. The impact of low-cost carriers can be felt mainly on international routes; the domestic market in Romania sees little penetration by low-cost carriers.

Table 3.15 Comparison of air transport markets in Romania and the Czech Republic

2011 statistic	Romania	Czech Republic
Total air pax	10,810,570	12,824,895
Domestic air pax	1,129,310	229,762
International pax	9,681,260	12,595,133
Air freight	26,156t	69,106t
LCC penetration	37%	29%
Total flights	95,836	152,215
Total domestic flights	24,492	7,075
Total international flights	71,344	145,140

Source :Eurostat

Intermodal Transport Trends

3.5.8 The table below demonstrates that Romania transports far fewer containers by rail than many other European countries (although in excess of neighbours Bulgaria). The table shows that containerisation is particularly advanced in Italy, Turkey, Austria and Germany but Bulgaria and Romania are lagging behind. The volume and percentage in countries like Austria are high due to the Alpine effect where on certain routes it is compulsory to use rail services and there is a considerable volume of transit traffic. Nevertheless Romania could potentially also attract significant volumes of transit traffic.

Table 3.16 Annual railway transport of goods (containers and swap bodies) in intermodal transport units (in 000s tonnes) and the % of total rail freight containers represent

Country	Total volume of containers and swap bodies ('000 tonnes)		% in containers of total goods transported by rail	
	2011	2012	2011	2012
Austria	16,312	15,806	18.2%	19.0%
Bulgaria	789	664	5.8%	5.6%
Czech Republic	7,321	7,852	8.4%	9.5%
Germany	64,301	66,230	17.2%	18.1%
Italy	34,275	33,985	43.4%	45.1%
Romania	2,611	2,372	4.6%	4.7%
Turkey	7,601	8,264	30.7%	33.2%
United Kingdom	11,098	11,742	11.1%	10.2%

(Source Eurostat)

3.6 Transport and Economic Development

3.6.1 Efficient transport is a critical component of economic development, globally and nationally. Transport availability affects global development patterns and can be a boost or a barrier to economic growth within individual nations. Transportation investments link factors of production together in a web of relationships between producers and consumers to create a more efficient division of production, leverage geographical comparative advantage, and provide the means to expand economies of scale and scope. Transport's contribution to economic development operates through the following mechanisms:

- Increasing business efficiency, through time savings and improved reliability for business travellers, freight and logistics operations.
- Increasing business investment and innovation by supporting economies of scale or new ways of working.
- Supporting clusters and agglomerations of economic activity. Transport improvements can expand labour market catchments, improve job matching, and facilitate business to business interactions. Such productivity effects extend across commuter and business travel catchment areas.
- Improving the efficient functioning of labour markets, increasing labour market flexibility and the accessibility of jobs. Transport can facilitate geographic and employment mobility in response to shifting economic activity e.g. in response to the forces of globalisation, new technological opportunities, and rising part-time and female participation in the labour market.
- Increasing competition by opening up access to new markets. Transport improvements can allow businesses to trade over a wider area, increasing competitive pressure and providing consumers with more choice. Romania will benefit from both improvements in internal connectivity and international connectivity.
- Increasing domestic and international trade by reducing the costs of trading. Domestic trade links are particularly important to the economic success of some urban areas.
- Attracting globally mobile activity to Romania by providing an attractive business environment and good quality of life. Such effects are of increasing importance but extremely difficult to quantify. However, the strategic focus of transport policy can be guided by the survey evidence which suggests that both domestic and international transport links can be important to attracting, retaining and expanding such activity, and that there is much commonality

3.6.2 The fundamental requirement from the Master Plan is that the identified investment plan, however funded and by whatever agency, must make a positive contribution to Romania's economic development. The economic benefits from the overall strategy must be greater than the investment required to produce them.

Road Transport

4 Road Transport

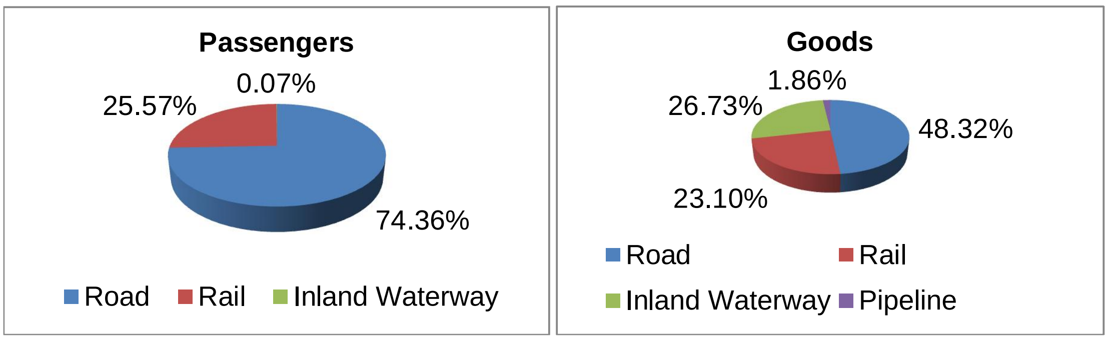
4.1 Current Situation

Context - Mode Share for Road Text.

4.1.1 According to the National Institute of Statistics, road accounts for almost 75% of all passenger kilometres, and just under 50% of all goods kilometres, travelled in Romania (INSSE 2010 data). This makes it the most significant mode in both cases as clearly illustrated in Figure 4.1.

4.1.2 The goods trip kilometres are based on tonne kilometres by mode.

Figure 4.1 Proportion of Trip Kilometres by Mode (2010)



Source: National Institute of Statistics (INSSE, 2010 Data)

4.1.3 The highway network in Romania is classified into five categories:

- o Motorways (Autostrăzi) - A;
- o National and European Roads (Dumuri Naționale si Europene) – DN/E;
- o National Roads (Dumuri Naționale) – DN;
- o County Roads (Dumuri Județene) – DJ; and
- o Communal Roads (Dumuri Comunale) – DC.

4.1.4 The motorway and national road network accounts for just 20% of the entire network as summarised in Table 4.1.

Table 4.1 Length of Road Network by Category

Road Type	Kilometres	Proportion
Motorway	362.6	0.5%
National European	5,697.7	7.1%
Other National	9,930.9	12.4%
County	36,009.8	45.1%
Commune	27,780.8	34.8%
Total	79,781.7	-

Source: AECOM analysis of individual DRDP data

Safety

4.1.5 Romania has a significant road accident problem as clearly evidenced by comparisons with other countries in the European Union (EU). The European Commission use three separate indicators to measure road safety as follows:

- Fatalities per million inhabitants;
- Fatalities per 10 billion passenger kilometres; and
- Fatalities per million passenger cars.

4.1.6 In this order, Romania's score and ranking is as follows:

- 24th out of 28 – 94 versus an EU average of 60;
- 28th out of 28 – 259 versus an EU average of 61; and
- 28th out of 28 – 466 versus an EU average of 126.

4.1.7 From this data, it is fair to conclude that Romania has the worst road fatality accident rate in Europe.

4.1.8 The following table provides a breakdown of all accidents within the database in terms of the road classification on which they occur. This is to highlight the scale of contribution of accidents on the national network to the overall total.

Table 4.2 Road Accident Numbers by Type of Road

Type	2007	2008	2009	2010	2011	2012	2007-12 Average	
Motorway	120	139	101	115	107	131	119	0.44%
National	7,092	8,628	8,195	7,483	7,119	7,192	7,618	28.09%
County	3,262	4,318	4,295	3,841	3,924	3,929	3,928	14.48%
Other	14,188	16,776	16,021	14,557	15,498	15,676	15,453	56.98%
Total	24,662	29,861	28,612	25,996	26,648	26,928	27,118	-

Source: AECOM analysis of police records

4.1.9 The contribution of around 30% of all accidents needs to be seen in the context of the motorway and national road accounting for just under 20% of all road network kilometres.

4.1.10 The economic impact of these accidents on the national network is €1.2billion per annum.

4.1.11 Single carriageway roads are recognised as the most dangerous with recent Euro RAP studies indicating that, across Europe, the average risk of single carriageway road is four times that of a motorway. This is also reflected in the Romanian statistics which show a significantly greater risk on single carriageway roads: over six times worse than motorways for all national roads and over three times if only rural national roads are considered. Currently almost 90% of the national network is single carriageway standard and this undoubtedly contributes to the poor accident record and the consequent significant economic cost.

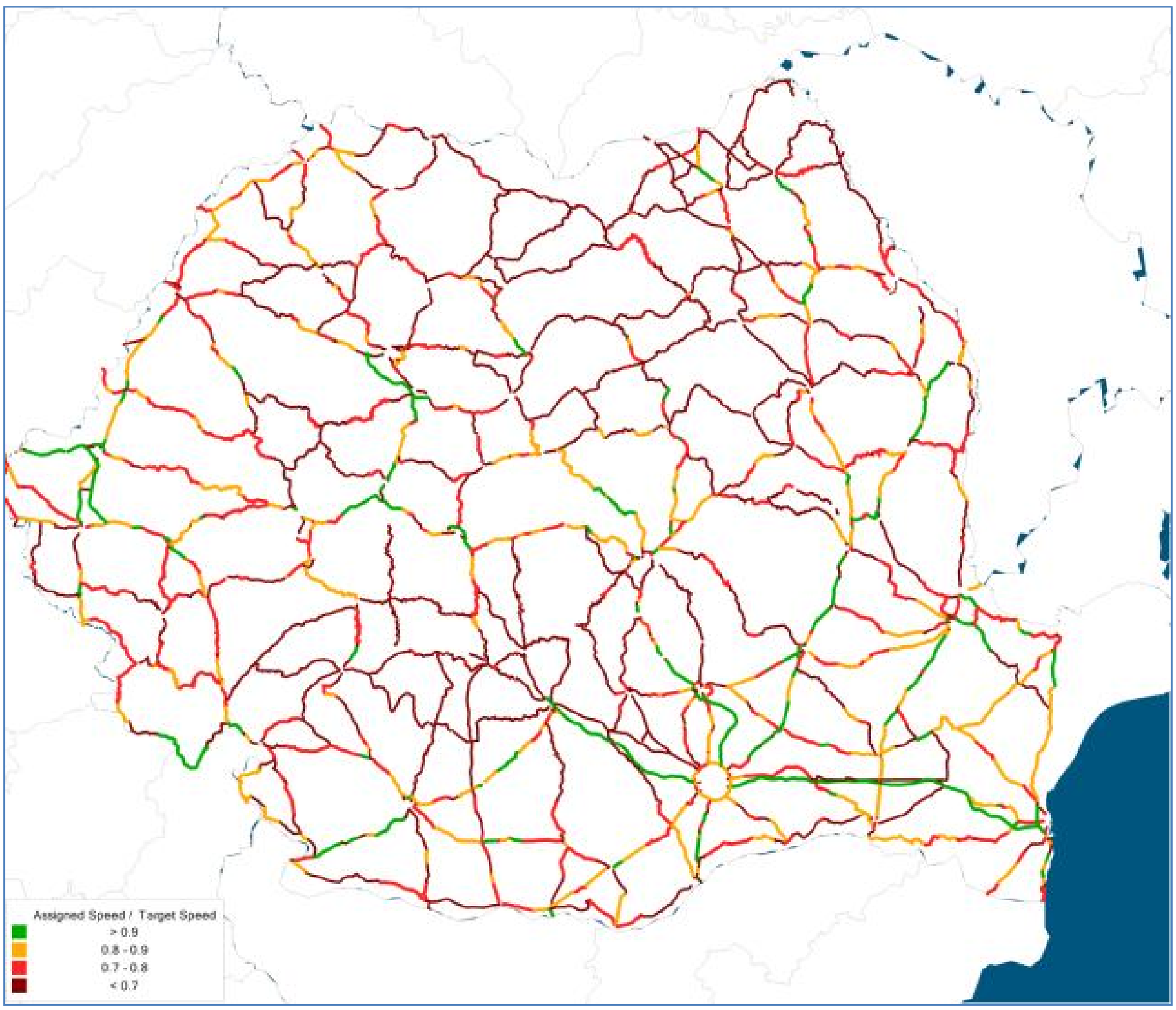
Level of Service

4.1.12 It is common practice to consider level of service in terms of volume to capacity ratios but this is not appropriate in the Romanian context.

4.1.13 Whilst flow levels for the majority of the national network are not high, as a proportion of the theoretical capacity, the effect of the high proportion of single carriageways is evident. Even at low flow levels, single carriageways offer limited safe overtaking opportunities particularly when the proportion of goods vehicles is high which is the case on a national network.

4.1.14 Setting aside the small proportion of the national network that is of motorway standard (less than 3%), the average speed for the inter-urban element of the national network is around 66 kph. This is not considered to be adequate for a national network where, international comparisons suggest, speeds of between 90 and 100 kph would be more reasonable.

Figure 4.2 National Network – Actual versus Target Speeds



Source: AECOM National Transport Model

4.1.15 Only those roads highlighted green are close to achieving what is considered a reasonable speed for a national network. Table 4.3 shows the length of road within each speed band. Over half of the national network has a speed less than 70% below the target.

Table 4.3 Assigned Speed vs. Target Speed of Road in Each Band

Ratio Interval	Percentage
> 0.9	9.6%
0.8 to 0.9	17.1%
0.7 to 0.8	22.4%
< 0.7	50.9%

Source: AECOM National Transport Model

4.1.16 Slow road journey speeds represent inefficient use of both work and non work time and have a significant adverse economic impact, reducing the opportunities for travel for individuals and businesses. In order to compete at an EU level the national network needs to improve journey times both in absolute terms and with regard to reliability.

4.1.17 The National Model has also been used to quantify, in both scale and locality, the amount of lost time on the network. The analysis took the following form:

$$\sum_{i=0}^{n} \frac{Flow_i(Target\ Time - Actual\ Time) \times VoT_i}{Length}$$

Where each model link was evaluated and:

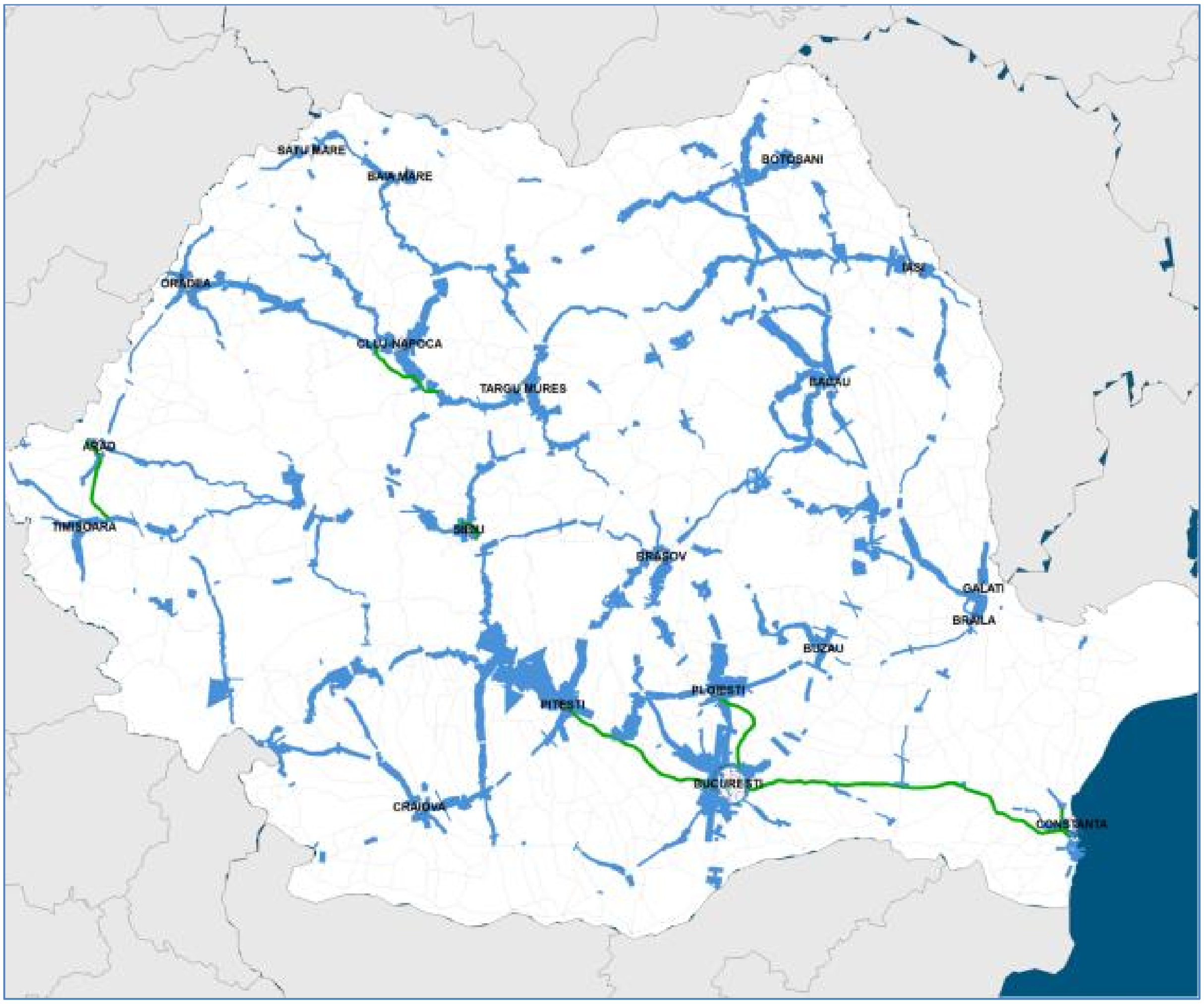
Flow = AADT;

i = vehicle purpose (e.g. commuting, business etc.); and

VoT = Value of Time.

The results of that analysis for the base year are shown in Figure 4.3.

Figure 4.3 Analysis of Lost Time – Base Year



Source: AECOM National Transport Model

Road Network Condition

4.1.18 CESTRIN have provided data to AECOM on the state of the national network as at 1st January 2012. The data provided includes information on the type of surfacing, an assessment of the quality of that surfacing (based on IRR surface roughness values) and also the type of topography through which the road section runs.

4.1.19 Table 4.4 considers the proportion of the network that is considered good, average or poor broken down by surface type and topography.

Table 4.4 National Road Network – Surface Condition

		Asphalt	Concrete	Paved	Light Bituminous Pavement	Stone	Earth	Total	
Hill	Good	19.2%	0.8%	0.0%	0.3%	0.0%	0.0%	20.4%	40.6%
	Average	11.5%	1.4%	0.1%	1.4%	0.3%	0.0%	14.6%	
	Poor	3.8%	0.9%	0.0%	0.8%	0.1%	0.0%	5.6%	
Mountain	Good	10.3%	0.4%	0.0%	0.1%	0.0%	0.0%	10.8%	18.3%
	Average	4.0%	0.2%	0.0%	0.2%	0.1%	0.0%	4.5%	
	Poor	1.2%	0.3%	0.0%	0.5%	0.9%	0.0%	2.9%	
Plains	Good	19.9%	1.0%	0.1%	0.7%	0.0%	0.0%	21.7%	41.2%
	Average	10.4%	0.5%	0.0%	0.7%	0.1%	0.0%	11.7%	
	Poor	5.5%	0.6%	0.1%	1.4%	0.1%	0.1%	7.7%	
Total		85.7%	6.3%	0.2%	6.0%	1.6%	0.1%	100.0%	100.0%

Source: AECOM analysis of CESTRIN Data

4.1.20 The notable point from this is that only just over 50% of the national network is classified as good with a further 30% average and 20% poor. The expectation should be that the national network should be at the top end of the standard for any country.

4.1.21 Further information has been obtained on the proportion of national road network for which the design life has expired; this is shown in Figure 4.4.

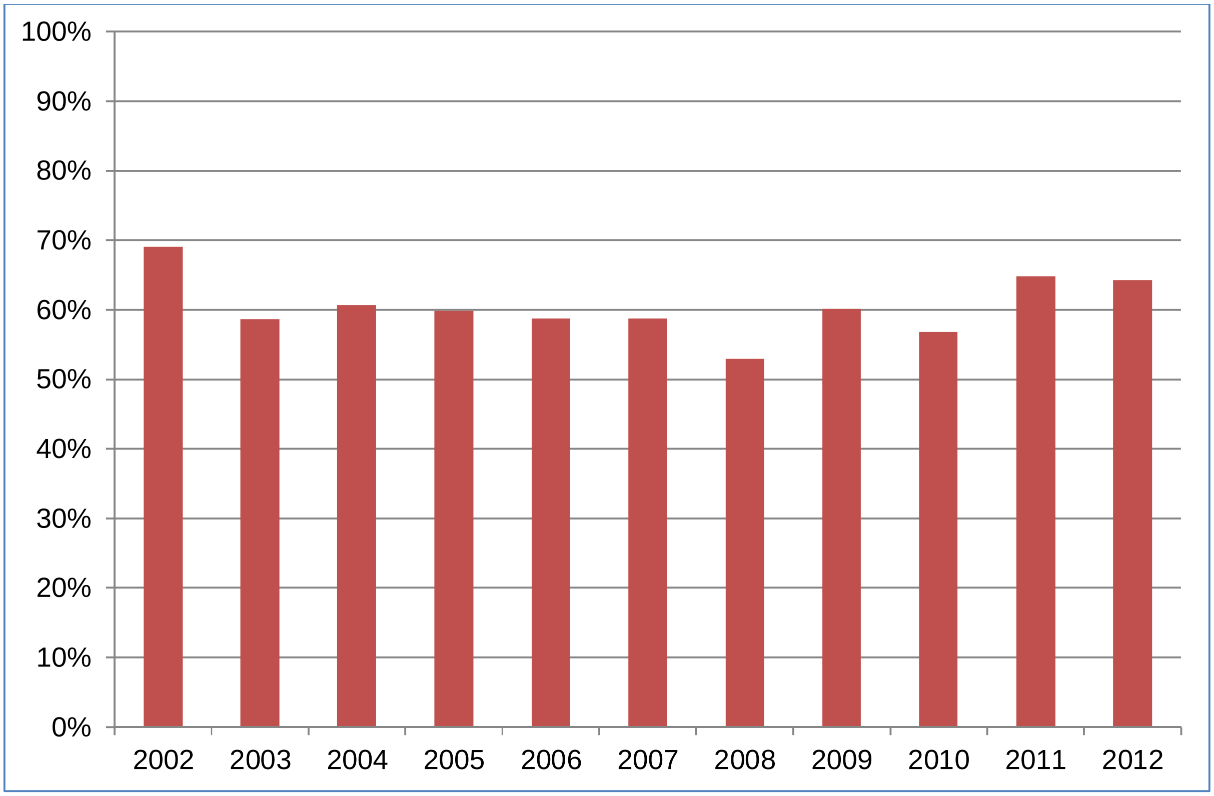
4.1.22 48% of all routes have some element classified poor. Of these the average proportion, by length, is 24%. There is no distinction by topography, thereby suggesting a network wide issue.

4.1.23 Whilst there are anecdotal references to the relative quality of the Romanian network and some subjective surveys by, for example, the World Economic Forum, in their report on “Global Competitiveness (2011–2012)”, places Romania 137th out of 142 countries considered with regard to the quality of the road infrastructure, we have not been able to obtain statistically robust comparative data.

4.1.24 As a proxy, we have looked at the level of motorway provision across Europe as motorway implies a level of quality and standard. The results are presented in the Figure 4.5 and Figure 4.6.

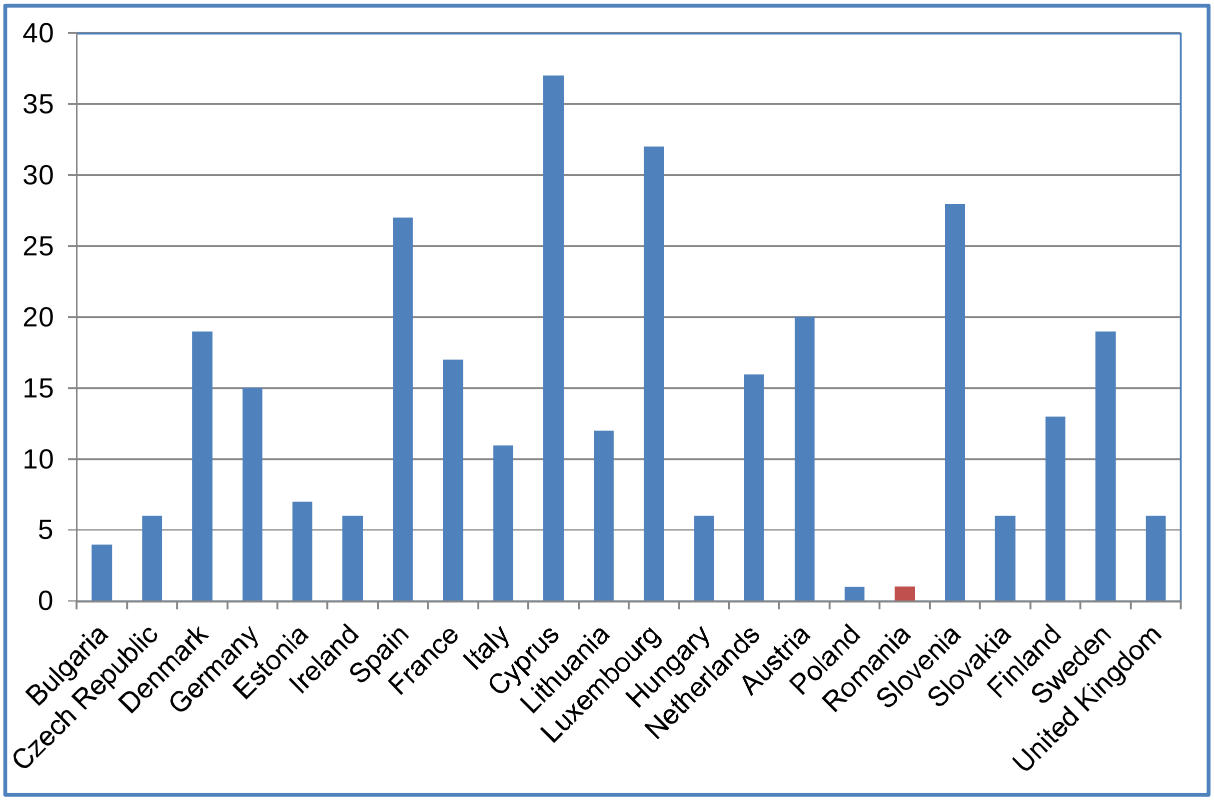
4.1.25 From both indicators used, it is clear that the relative proportion of motorway standard routes is low compared to the rest of Europe.

Figure 4.4 Proportion of National Network Beyond Service Life



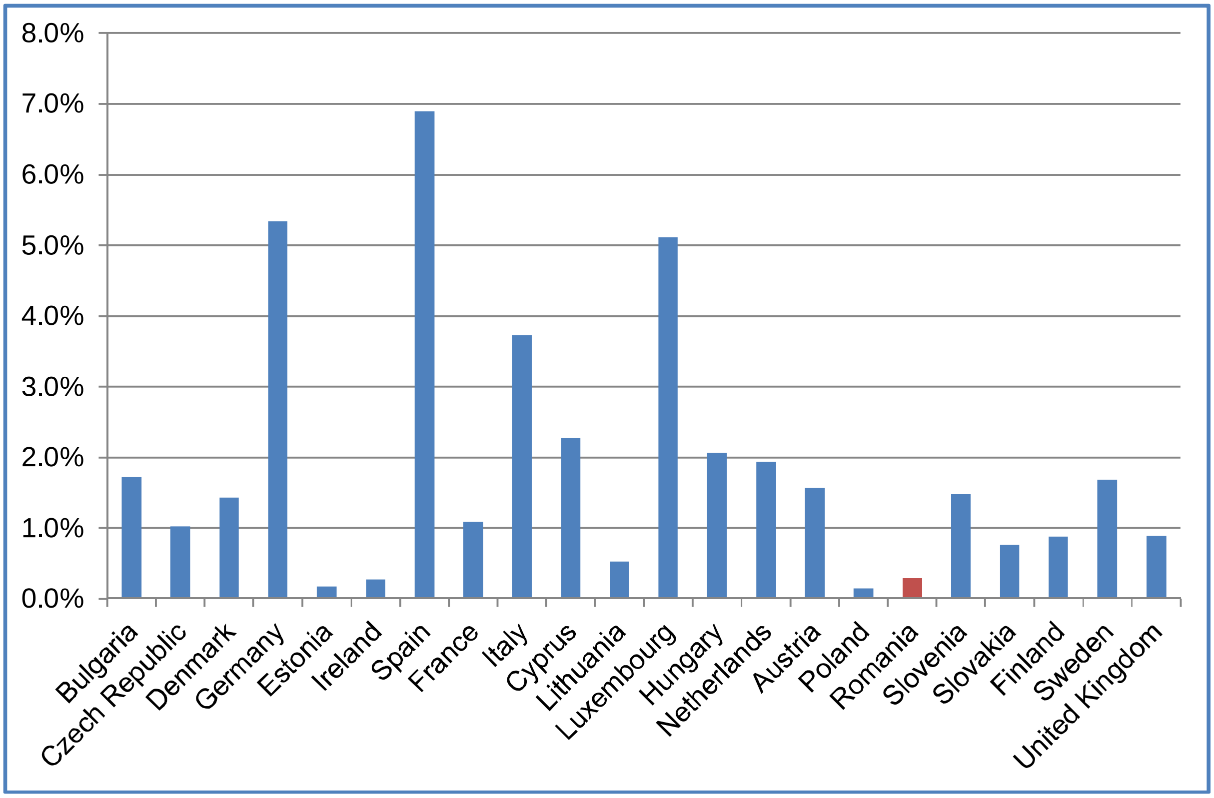
Source: CNADNR

Figure 4.5 Length of Motorway per 100,000 Population (2005)



Source: AECOM analysis of Eurostat Data

Figure 4.6 Proportion of Network Classified as Motorway (2005)



Source: AECOM analysis of Eurostat Data

4.1.26 There are currently of the order of 50 framework agreements in place covering maintenance activities on the national network which are subject to renewal every two years. In the UK, which has around ten times as much motorway network, there are 13 area based framework arrangements. Typical contract durations of between 5 and 10 years are prevalent in the rest of Europe.

4.1.27 The case study of the Rijkswaterstaat in the Netherlands indicated savings of 20% in road maintenance costs through the extension of contract terms from 1–2 years to 5–7 years and by bundling more maintenance activities together in the same contract. In addition to these contract savings, longer contract periods incentivise the suppliers to invest in more efficient plant as the ‘payback’ will be more transparent.

4.1.28 Consultation with suppliers in the UK has also revealed that bulk-buying of materials across a large programme can provide greater efficiency and savings are likely to be significant. Contractors could use their fixed and mobile plant with significantly greater efficiency if contracts included both local and national roads.

4.1.29 The level of maintenance spend required has been determined with reference to the World Bank report “Road and Railway Cost Recovery in Romania”, prepared by AECOM.

4.1.30 The model used in that project derived Base Case Lifecycle Expenditure (CapEx), Operations and Maintenance Expenditure (OpEx) and Revenues forecasts for the road and railways networks in Romania.

4.1.31 The resulting Base Case OpEx and CapEx forecasts were governed by the following key assumptions:

- o Asset physical characteristics
- o Key socio-economic factors such as GDP growth and other specific indicators (for example car ownership growth in the case of the road model);
- o Key project environmental factors such as initial and forecast traffic volumes;
- o Local standards and practices applicable to O&M and whole life costs;
- o Assumed unit rates (derived from benchmarks and local knowledge);
- o Proposed maintenance strategy (for example pavement in the case of the road model); and
- o Proposed rehabilitation programs.

4.1.32 The resulting revenues forecasts were governed by the following key assumptions:

- o Asset physical characteristics;
- o Key socio-economic factors such as GDP growth and other specific indicators (for example car ownership growth in the case of the road model);
- o Key project environmental factors such as initial and forecast traffic volumes;
- o User charges; and
- o Other sources of revenues.

4.1.33 The work for the National Transport Strategy was able to refine further this model based upon our improved knowledge of the condition of the road network as developed with assistance from CESTRIN.

4.1.34 The outputs of that process are provided in Table 4.5 below.

Table 4.5 Road Maintenance and Lifecycle Costs (million Lei)

Period	Total Cost in period			Average Annual		
	Maintenance	Lifecycle	Total	Maintenance	Lifecycle	Total
2014-2020	6,033.3	36,924.6	42,957.9	861.9	5,274.9	6,136.8
2021-2030	8,260.4	59,113.5	67,373.9	826.0	5,911.3	6,737.4

Source: AECOM

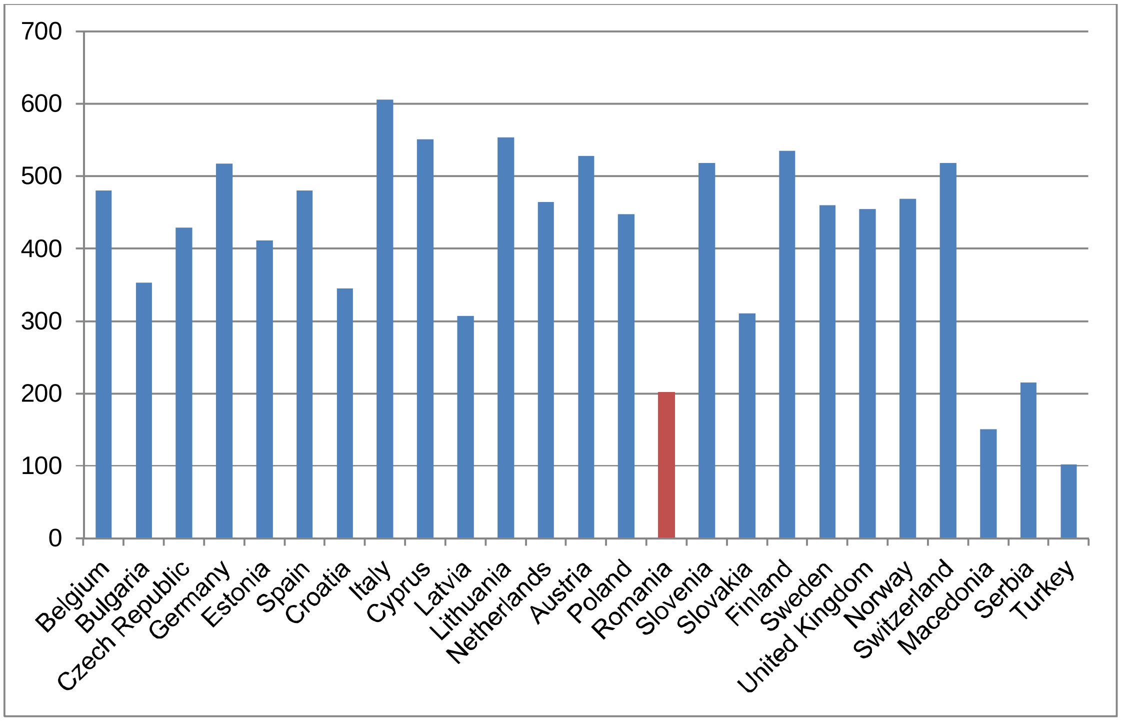
Future Trends

4.1.35 Whilst road is already a highly significant mode for passenger transport in Romania, it is also worth reflecting on the level of car ownership currently, and how that may change in the future, as that directly influences mode choice.

4.1.36 There has been a steady growth in car ownership levels in Romania with the long term trend averaging around 5% per annum.

4.1.37 This needs to be seen in context however with car ownership levels in the rest of Europe. The comparison is provided in Figure 4.7 with the values for Romania highlighted in red.

Figure 4.7 Comparison of EU Car Ownership Levels (2010)



Source: AECOM analysis of Eurostat Data

4.1.38 Clearly car ownership levels are currently lagging some way behind the rest of Europe. It is reasonable to expect that this is going to increase significantly over time which will have a direct impact on the likelihood of road becoming the mode of choice for even more passenger journeys than presently is the case.

4.1.39 The road sector is the most dominant element of the Romanian transportation system, in terms of the transportation of both passengers and goods. The road network carries almost 75% of all passenger kilometres and just under 50% of all goods kilometres.

4.1.40 As the Reference Case model relates to a forecast year of 2020, growth has been applied to the various trip demand matrices which feed into the modelling process. The following Table 4.6 summarises the trip matrix totals for the 2011 Base case and the 2020 Reference Case.

4.1.41 This shows that the overall demand for road travel has increased by just under 20%. In absolute terms, the growth in car trips is more significant but there is a proportionately higher growth in road freight.

Table 4.6 Base 2011 and Reference Case 2020 Trip Totals

Vehicle Type	Trip Purpose	Trip Matrix Totals					
		Base 2011		Reference 2020		Absolute Change	Percentage Change
Car	Business	282,410	12.0%	350,013	12.9%	+67,603	+23.9%
Car	Commuting	780,498	33.1%	757,018	27.9%	-23,480	-3.0%
Car	Private Business	1,056,692	44.9%	1,309,547	48.3%	+252,855	+23.9%
Car	Vacation	236,231	10.0%	295,500	10.9%	+59,268	+25.1%
Car	**Total**	**2,355,831**		**2,712,078**		**+356,246**	**+15.1%**
Goods	**Total**	**582,982**		**762,618**		**+179,635**	**+30.8%**
All	**Total**	**2,938,813**		**3,474,695**		**+535,882**	**+18.2%**

Source: AECOM National Transport Model

4.1.42 Within the following sections, we present the results of the Reference Case model run with reference to the 2011 Base Year equivalent.

4.1.43 Tables 5.7 to 5.9 show the changes forecast by the model in terms of vehicle kilometres, vehicle hours and average speed for car based trips.

Table 4.7 Vehicle Kilometres (Cars) – Base 2011 and Reference Case 2020

Road Type	Vehicle Kilometres - Cars			
	Base 2011	Reference 2020	Absolute Change	Percentage Change
Motorway	5,208,907	15,223,860	+10,014,954	+192.3%
National	50,552,218	66,955,719	+16,403,502	+32.4%
County	8,195,541	9,925,182	+1,729,641	+21.1%
Local	2,391,810	2,768,864	+377,055	+15.8%
All journeys	66,348,475	94,873,625	+28,525,151	+43.0%

Source: AECOM National Transport Model

Table 4.8 Vehicle Hours (Cars) – Base 2011 and Reference Case 2020

Road Type	Vehicle Hours - Cars			
	Base 2011	Reference 2020	Absolute Change	Percentage Change
Motorway	42,293	120,307	+78,014	+184.5%
National	767,805	1,031,980	+264,175	+34.4%
County	179,788	218,008	+38,220	+21.3%
Local	73,659	86,546	+12,887	+17.5%
All journeys	1,063,546	1,456,841	+393,295	+37.0%

Source: AECOM National Transport Model

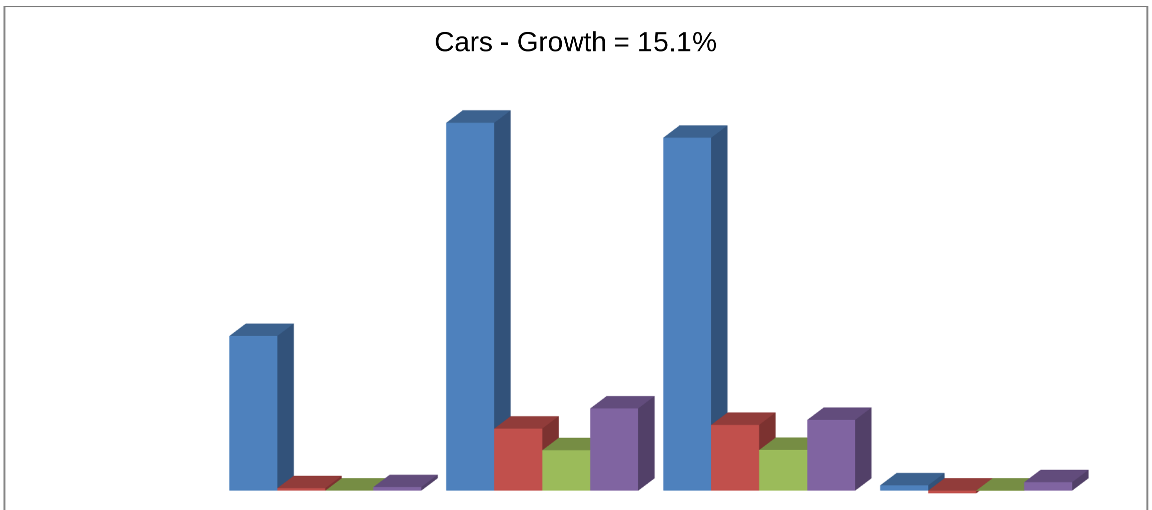
Table 4.9 Vehicle Speeds (Cars) – Base 2011 and Reference Case 2020

Road Type	Average Speed - Cars			
	Base 2011	Reference 2020	Absolute Change	Percentage Change
Motorway	123.2	126.5	+3.4	+2.7%
National	65.8	64.9	-1.0	-1.5%
County	45.6	45.5	-0.1	-0.1%
Local	32.5	32.0	-0.5	-1.5%

Source: AECOM National Transport Model

4.1.44 Figure 4.8 illustrates the impact of the reference case, relative to the base year for cars across the indicators discussed earlier.

Figure 4.8 Base Year to Reference Case (2020) – Cars



	Network Kilometres	Vehicle Kilometres	Vehicle Hours	Average Speed
Motorway	+80.9%	+192.3%	+184.5%	+2.7%
National	+1.3%	+32.4%	+34.4%	-1.5%
County	0%	+21.1%	+21.3%	-0.1%
Total	2%	+43.0%	+37.0%	+4.4%

Source: AECOM National Transport Model

4.1.45 Tables 5.10 to 5.12 show the changes forecast by the model in terms of vehicle kilometres, vehicle hours and average speed for all goods vehicle trips.

Table 4.10 Vehicle Kilometres (Goods) – Base 2011 and Reference Case 2020

Road Type	Vehicle Kilometres - Goods			
	Base 2011	Reference 2020	Absolute Change	Percentage Change
Motorway	2,142,744	7,186,109	+5,043,365	+235.4%
National	19,960,803	27,917,204	+7,956,400	+39.9%
County	2,644,422	3,435,490	+791,069	+29.9%
Local	615,180	747,814	+132,634	+21.6%
All journeys	25,363,150	39,286,618	+13,923,468	+54.9%

Source: AECOM National Transport Model

Table 4.11 Vehicle Hours (Goods) – Base 2011 and Reference Case 2020

Road Type	Vehicle Hours - Goods			
	Base 2011	Reference 2020	Absolute Change	Percentage Change
Motorway	59,267	161,772	+102,506	+173.0%
National	627,635	803,666	+176,032	+28.0%
County	101,877	125,196	+23,318	+22.9%
Local	27,055	33,100	+6,045	+22.3%
All journeys	815,834	1,123,734	+307,901	+37.7%

Source: AECOM National Transport Model

Table 4.12 Vehicle Speeds (Goods) – Base 2011 and Reference Case 2020

Road Type	Average Speed - Goods			
	Base 2011	Reference 2020	Absolute Change	Percentage Change
Motorway	36.2	44.4	+8.3	+22.9%
National	31.8	34.7	+2.9	+9.2%
County	26.0	27.4	+1.5	+5.7%
Local	22.7	22.6	-0.1	-0.6%

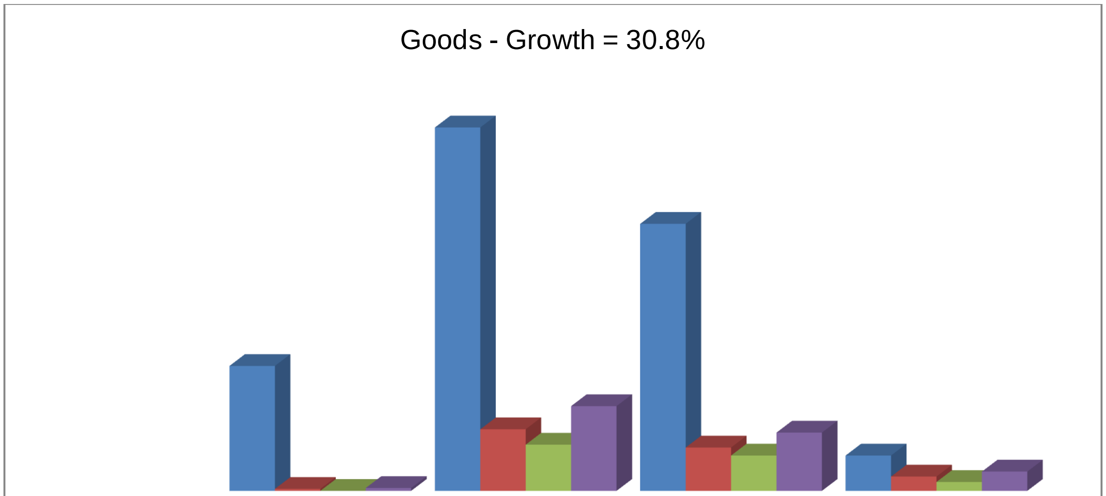
Source: AECOM National Transport Model

4.1.46 Figure 4.9 illustrates the impact of the reference case, relative to the base year for goods vehicles across the same indicators used for cars.

4.1.47 The growth in goods traffic is greater than that for cars, (31% compared to 15%) but the overall pattern of impacts is similar to that reported on for cars.

4.1.48 There is a significant growth in vehicle kilometres on motorways (235%) and a more modest traffic growth (40%) on the National network. As with cars, the road network, and motorways in particular, are becoming a much more attractive mode as a consequence of the Reference Case schemes.

Figure 4.9 Base Year to Reference Case (2020) – Goods



	Network Kilometres	Vehicle Kilometres	Vehicle Hours	Average Speed
Motorway	+80.9%	+235.4%	+173.0%	+22.9%
National	+1.3%	+39.9%	+28.0%	+9.2%
County	0%	+29.9%	+22.9%	+5.7%
Total	2%	+54.9%	+37.7%	+12.5%

Source: AECOM National Transport Model

4.1.49 The Reference Case predicts significant increases on many of the main corridors for car traffic, reflecting a number of factors raised earlier in this report, notably:

- Increasing levels of car ownership;
- Improvements to the national highway network; and
- Reductions in the performance of rail services, as discussed in Chapter 6.

4.1.50 Without improvements in the public transport offer, the result is a mode shift towards car with an increase in car trips of over 15% against a total increase in passenger trips across all modes of just under 11%. Longer trip lengths are also forecast with passenger kilometres increasing for car by 43% against an all modes figure of 27%.

4.1.51 The most significant increases are on the East-West corridor of Constanta-Bucharest-Sibiu-Arad but these are also increases on the North-South movements on Bucharest-Buzau-Bacau and Sibiu-Cluj.

4.1.52 Road freight experiences similar patterns of growth with volumes up by 31% against a total figure of around 27%. Again the trip length is increasing with road freight tonne kilometres increasing by almost 40% against an all modes figure of 34%.

4.1.53 The spatial distribution of increases is similar to passenger but with added impact on the Bucharest-Alexandria-Craiova corridor to the border at Drobeta-Turnu-Severin.

4.2 Strategic Objectives

4.2.1 The strategic objectives for the Road Sector have been identified as:

- Improving the population mobility and freight traffic along the TEN – T Core and Comprehensive network through the execution of a motorway and expressway network;
- Ensuring the accessibility of population and business environment to the TEN – T Core and Comprehensive network through the execution of the national connectivity corridors;
- Ensuring a safe and operational road transport network which contributes to the reduction in the number of road accidents as well as the reduction of journey times;
- Ensuring international accessibility through the connection with the neighbour countries; and
- Ensuring an environmental friendly transport network through the implementation of by-pass schemes.

4.2.2 In the context of limited funding, there is a need to focus national policy and investment on those parts of the network which, in terms of role and function, form the primary sections of the national network. We refer to this as the Primary Economic Network (PEN).

4.2.3 The definition of the Primary Economic Network for roads is a function of the following factors:

- Connectivity between significant population centres with significant centres being defined by population levels in excess of 125,000;
- Connectivity with international gateways such as border crossings, airports and ports; and
- Economically significant corridors, defined as those which carry high volumes of goods traffic.

4.2.4 The population centres and border crossing points that have been used to define the primary network are set out in Table 4.13 and Table 4.14.

Table 4.13 Top 20 Cities by Population

Order	City	Population	Order	City	Population
1	Bucharest	1,883,425	11	Brăila	180,302
2	Cluj-Napoca	324,576	12	Arad	159,704
3	Timișoara	319,279	13	Pitești	155,383
4	Iași	290,422	14	Sibiu	147,245
5	Constanța	283,872	15	Bacău	144,307
6	Craiova	269,506	16	Târgu Mureș	134,290
7	Brașov	253,200	17	Baia Mare	123,738
8	Galați	249,342	18	Buzău	115,494
9	Ploiești	209,945	19	Botoșani	106,847
10	Oradea	196,367	20	Satu Mare	102,441

Source: Romanian National Census

Table 4.14 Top 10 Border Crossings (Goods Vehicle Flows – AADT)

Order	Border Crossing	HGV Volumes	Proportion of Countrywide Border Flows	
			Individual	Cumulative
1	Nadlac	1,778	22.7%	22.7%
2	Bors	1,498	19.2%	41.9%
3	Giurgiu	1,126	14.4%	56.3%
4	Varsad	680	8.7%	65.0%
5	Stanca-Costesti	501	6.4%	71.4%
6	Petea	298	3.8%	75.2%
7	Bechet	290	3.7%	78.9%
8	Siret	234	3.0%	81.9%
9	Calafat	155	2.0%	83.9%
10	Negru Voda	153	2.0%	85.8%

Source: Romanian Customs

4.2.5 The corridors with significant goods vehicle traffic flows, as derived from the National Transport Model, are shown in Figure 4.10 together with the top twenty population centres and top 10 border crossing points.

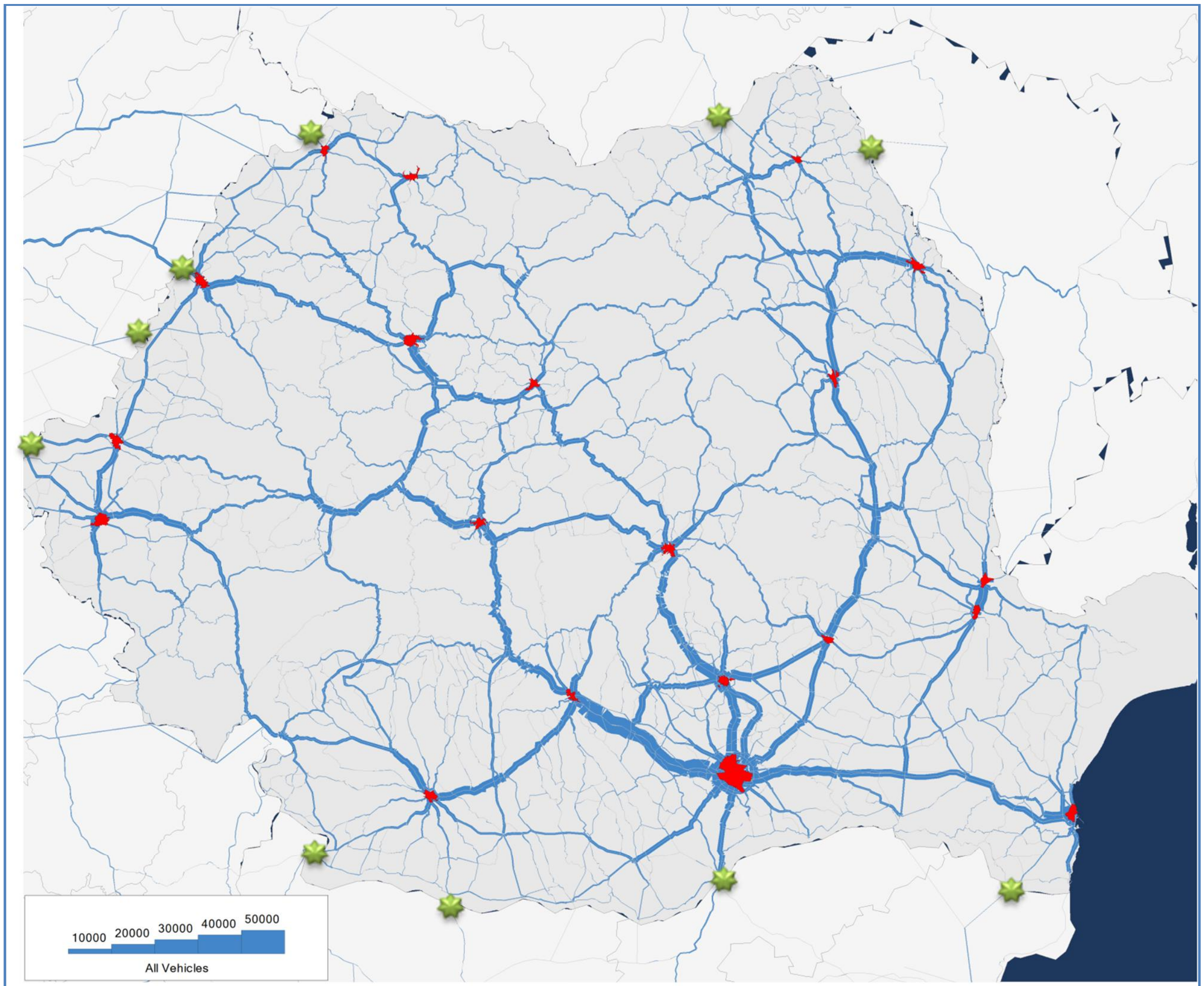
4.2.6 We also provide a similar plot but taking account of total vehicle flows – this is provided in Figure 4.11.

4.2.7 This leads to a definition of the Primary Economic Network as shown in Figure 4.12. This takes the results from Figure 4.10 and Figure 4.11 and highlights the relevant links in red.

4.2.8 Although not used in the definition of the Primary Economic Network, it is worth noting the close correlation between it and the TEN-T corridors as shown in Figure 4.13.

4.2.9 We have also analysed the major movements at an aggregate level to identify the most important international, regional and county level movements. Figures 4.14 to 4.16 present the results of that analysis.

Figure 4.10 Goods Vehicle Flows, Population Centres and Major Border Road Crossings



Key:

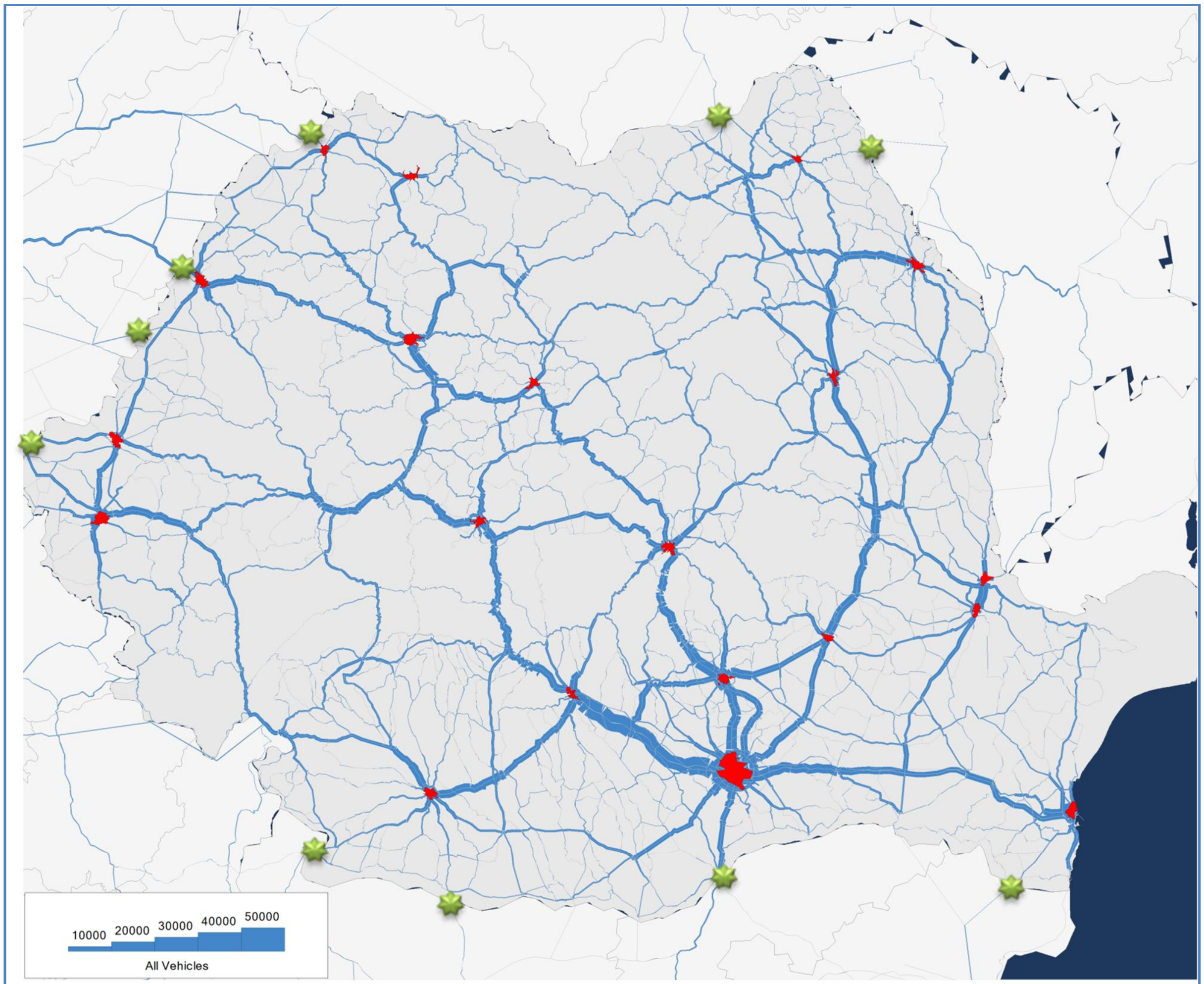
Bandwidth = 2011 AADT Goods Vehicle Flows

= Population Centres

= Border Crossings

Source: AECOM National Transport Model

Figure 4.11 Total Vehicle Flows, Population Centres and Major Border Road Crossings



Key:

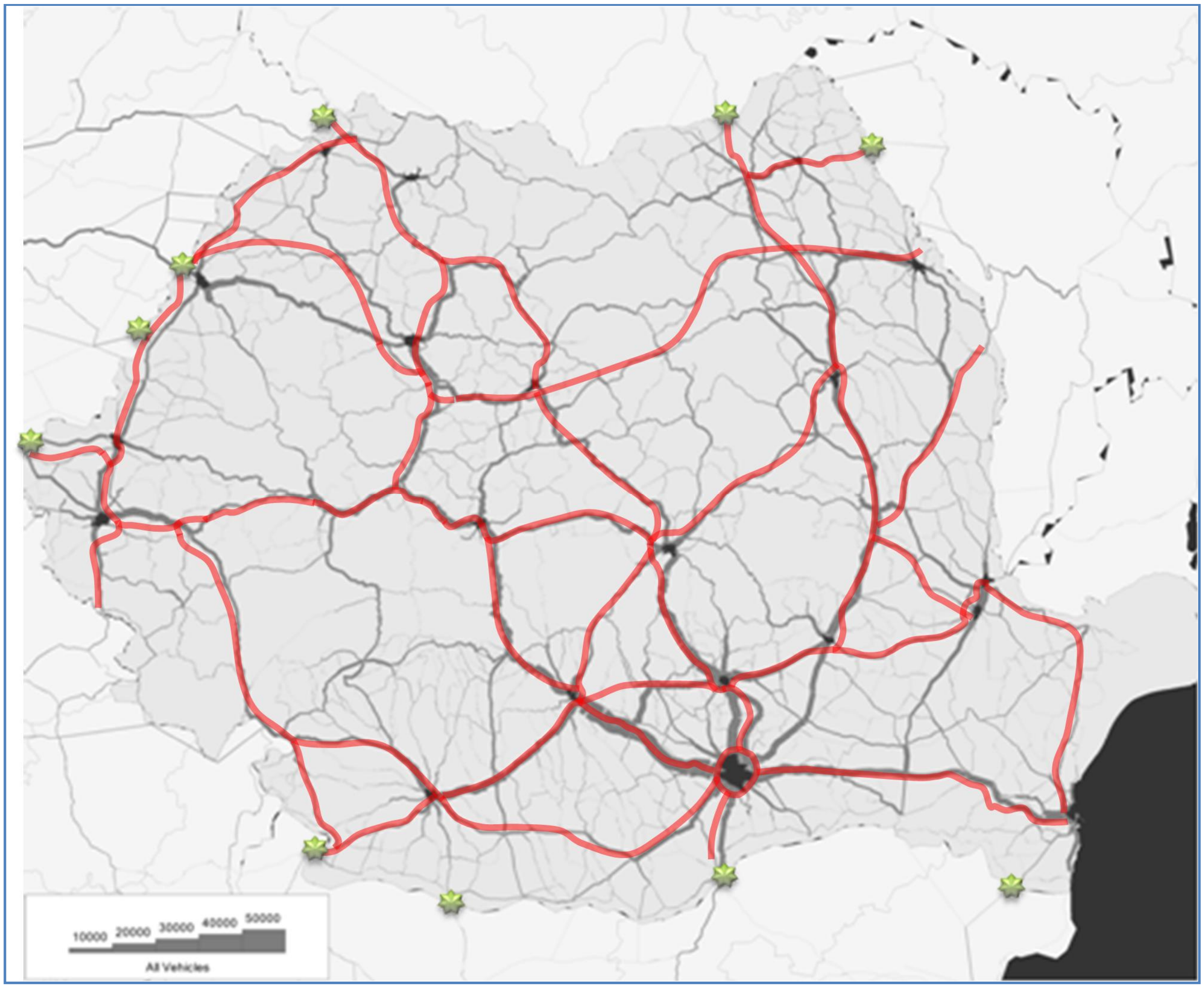
Bandwidth = 2011 AADT Total Vehicle Flows

= Population Centres

= Border Crossings

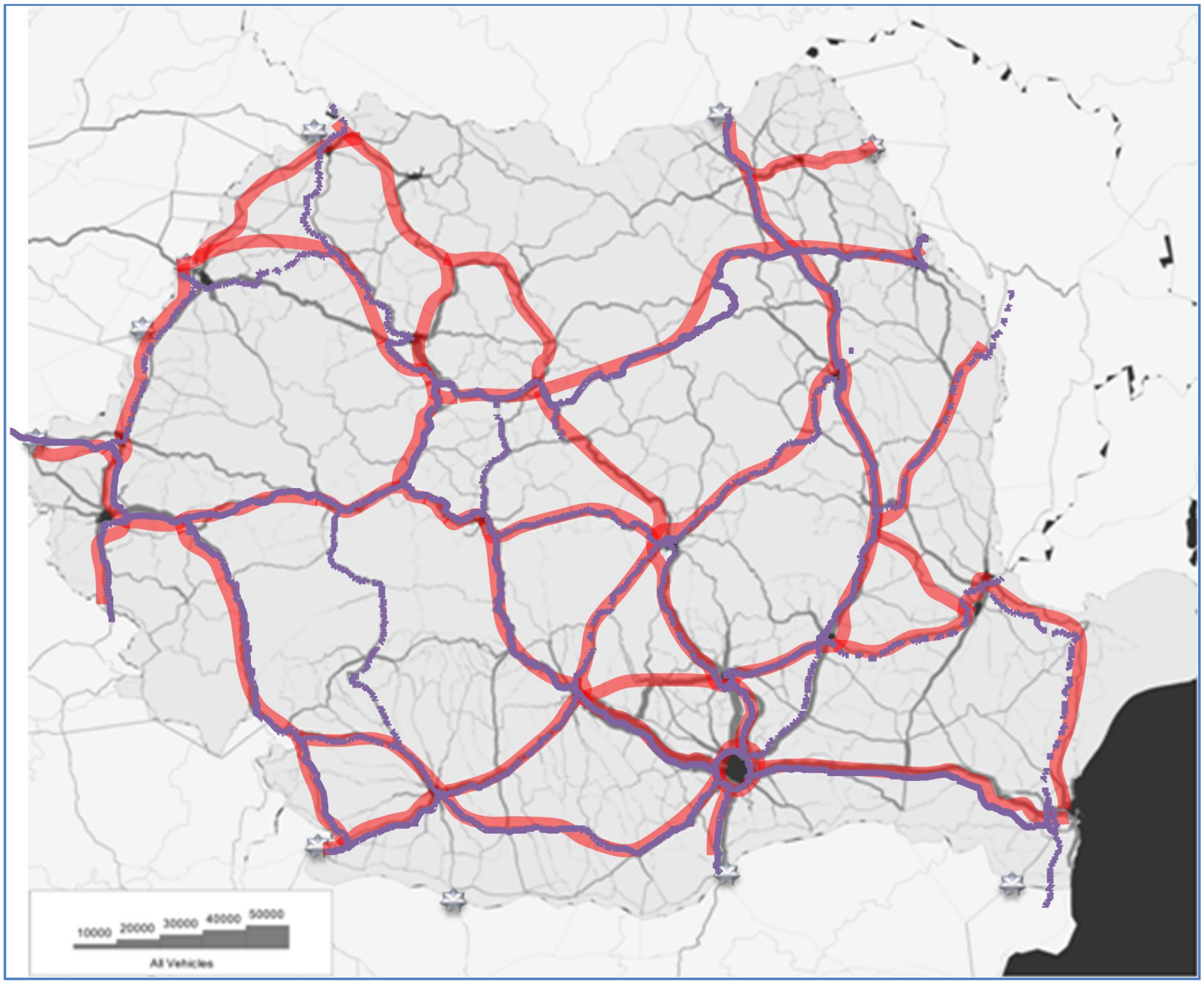
Source: AECOM National Transport Model

Figure 4.12 Proposed Primary Economic Network (Overlaid on National Model Analysis)



Source: AECOM National Transport Model

Figure 4.13 Correlation Between PEN (Red) and TEN-T (Purple)



Source: AECOM National Transport Model

Figure 4.14 County Level Analysis of Road Demand – 2020 Reference Case (Vehicles)

Note: Excludes international trips, source = AECOM National Transport Model

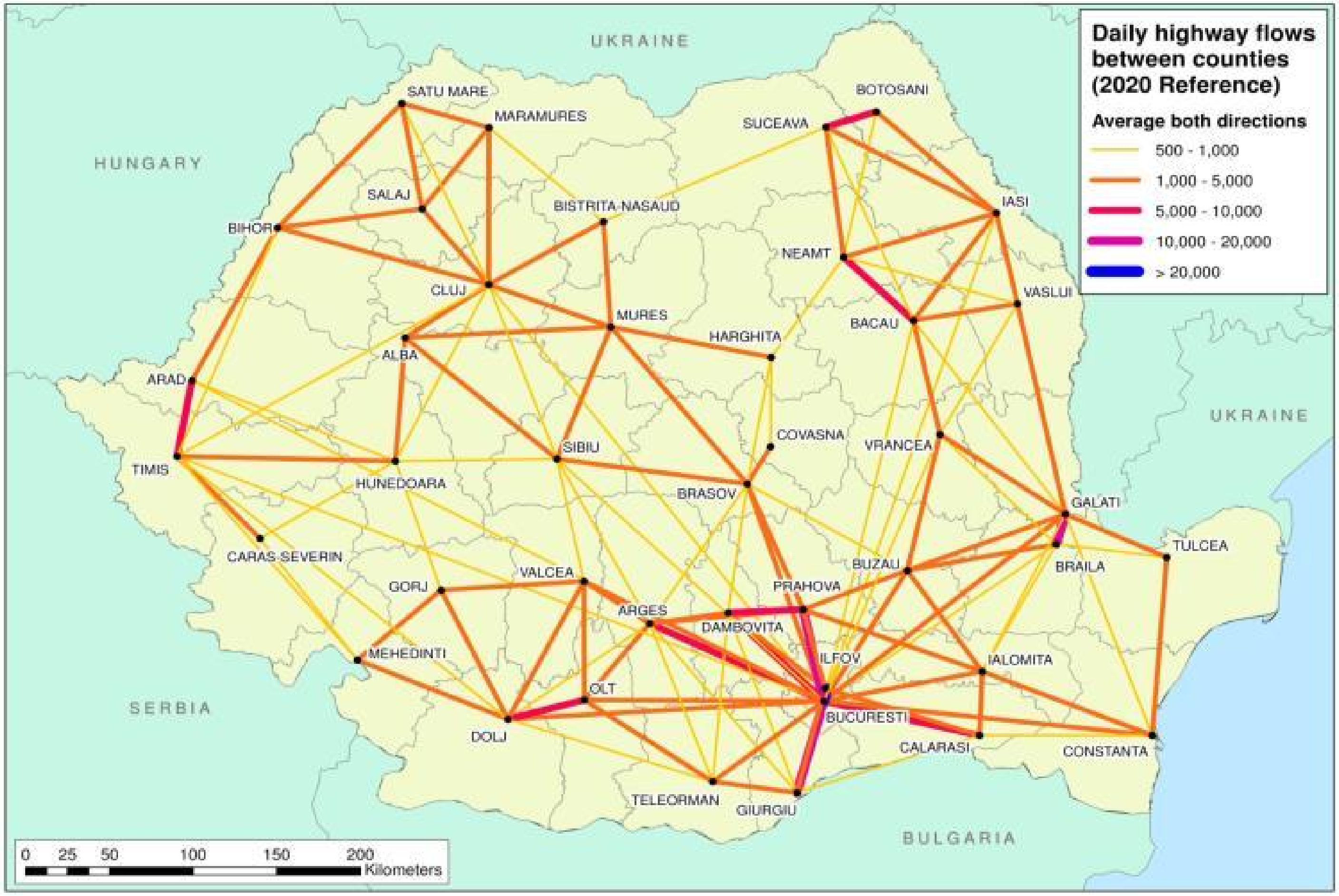


Figure 4.15 Regional Level Analysis of Road Demand – 2020 Reference Case (Vehicles)

Note: Excludes international trips, source = AECOM National Transport Model

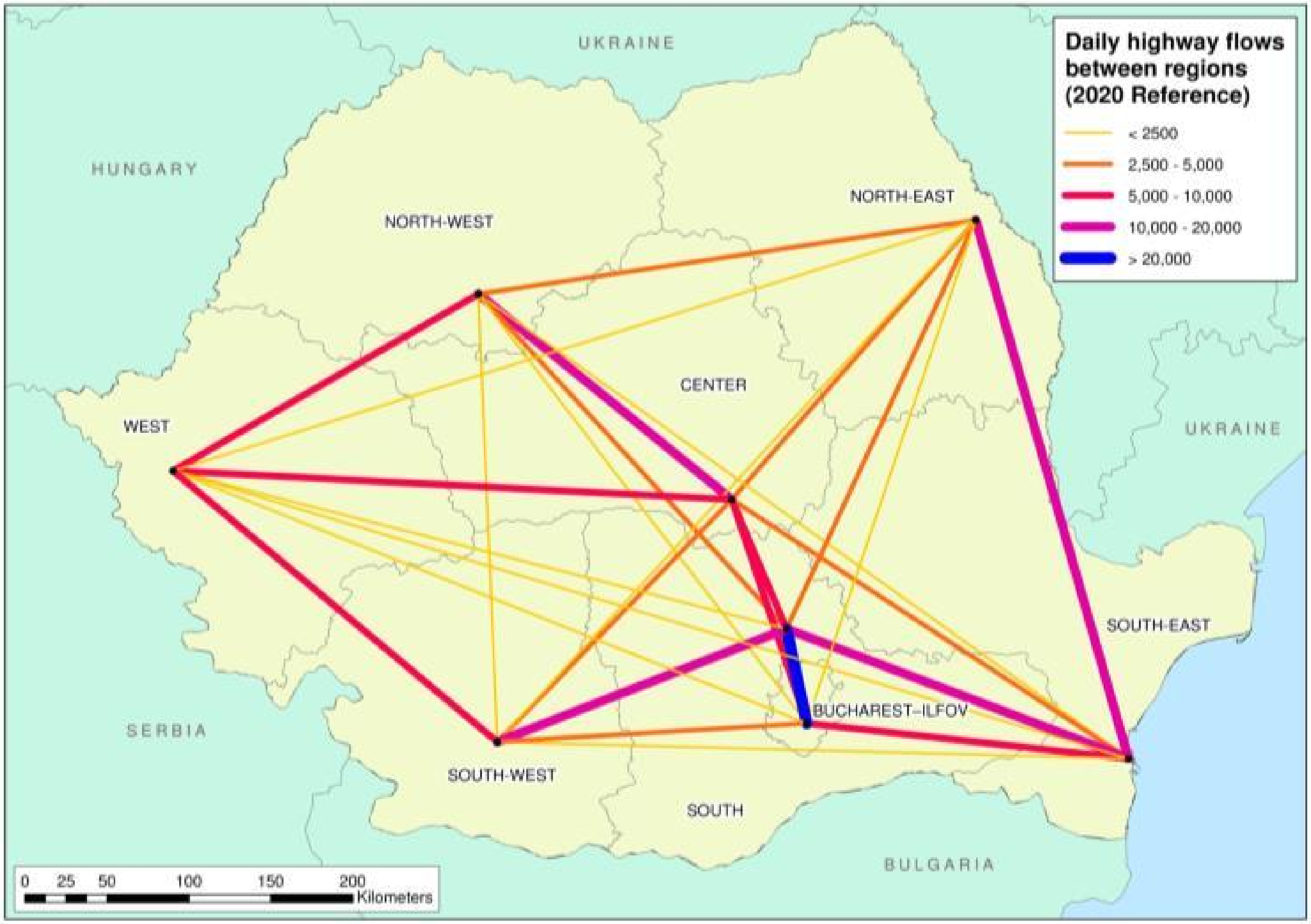
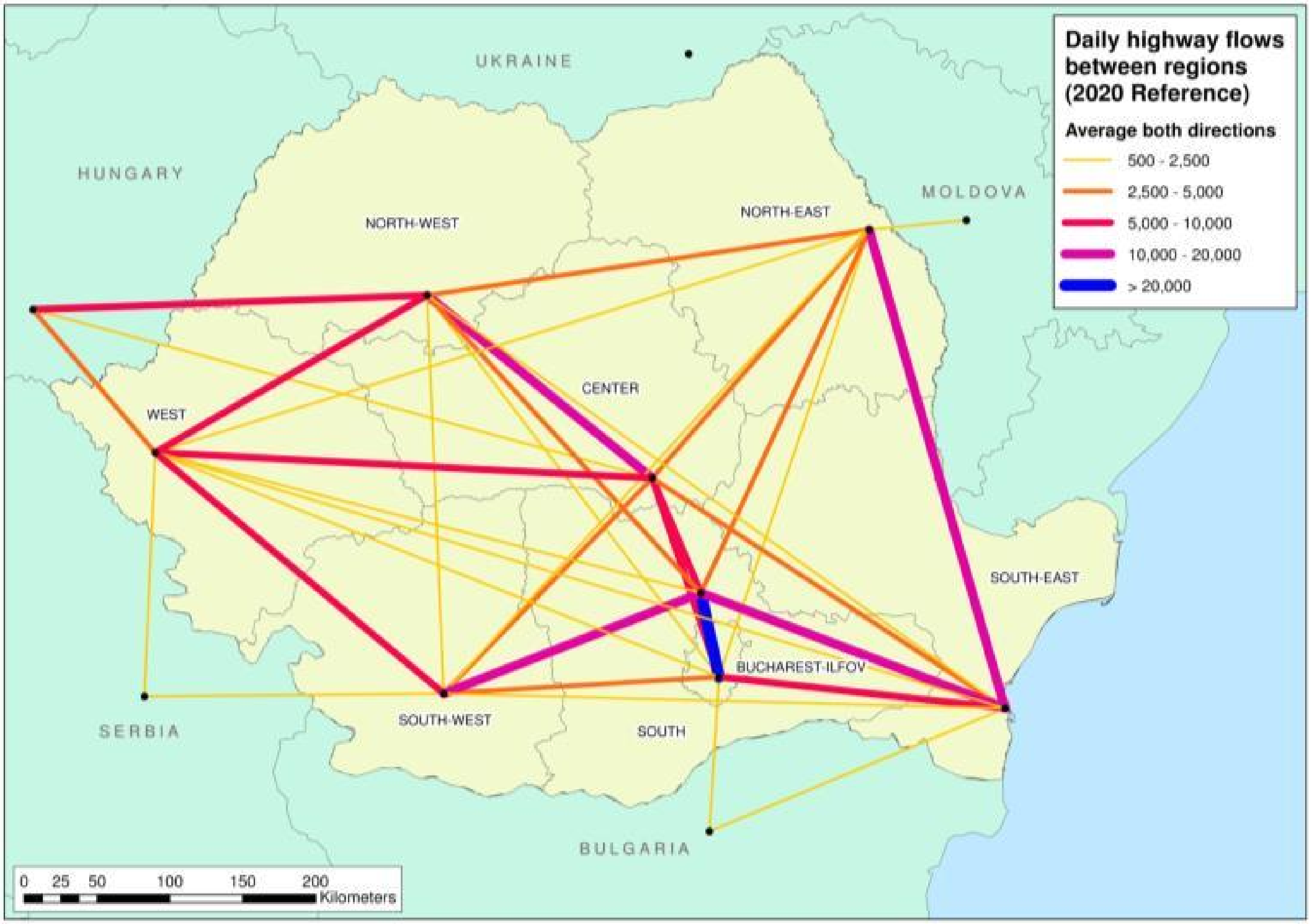


Figure 4.16 Regional Level Analysis of Road Demand – 2020 Reference Case (Vehicles)

Note: Includes international trips over 500 vehicles, source = AECOM National Transport Model



4.3 Operational Objectives

Defining the Motorway Network

4.3.1 As previously identified, the proportion of motorway standard network in Romania is low. There are a number of Reference Case schemes which will improve the situation but there is forecast to remain a number of corridors where travel times will be poor even with this investment.

4.3.2 The National transport model has been used to investigate the economic impact of the remaining delays on the road network in 2020 assuming all the Reference Case Schemes are constructed.

The analysis took the following form:

$$\sum_{i=0}^{n} \frac{Flow_i \times (Target\ Time - Actual\ Time) \times VoT_i}{Length}$$

Where each model link was evaluated and:

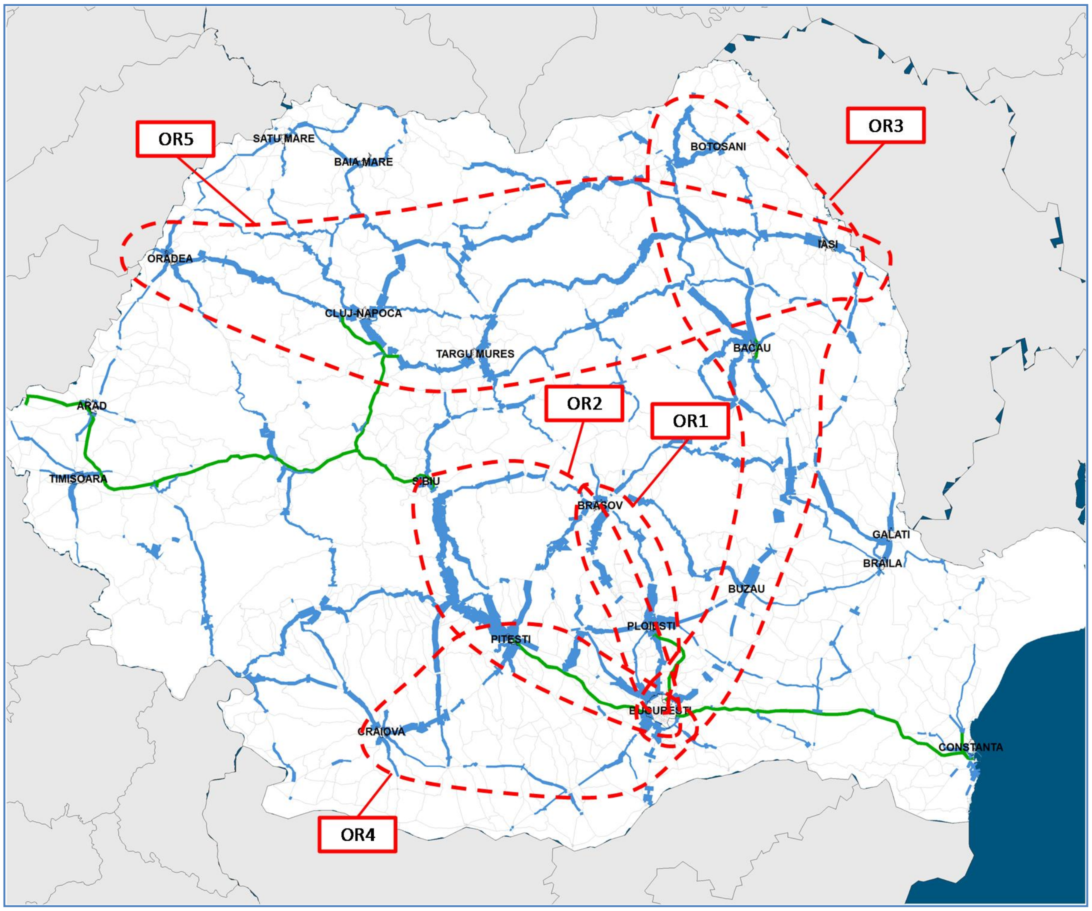
Flow = AADT;

I = vehicle purpose (e.g. commuting, business etc.); and

VoT = Value of Time.

The plot below shows the results of that computation.

Figure 4.17 Analysis of Lost Time by Corridor



Source: AECOM National Transport Model

4.3.3 The plot highlights five main corridors or areas of movement which still require improvement. Within each corridor or area, a number of options were identified which would meet the strategic and operational objectives and address the particular lost time issues.

4.3.4 Each option was coded into the National Model and then subjected to a full model run, economic and multi-criteria analysis in order to objectively determine the most appropriate scheme to take forward in each area.

4.3.5 The results of these tests, referred to as the Level 1 tests, are summarised in the following table.

Table 4.15 Summary of Level 1 Testing Results (CBA)

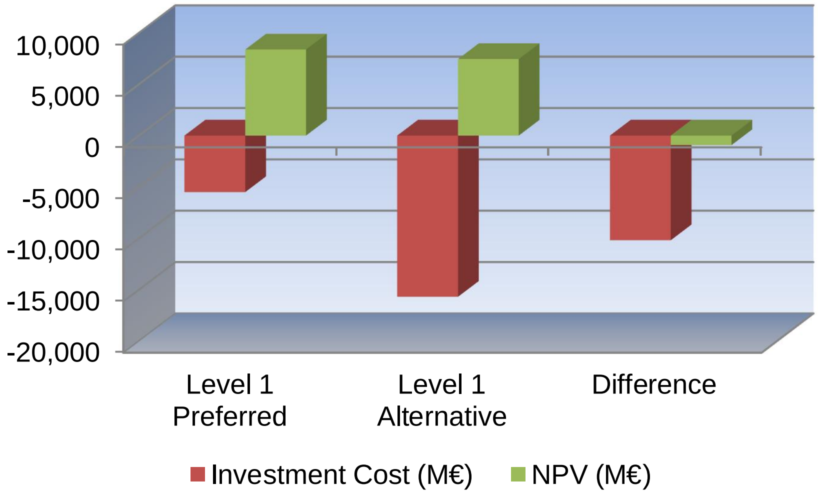
Ref.	Project	Investment cost (undiscounted) *€M*	NPV *€M*	BCR	EIRR *%*
OR1	Ploiesti-Brasov Motorway	1,312	2,495	3.55	13.7%
OR2, Option A	Pitesti-Sibiu	2,271	3,301	2.96	12.1%
OR2, Option B	Ploiesti-Brasov-Sibiu	1,946	6,895	5.70	18.1%
OR3, Option A	Ploiesti-Buzau-Bacau-Iasi	2,320	3,232	2.81	11.5%
OR3, Option B	Ploiesti-Brasov-Bacau-Iasi	4,070	3,440	2.13	9.9%
OR3, Option C	Ploiesti-Brasov-Bacau-Iasi (via Pacsani spur)	4,192	943	1.30	6.8%
OR4, Option A	Pitesti-Craiova	800	1,242	3.03	12.2%
OR4, Option B	Bucharest-Alexandria-Craiova	1,094	329	1.43	7.2%
OR5, Option A	Iasi-Turda-Nadaselu-Bors	4,619	5,625	2.62	11.4%
OR5, Option B	Iasi-Bacau-Brasov-Sibiu	3,392	3,851	2.50	11.0%
Preferred L1 Highway Network	Comprising OR1,OR2B, OR3B, OR4A and OR5B	5,504	9,835	3.36	13.2%
Alternative L1 Highway Network	Comprising OR1, OR2A, OR3A, OR4B and OR5A	15,698	9,470	1.82	8.6%

Source: AECOM National Transport Model

4.3.6 The composition of the Preferred Level 1 network was done primarily based on the performance of the individual component schemes but also taking into consideration the connectivity of the combined network and ensuring that it provided a logical structure.

4.3.7 Figure 4.18 shows the comparison of the two alternative strategies in terms of investment cost and Net Present Value (i.e. total benefits minus total costs over the full appraisal period).

Figure 4.18 Comparison of Preferred and Alternative Level 1 Strategies



4.3.8 The Preferred Level 1 Network and the Alternative Level 1 Network are illustrated in Figure 4.19 and Figure 4.20.

Figure 4.19 Level 1 Preferred Network

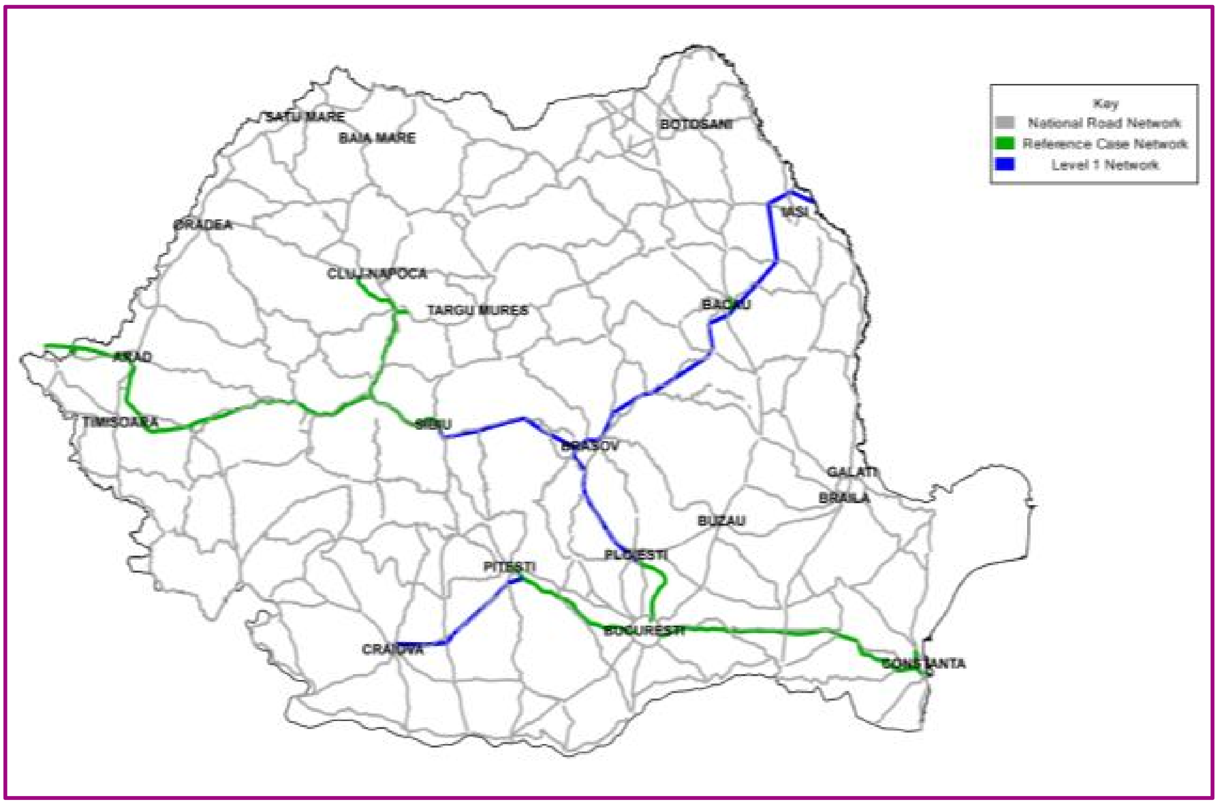
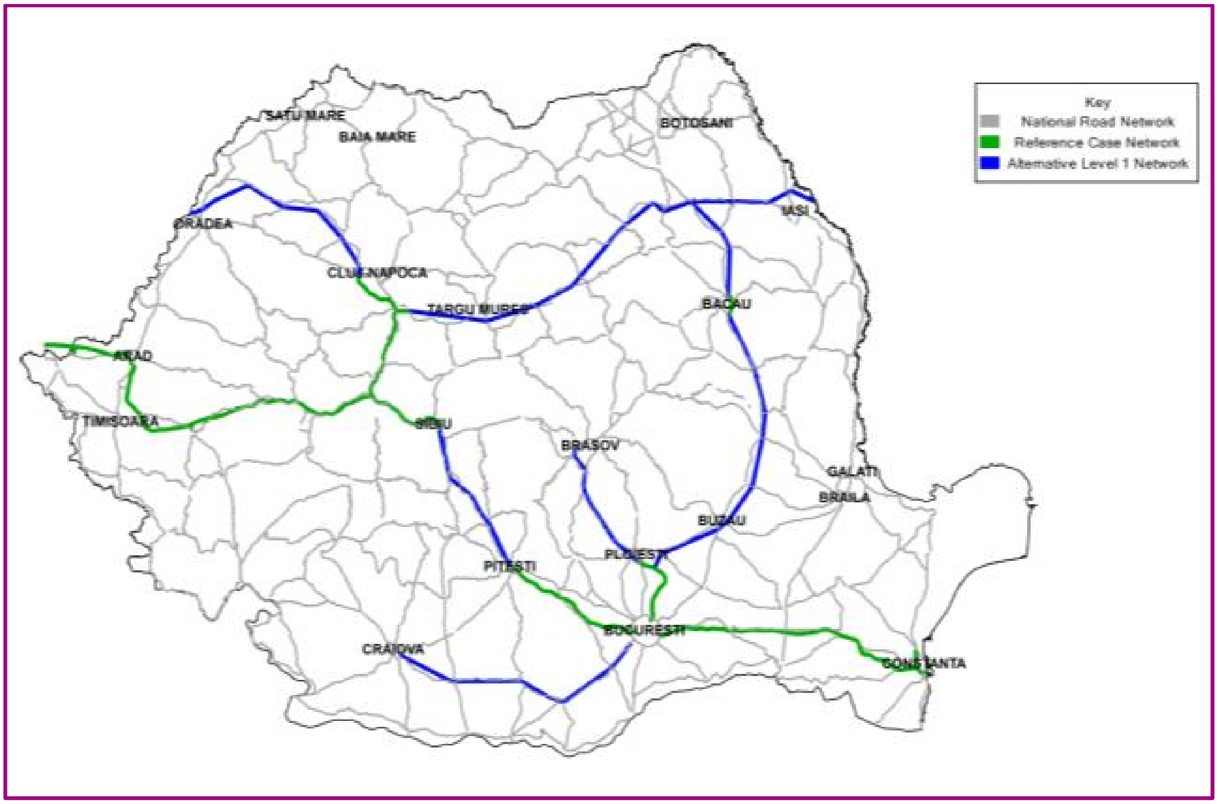
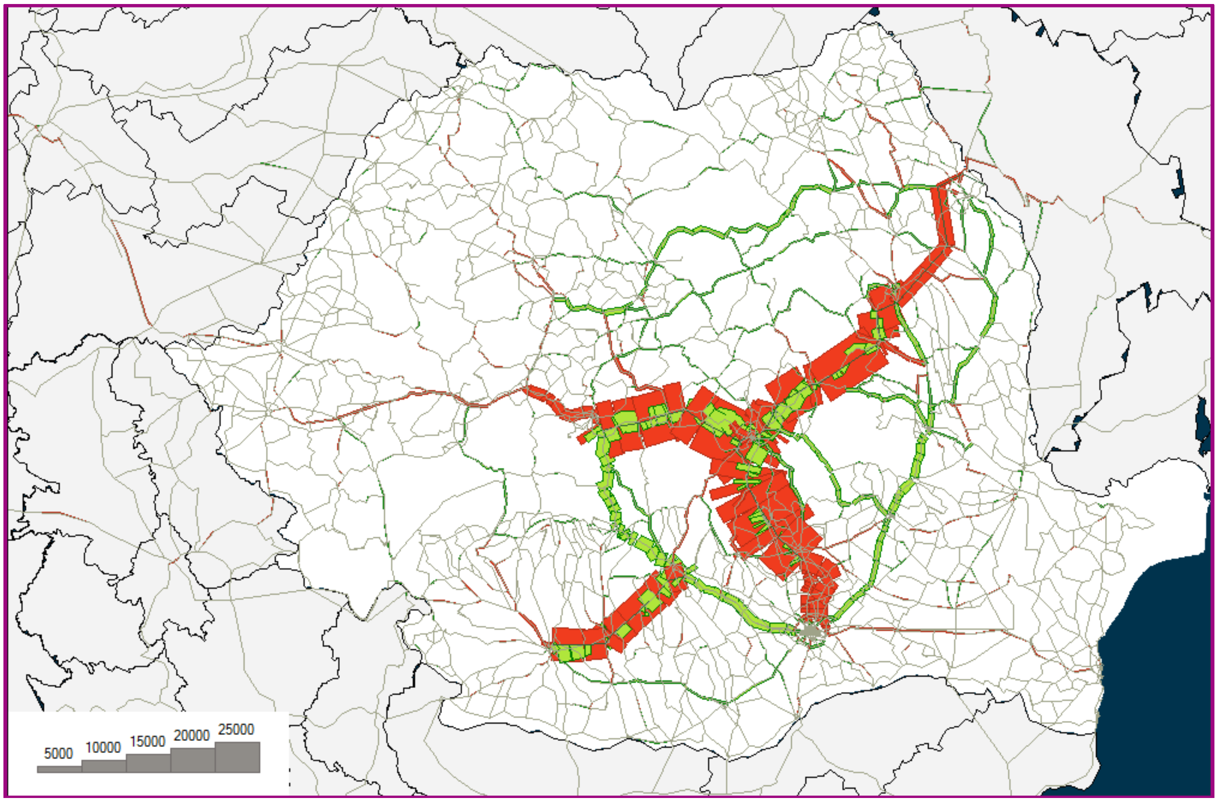


Figure 4.20 Level 1 Alternative Network



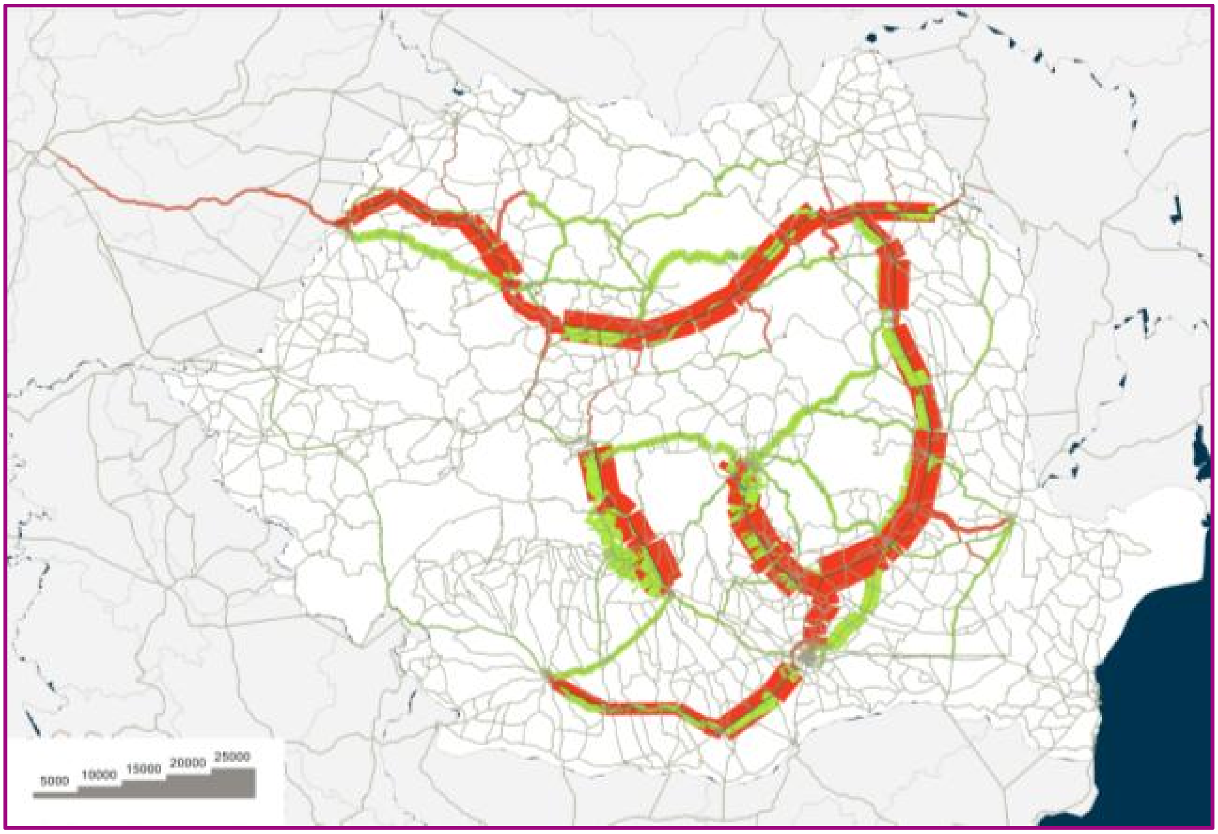
4.3.9 The impact of the preferred Level 1 Strategy is shown in Figure 4.21 in terms of the change in total flow compared to the Reference Case Situation. Increases are shown in red and reductions in green. Flows are in AADT.

Figure 4.21 Change in Total Flow for Level 1 Preferred Relative to Reference Case



4.3.10 For comparative purposes, the equivalent changes in flow were the Alternative Level 1 network to be adopted, are shown in Figure 4.22.

Figure 4.22 Change in Total Flow for Level 1 Alternative Relative to Reference Case



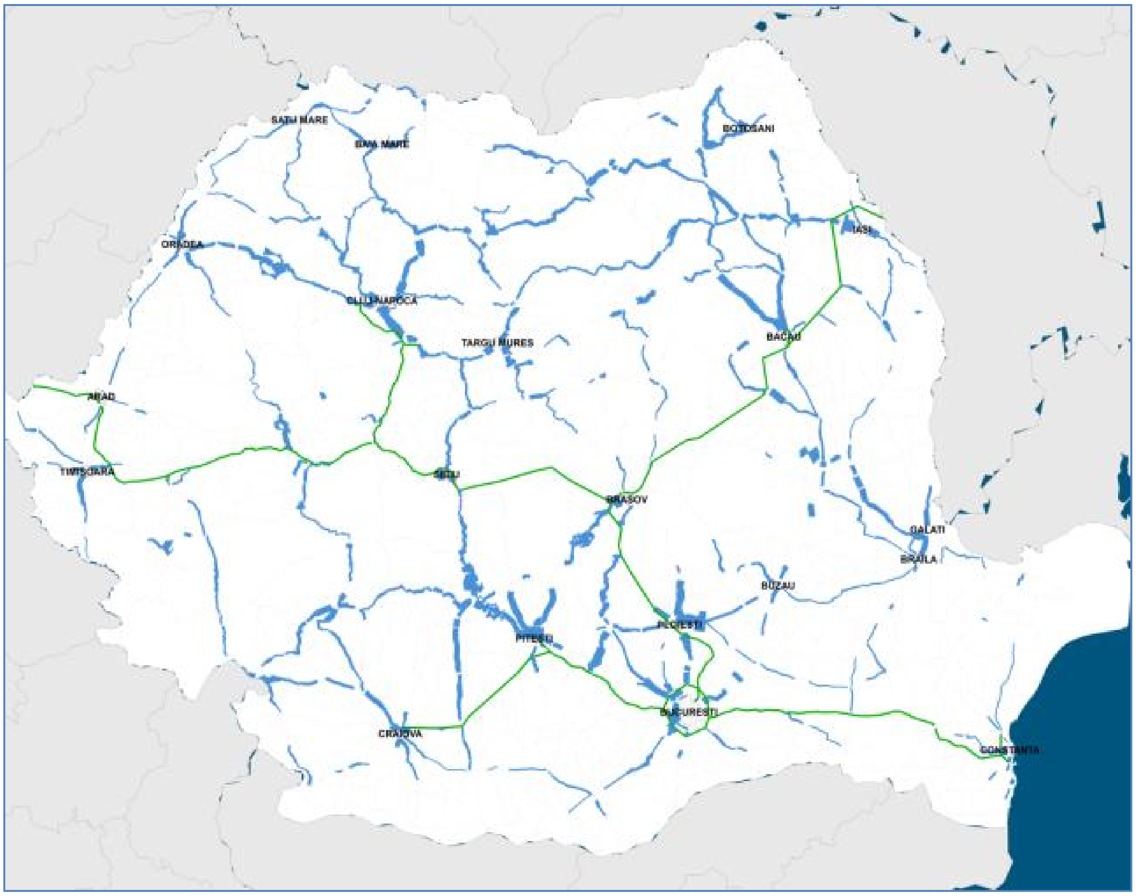
Defining the Expressway Network

4.3.11 The Level 1 testing determined those parts of the network which were most in need of significant improvement, and for which a motorway standard project was appropriate. However there remain a number of corridors which still require enhancement in order to ensure the road network meets the strategic objectives as previously defined.

4.3.12 The lost time analysis was therefore repeated using the National Model but in this scenario all of the Level 1 Motorway schemes, as well as the agreed Reference Case schemes, were assumed to be complete.

4.3.13 The output from the analysis is shown in Figure 4.23.

Figure 4.23 Analysis of Lost Time by Corridor Post Level 1



4.3.14 The candidate projects were then identified and each option coded into the National Model. All schemes were then subjected to a full model run, economic and multi-criteria analysis in order to objectively determine the most appropriate scheme to take forward in each area.

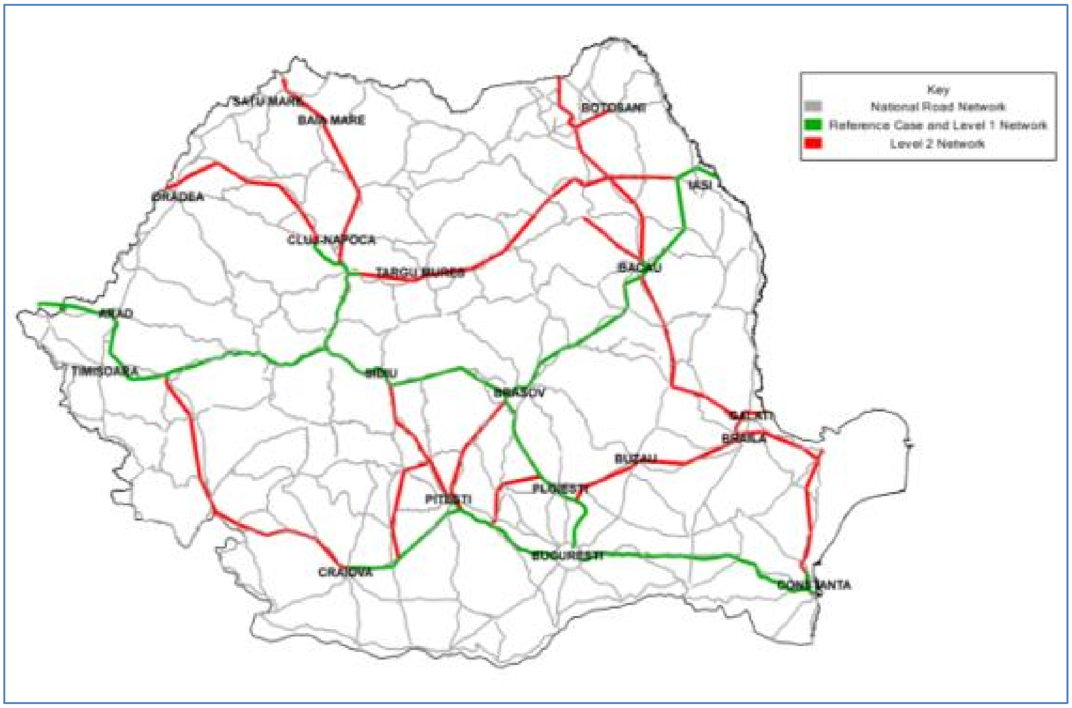
4.3.15 The results of these tests, referred to as the Level 2 tests, are summarised in the following table.

4.3.16 The selected Level 2 schemes are illustrated in Figure 4.24 in order to show the linkage and connectivity with the Reference Case and Level 1 schemes.

Table 4.16 Summary of Level 2 Testing Results (CBA)

Ref.	Project	Investment cost (undiscounted) *€M*	NPV *€M*	BCR	EIRR *%*
OR6	Focsani-Braila-Galati Expressway	525	536	2.28	10.1%
OR6B	Bacau-Focsani-Braila-Galati Expressway	984	1,268	2.63	11.2%
OR7A	Bacau-Suceava Expressway	631	1,107	3.23	12.6%
OR7B	Suceava-Siret Expressway	802	1,172	2.84	11.7%
OR7C	Suceava-Botosani Expressway	949	623	1.83	8.9%
OR8	Bacau-Piatra Neamt Expressway	308	350	2.45	10.6%
OR9	Turda/ Targa Mures - Halmeu Expressway	1,748	2,742	3.02	12.7%
OR9B	Turda-Halmeu Expressway	991	1,766	3.29	13.5%
OR10	Lugoj- Craiova Expressway	1,764	1,654	2.23	10.0%
OR11	Constanta-Tulcea-Braila Expressway (including Braila Bridge)	1,259	66	1.07	5.4%
OR12	Gilau-Bors Expressway	1,128	1,219	2.41	10.7%
OR13	Campia Turzii-Targu Mures-Iasi Expressway	4,049	2,213	1.74	8.4%
OR13B	Cluj-Dej-Suceava Expressway	4,006	1,224	1.42	7.1%
OR14	Brasov-Pitesti Expressway	1,694	1,222	1.97	9.1%
OR15	Sibiu-Pitesti Expressway	1,817	1,358	2.01	9.3%
OR16	Slatina-Curtea de Arges Expressway	762	62	1.11	5.6%
OR17	Gaesti-Ploiesti-Buzau-Braila Expressway	1,176	1,754	2.87	11.9%
OR18A	Bucharest Southern Ring Road (new construction)	488	261	1.75	8.2%
OR18B	Bucharest Southern Ring Road Upgrade	161	380	4.42	14.5%

Figure 4.24 Level 2 Network in Relation to Level 1 & Reference Case Schemes



National Road Network

4.3.17 Following the selection of the Level 1 and Level 2 projects, there remain some sections of the National Network which, although not meriting an improvement scheme, perform an important function as they provide linkages to county towns and/or the Core TEN-T network.

4.3.18 An approach was developed to prioritise these sections of the network which is summarised in the following text.

Step 1:

4.3.19 Calculation of a weighted average (by length) of the surface condition using the classifications provided by CESTRIN:

- o Very Bad – 5;
- o Bad, very bad – 4;
- o Mediocre – 3;
- o Good – 2;and
- o Very Good – 1.

4.3.20 The rationale being that if the road is in a precarious technical condition, the priority approach will increase the need for rehabilitation (assigned value will increase) and vice versa.

Step 2:

4.3.21 Assign values of 1 to 5 based on population service indicator which takes account of the total population within a radius of 25 km from a given side road as follows:

- o under 4,000 inhabitants / km scores one;
- o 4,000 - 5,000 inhabitants / km scores two;
- o 5,000 - 6,000 inhabitants / km scores three;

- o 6,000 - 7,000 inhabitants / km scores four; and
- o more than 7,000 inhabitants / km scores five.

4.3.22 The rationale here is that if the road serves a smaller population then this will decrease the need for prioritizing that section for rehabilitation (score allocated will be lower) and vice versa.

Step 3:

4.3.23 Assign values of 1 to 5 for the Urban Mobility indicator calculated as the ratio of the urban population in the area of analysis (25 km one side of the road) and the total population in the area of analysis, as follows:

- o below 0.5 - scores one;
- o 0.5 to 0.6 - scores two;
- o 0.6 to 0.7 - scores three;
- o 0.7 to 0.8 - scores four; and
- o over 0.8 - scores five.

4.3.24 Where the ratio of the urban population to the total population, in the area of analysis, is smaller, then the score will be smaller as the need to prioritize the rehabilitation will decrease (amount allocated will fall) and vice versa.

Step 4:

4.3.25 Finally, to obtain the multi-criteria analysis score, the following weights are applied to reflect the relative importance of the factors, as follows:

- o 50% - technical condition of the road;
- o 30% - target service population;
- o 20% - indicator of urban mobility.

4.3.26 The results of the methodology are presented in Table 4.17.

Table 4.17 National Network Rehabilitation Schemes (Ranked)

Route	Technical Condition	Population	Population Service Indicator	Urban Mobility Score	Urban Mobility Indicator	Final Score
Galati - Giurgiulesti (MD si UA)	5.00	90388	5	0.90	5	5.00
A1 - Timisoara - Moravita (SRB)	3.90	8577	5	0.67	3	4.05
Braila - Slobozia - Dranjna (A2) - Calarasi - Chiciu (BG)	2.33	7289	5	0.71	4	3.46
Brasov - Sighisoara - Tg Mures (DE 3)	2.64	7353	5	0.65	3	3.42
A5 - Sf. Gheorghe - B. Tusnad - Miercurea Ciuc - Ditrau (DE 3)	3.32	5928	3	0.65	3	3.16
Bucuresti - Alexandria - Rosiori - Caracal - Craiova	2.89	8698	5	0.46	1	3.15
Iasi - Vaslui - Bacau - Piatra Neamt - Tg. Neamt - DE 3	3.38	6702	4	0.49	1	3.09
Braila - Focsani - A5 - Tg. Secuiesc	2.37	6287	4	0.60	3	2.99

Route	Technical Condition	Population	Population Service Indicator	Urban Mobility Score	Urban Mobility Indicator	Final Score
A3 (Oradea) - Carei - Satu Mare - DE 4	2.88	5881	3	0.54	2	2.74
Bucuresti - Giurgiu (BG)	2.02	11041	5	0.35	1	2.71
Corabia - Caracal - Dragasani - Rm. Valcea - DE 1	2.61	5234	3	0.37	1	2.41
Craiova - Calafat (BG)	1.00	7977	5	0.56	2	2.40
A1 - Arad - Salonta - Oradea	1.15	6081	4	0.63	3	2.37
Saratel - Reghin - Tg Mures	1.00	9154	5	0.49	1	2.20
Drobeta Tr. Severin - Calafat (BG)	2.22	4308	2	0.41	1	1.91
Botosani - Suceava - Vatra Dornei - Bistrita - Saratel -Dej	2.03	4387	2	0.40	1	1.82
Iacobeni - Borsa - S.Marmatiei - Negresti Oas - DE 4	2.03	3359	1	0.53	2	1.71
Caransebes - Resita - Bocsa - Voiteg	1.83	3231	1	0.52	2	1.62
Filiasi - Tg. Jiu - Petrosani - Hateg - Deva - A1	1.08	4518	2	0.57	2	1.54
A1 (Deva) - Brad - Stei - Oradea - A3	1.00	4197	2	0.57	2	1.50

Priorities for Bypasses

4.3.27 The National Transport Model was developed primarily for assessing strategic issues on the transport network. This means that the representation and forecasts of local traffic around smaller settlements may be less robust than that for major inter-urban movements.

4.3.28 The model assignment proess would also be less likely to reflect the relatively small scale journey time improvements which may arise from localised small scale bypass schemes.

4.3.29 In order to ensure that these valuable, albeit smaller scale schemes, were not overlooked, an additional analysis was undertaken. The starting point for this was a road network containing all of the Reference Case, Level 1 and Level 2 schemes.

4.3.30 As a first stage, all towns/cities that the National road network passes through, and which are not already to be by-passed by Level 1 and Level 2, projects were identified. For each of these centres, those with a population of greater than 10,000 were selected. It is unlikely that a population smaller than this would justify a bypass.

4.3.31 Based on analysis undertaken when developing the National Model, the volume of 'through' traffic (i.e. trips not starting or finishing in the area in question) was then derived. Thresholds were then set separately for cars and goods traffic (25% and 50%) respectively. Locations where these thresholds were exceeded were then taken forward for full testing in through the modelling and appraisal process.

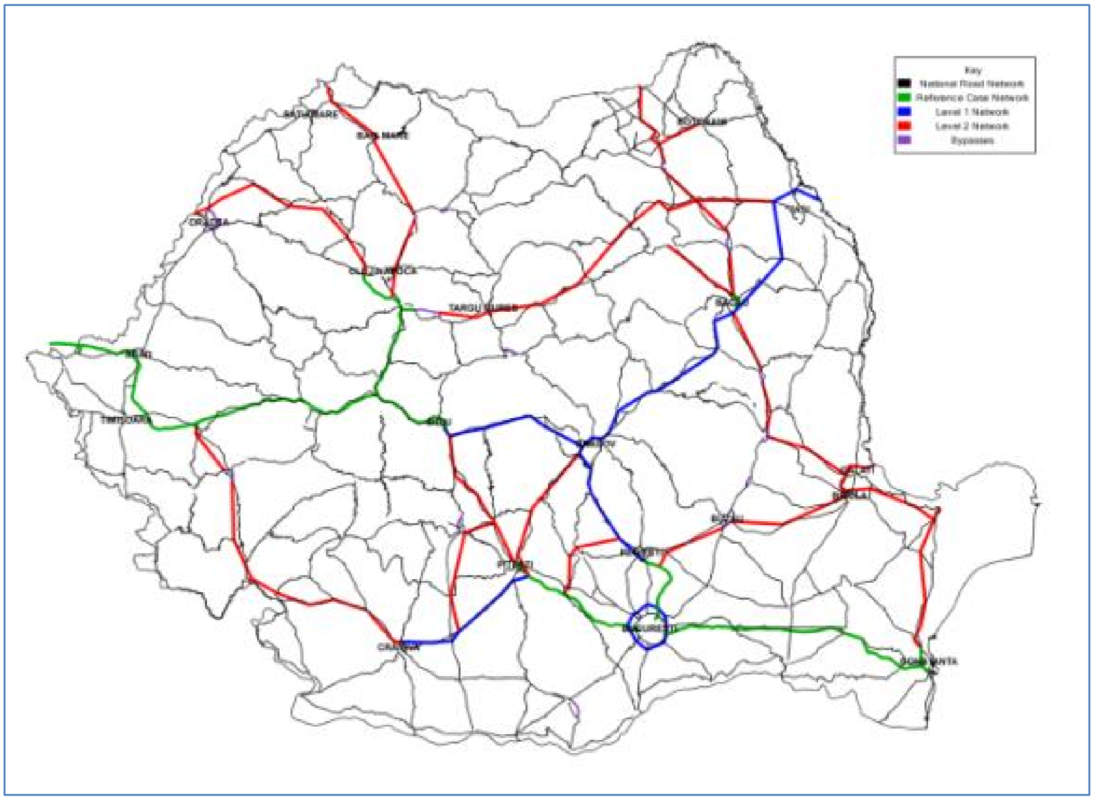
4.3.32 The Bypasses which were taken forward for testing, and their performance, is summarised in Table 4.18.

Table 4.18 Summary of Bypass Testing Results (CBA)

Ref.	Project	Investment cost (undiscounted) *€M*	NPV *€M*	BCR	EIRR *%*
BP1	Oradea	99	20	1.28	6.5%
BP2	Dej	28	107	5.91	19.7%
BP3	Sighisoara	44	92	3.84	15.8%
BP4	Roman	57	129	4.11	15.9%
BP5	Focsani	70	130	3.44	13.1%
BP6	Ramnicu Sarat	34	8	1.31	6.8%
BP7	Buzau	96	37	1.51	7.5%
BP8	Alexandria	50	-18	0.53	1.5%
BP9	Ramnicu Valcea	180	31	1.23	6.2%
BP10	Targoviste	72	358	7.83	22.7%
BP11	Filiasi	25	68	4.40	15.6%
BP12	Adjud	42	170	5.96	19.0%
BP13	Mizil	33	-11	0.57	1.9%
BP14	Ludus	94	113	2.53	11.2%
BP15	Falticeni	38	70	3.34	13.2%
BP16	Caransebes	74	7	1.13	5.7%
BP17	Beclean	39	24	1.81	8.4%

4.3.33 The location of the selected bypass schemes, with reference to the Reference Case, Level 1 and Level 2 schemes, is shown in Figure 4.25.

Figure 4.25 Bypass Schemes in Relation to Level 1, Level 2 & Reference Case Schemes



Safety Measures

4.3.34 The identification of safety interventions for the blackspot sites has been undertaken through the following process:

- o Collate the accident records for the fatal, serious and slight accidents by blackspot site;
- o Identify settlement type where the blackspot is - i.e. open country, city, town, village e.t.c;
- o Allocate each site to an urban or rural category and identify the number of lanes per direction;
- o Examine the detailed accident records and group the accident descriptions and accident causes into categories that can be linked to specific interventions at each site;
- o Based on the interventions to be implemented at each site derive the reduction in fatal and serious accidents that would take place at each site; and
- o Determine the total costs of the intervention measures by site based on unit rates for the interventions identified.

4.3.35 The allocation of interventions by site was based on a set of criteria linked to accident description, accident cause, location, and carriageway type. This is summarised in Table 4.19.

Table 4.19 Identification of Safety Interventions for Blackspot Sites

Intervention Type	Conditions for Implementation
Village entry treatment (Splitter island, signs, lines)	Village or commune
4 lanes into 2 at village entrance (build-outs, lining)	Village or commune
Rumble strips	Village or commune
Continuous kerbed median strip	Urban areas and in rural areas where frontal impact accidents are prevalent
Plastic median separation	Locations where neither New Jersey style barriers or continuous kerbed medians are installed.
Pedestrian refuge	Where there are low levels of pedestrian accidents.
Plastic road humps	Villages and communes on single carriageways
Footpaths (2m wide)	Villages and communes where not already in place.
Signal controlled pedestrian crossing	Where there are high volumes of pedestrian accidents on single carriageways
Dedicated left turn lane (lines + island)	Where there are high numbers of lateral collisions
Lay-by for buses / local parking (for stalls, etc.)	Villages and communes
Street lighting	Where there are high volumes of pedestrian accidents
Speed cameras	Where there are high numbers of accidents caused by speed/reckless driving, and/or accidents involving shunts
Interurban 2*2 Undivided Carriageway New Jersey Style Barriers	In rural areas where road is four lanes wide.
Pedestrian footbridge/underpass	Where there are high numbers of pedestrian accidents and the road is 4 lanes wide, or dual carriageway
Safety Barriers (Verge)	Where there are high numbers of accidents involving vehicles leaving the carriageway

Source: AECOM analysis

4.4 Cost-Benefit Analysis

4.4.1 Within this section we provide details of all of the road infrastructure schemes taken through the model testing and appraisal process and which have been selected to form part of the overall strategy.

4.4.2 For each scheme, we provide information as follows:

- Brief description of proposal;
- Brief Description of Problem(s) Addressed;
- Undiscounted Costs;
- Outcome(s);
- Implementing Organisation ; and
- Implementation Year(s).

4.4.3 We have considered two implementation scenarios, ‘ES’ and ‘EES’ and implementation years are provided for both cases. We present the information in the order of Level 1 schemes first, then Level 2 and finally Bypass schemes.

Level 1 Schemes - OR1 - Ploiesti-Brasov Motorway

Brief Description of Proposal:

4.4.4 The proposal will provide a new motorway link between Ploiesti and Brasov to link with the existing Bucharest to Ploiesti motorway. The combination will provide a motorway standard route between Bucharest and Brasov.

4.4.5 The alignment of the route and its linkage to the existing network is shown in Figure 4.26 below.

Figure 4.26 Ploiesti-Brasov Motorway Indicative Alignment

4.4.6 The route forms part of the corridor that will provide a link between the two TEN-T core nodes of Bucharest and Timisoara. It also directly links Brasov, which is a TEN-T node to Bucharest.

Brief Description of Problem(s) Addressed

4.4.7 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds in the Bucharest to Brasov corridor.

4.4.8 There are poor average travel times between Bucharest and Brasov; typical average peak speeds for this route are around 67 kph. Bucharest and Brasov are the first and seventh most populace cities in Romania and this is a key transport corridor as it also provides a link, via Sibiu, to the committed A1 motorway and out to the Hungarian border.

4.4.9 The corridor was identified as part of an analysis of the economic impact of delays and there are multiple accident blackspot locations in the corridor.

4.4.10 Domestically, accessibility to Brasov is poorer than cities such as Pitesti which do have a high quality link to Bucharest.

4.4.11 Whilst there is a good quality route from Bucharest to south of Ploiesti, the remainder of the infrastructure provision in the corridor is poor – 44 % of the remainder of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

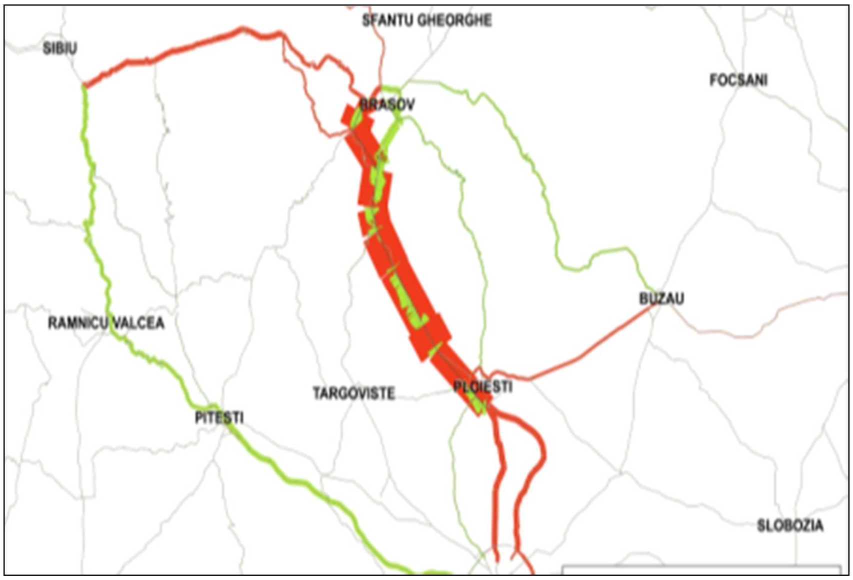
- CAPEX €1,312M

Outcome(s):

4.4.12 This project returns a BCR value of 3.55 and carries around 77,000 vehicles (AADT). The impact on the other modes is small with rail experiencing some reduction in passengers and freight.

4.4.13 Almost all of the existing traffic in the immediate corridor switches to the new route (35,000 AADT). A significant amount of traffic is attracted from the route between Bucharest and Sibiu (via Pitesti) and Buzau - Brasov. The flow changes are illustrated in Figure 4.27.

Figure 4.27 Flow Changes Due to Ploiesti-Brasov Motorway Project



4.4.14 Average speeds between Bucharest and Brasov increase to 88 kph as a consequence of the scheme. Peak time journey times are reduced by 25%.

4.4.15 The primary economic indicators for the project are as follows:

- NPV = €2,495M;
- BCR = 3.55; and
- EIRR = 13.7%.

Implementing Organisation:

4.4.16 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.17 In both ES and EES scenarios this project would be delivered in two stages as follows in the implementation period 2014-2020:

- Ploiesti to Comarnic; and
- Comarnic to Brasov.

Level 1 Schemes – OR2 - Brasov-Sibiu Motorway

Brief Description of Proposal

4.4.18 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds in the west corridor from Bucharest to Sibiu.

4.4.19 The proposal will provide a new motorway link between Brasov and Sibiu. In combination with OR1, this will provide a motorway standard route between Bucharest and Sibiu and thereafter, via the committed A1 improvements, to the Hungarian border.

4.4.20 The alignment of the route and its linkage to the existing network is shown in Figure 4.28 below.

Figure 4.28 Brasov-Sibiu Motorway Indicative Alignment

4.4.21 The route forms part of the corridor that will provide a link from the TEN-T core node of Bucharest. It also directly links Brasov and Sibiu; both TEN-T nodes.

Brief Description of Problem(s) Addressed:

4.4.22 The corridor was identified as part of an analysis of the economic impact of delays and there are multiple accident blackspot locations in the corridor.

4.4.23 Domestically, accessibility is poorer than in cities which do have a high quality link to Bucharest.

4.4.24 There are poor average travel times between Brasov and Sibiu; typical average speeds for this route are around 68kph.

4.4.25 The bulk of the infrastructure provision in the corridor is poor – 72% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

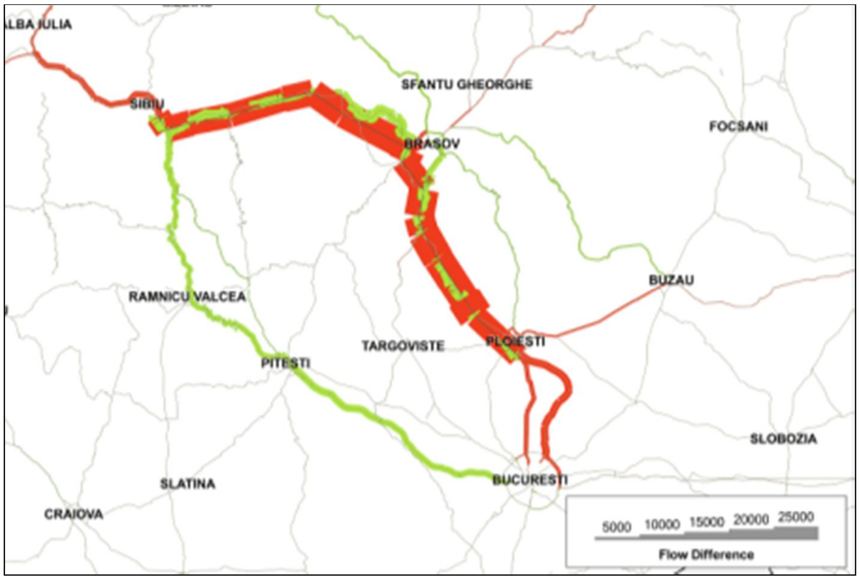
- CAPEX €1,946M

Outcome(s)

4.4.26 This project returns excellent value for money (BCR of 5.70), and carries around 82,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (30,000 AADT).

4.4.27 The flow changes are illustrated in Figure 4.29.

Figure 4.29 Flow Changes Due to Brasov-Sibiu Project



4.4.28 Average speeds between Bucharest and Sibiu increase to 89 kph as a consequence of the scheme. Peak time journey times are reduced by 29%.

4.4.29 The primary economic indicators for the project are as follows:

- NPV = €6,895M;
- BCR = 5.70; and
- EIRR = 18.1%.

Implementing Organisation:

4.4.30 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.31 In both implementation scenarios cases the Brasov-Sibiu Motorway would be delivered in the period 2014 to 2020.

Level 1 Schemes – OR3 - Brasov-Bacau-Iasi Motorway

Brief Description of Proposal:

4.4.32 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds in the corridor from Bucharest to the North East.

4.4.33 The proposal will provide a new motorway link between Brasov and Iasi near the Moldovan Border.

4.4.34 The alignment of the route and its linkage to the existing network is shown in Figure 4.30 below.

Figure 4.30 Brasov-Bacau-Iasi Motorway Indicative Alignment

4.4.35 The route forms part of the corridor that will provide a link from the TEN-T core node of Bucharest. It also directly links Brasov and Bacau; both TEN-T nodes.

Brief Description of Problem(s) Addressed:

4.4.36 The corridor was identified as part of an analysis of the economic impact of delays and there are multiple accident blackspot locations in the corridor.

4.4.37 Domestically, accessibility is poorer from cities which do not have a high quality link to Bucharest.

4.4.38 There are poor average travel times between Brasov and Iasi; typical average speeds for this route are around 64 kph.

4.4.39 The bulk of the infrastructure provision in the corridor is poor – 82% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

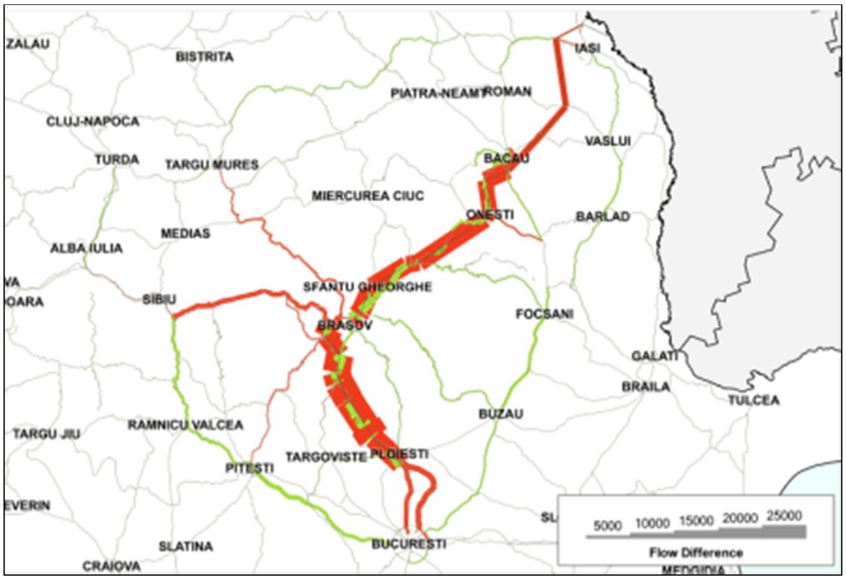
- CAPEX €4,070M

Outcome(s):

4.4.40 This project returns a value for money figure of 2.13, and carries around 63,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (22,000 AADT).

4.4.41 The flow changes are illustrated in Figure 4.31.

Figure 4.31 Flow Changes Due to Brasov-Bacau-Iasi Motorway Project



4.4.42 Average speeds between Bucharest and Brasov increase to 95 kph as a consequence of the scheme. Peak time journey times are reduced by 34%.

4.4.43 The primary economic indicators for the project are as follows:

- NPV = €3,440M;
- BCR = 2.13; and
- EIRR = 9.9%

Implementing Organisation:

4.4.44 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.45 This scheme will be delivered in the implementation period 2021-2030 in both scenarios.

Level 1 Schemes – OR4 - Pitesti-Craiova Motorway

Brief Description of Proposal

4.4.46 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds in the corridor from Bucharest to the South West.

4.4.47 The proposal will provide a new motorway link between Pitesti and Craiova. In combination with the existing A1 Motorway, this will provide a motorway standard route between Bucharest and Craiova.

4.4.48 The alignment of the route and its linkage to the existing network is shown in Figure 4.32 below.

Figure 4.32 Pitesti-Craiova Motorway Indicative Alignment

4.4.49 The route forms part of the corridor that will provide a link from the TEN-T core node of Bucharest. It also directly links to Craiova, a TEN-T node.

Brief Description of Problem(s) Addressed:

4.4.50 The corridor was identified as part of an analysis of the economic impact of delays and there are multiple accident blackspot locations in the corridor.

4.4.51 Domestically, accessibility is poorer from cities which do not have a high quality link to Bucharest.

4.4.52 There are poor average travel times between Pitesti-Craiova; typical average speeds for this route are around 82 kph.

4.4.53 The bulk of the infrastructure provision in the corridor is poor – 92% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

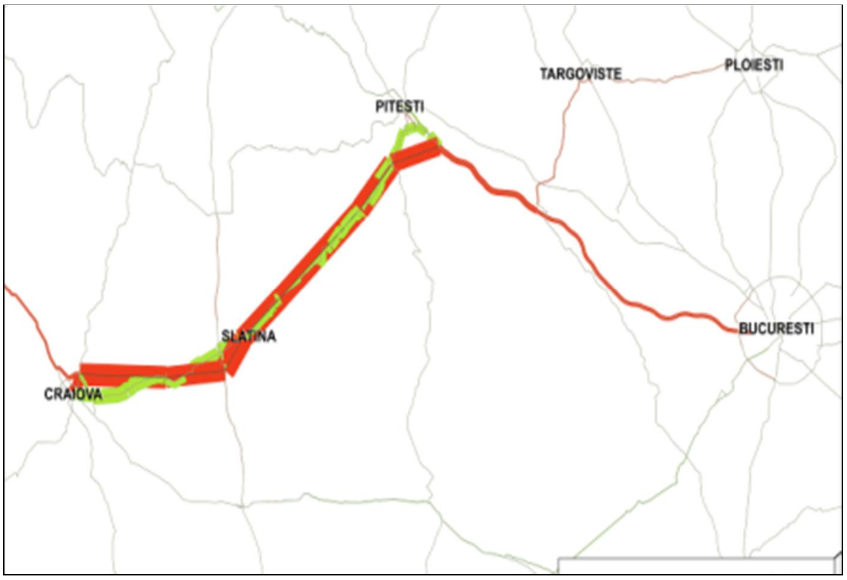
- CAPEX € 800M

Outcome(s):

4.4.54 This project returns excellent value for money (BCR of 3.03), and carries around 46,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (26,000 AADT).

4.4.55 The flow changes are illustrated in Figure 4.33.

Figure 4.33 Flow Changes Due to Pitesti-Craiova Motorway Project



4.4.56 Average speeds between Bucharest and Craiova increase to 110 kph as a consequence of the scheme. Peak time journey times are reduced by 27%.

4.4.57 The primary economic indicators for the project are as follows:

- NPV = €1,242M;
- BCR = 3.03; and
- EIRR = 12.2%.

Implementing Organisation:

4.4.58 The implementing organisation would be CNADNR.

Implementation Year(s)

4.4.59 The Pitesti-Craiova Motorway Project will be delivered in the period 2014 to 2020 in both scenarios.

Level 1 Schemes – OR5 – Iasi-Bacau-Brasov-Sibiu Motorway

Brief Description of Proposal:

4.4.60 The proposal will provide a new motorway link between Sibiu and Iasi.

4.4.61 The alignment of the route and its linkage to the existing network is shown in Figure 4.34 below.

Figure 4.34 Iasi-Bacau-Brasov-Sibiu Motorway Indicative Alignment

4.4.62 The route forms a corridor that will provide a link between the four TEN-T nodes.

Brief Description of Problem(s) Addressed

4.4.63 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds on North-East – Center – West corridor.

4.4.64 There are poor average travel times between Iasi and Sibiu; typical average peak speeds for this route are around 67 kph. This is a key transport corridor as it also provides a link, via Sibiu, to the committed A1 motorway and out to the Hungarian border.

4.4.65 The corridor was identified as part of an analysis of the economic impact of delays and there are multiple accident blackspot locations in the corridor.

4.4.66 Domestically, accessibility is poorer compared to cities which do have a high quality link to Bucharest.

4.4.67 The infrastructure provision in the corridor is poor – 91 % of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

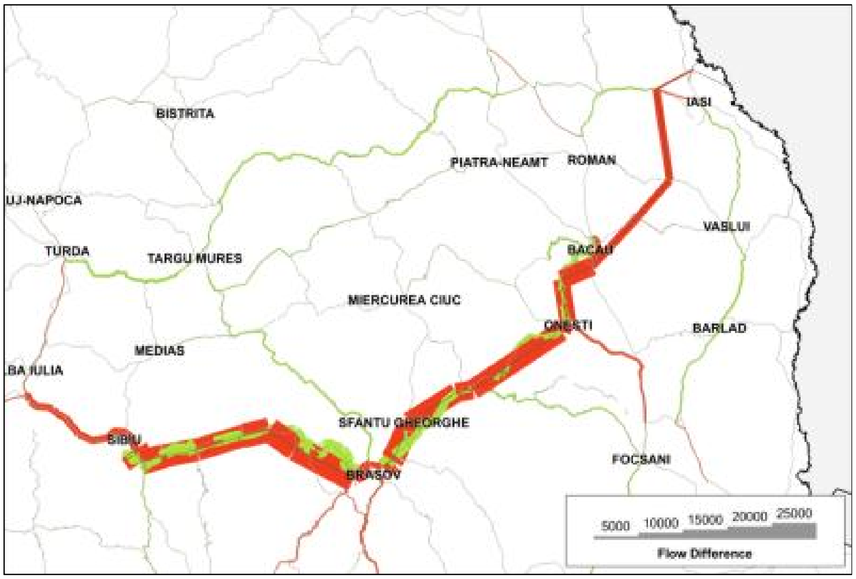
- CAPEX €3,392M

Outcome(s):

4.4.68 This project returns a BCR value of 2.50 and carries around 49,000 vehicles (AADT).

4.4.69 Almost all of the existing traffic in the immediate corridor switches to the new route (20,000 AADT). The flow changes are illustrated in Figure 4.35.

Figure 4.35 Flow Changes Due to Iasi-Bacau-Brasov-Sibiu Motorway Project



4.4.70 Average speeds between Iasi and Sibiu increase to 104 kph as a consequence of the scheme. Peak time journey times are reduced by 41%.

4.4.71 The primary economic indicators for the project are as follows:

- NPV = €3,851M;
- BCR = 2.50; and
- EIRR = 11.0%.

Implementing Organisation:

4.4.72 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.73 In both ES and EES scenarios this project would be delivered in the implementation period to 2020.

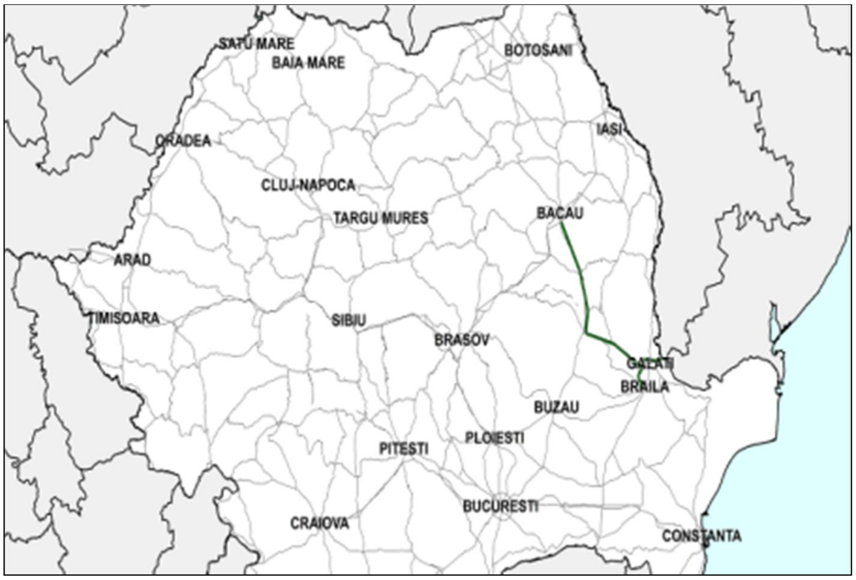
Level 2 Schemes – OR6B – Bacau-Focsani-Braila-Galati Expressway

Brief Description of Proposal:

4.4.74 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Bacau and Galati, thus improving regional connectivity.

4.4.75 Figure 4.36 shows the expressway alignment.

Figure 4.36 Bacau-Focsani-Braila-Galati Expressway Indicative Alignment



4.4.76 The route links the nodes of Bacau, Braila and Galati on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.77 There are poor average travel times; typical average speeds for this route are around 65 kph. The bulk of the infrastructure provision in the corridor is poor – 98% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

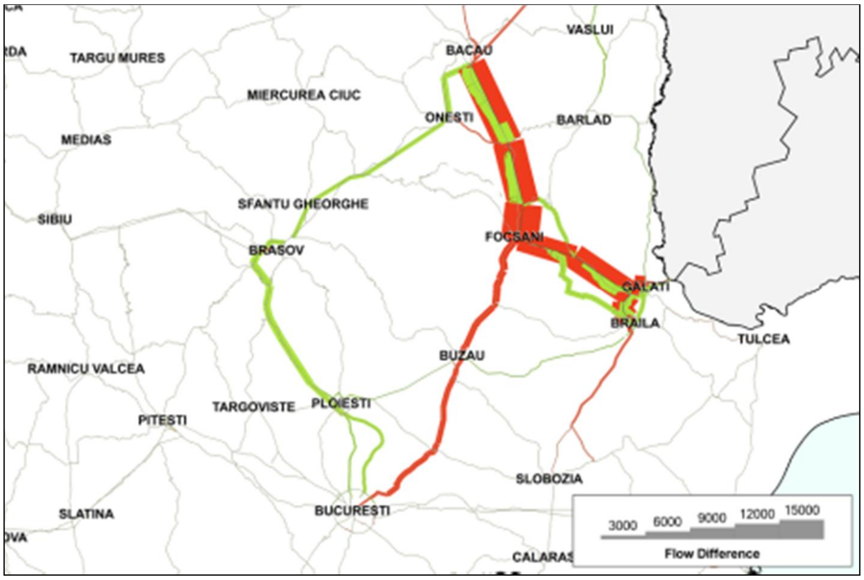
- CAPEX €984M

Outcome(s):

4.4.78 This project returns excellent value for money (BCR of 2.63), and carries around 33,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (15,000 AADT).

4.4.79 The flow changes are illustrated in Figure 4.37.

Figure 4.37 Flow Changes Due to Bacau-Focsani-Braila-Galati Expressway Project



4.4.80 Average speeds increase to 106 kph as a consequence of the scheme. Peak time journey times are reduced by 40%.

4.4.81 The primary economic indicators for the project are as follows:

- NPV = €1,268M;
- BCR = 2.63; and
- EIRR = 11.2%.

Implementing Organisation:

4.4.82 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.83 Bacau-Focsani-Braila-Galati Expressway will be delivered in the period 2021 to 2030 in the ES scenario and post 2030 in the EES implementation scenario.

Level 2 Schemes – OR7A - Bacau-Suceava Expressway

Brief Description of Proposal

4.4.84 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Bacau and Suceava, thus improving regional connectivity.

4.4.85 The alignment of the route is shown in Figure 4.38.

Figure 4.38 Bacau-Suceava Expressway Indicative Alignment

4.4.86 The route links the nodes of Bacau and Suceava, both on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.87 There are poor average travel times; typical average speeds for this route are around 69 kph.

4.4.88 The bulk of the infrastructure provision in the corridor is poor – 97% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

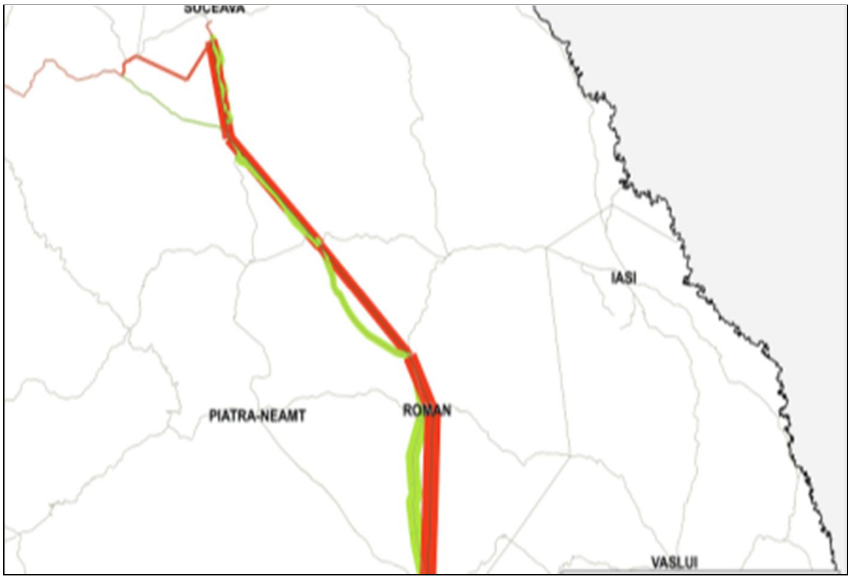
- CAPEX €631M

Outcome(s):

4.4.89 This project returns excellent value for money (BCR of 3.23), and carries around 31,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (21,000 AADT).

4.4.90 The flow changes are illustrated in Figure 4.39.

Figure 4.39 Flow Changes Due to Bacau-Suceava Expressway Project



4.4.91 Average speeds increase to 96 kph as a consequence of the scheme. Peak time journey times are reduced by 28%.

4.4.92 The primary economic indicators for the project are as follows:

- NPV = €1,107M;
- BCR = 3.23; and
- EIRR = 12.6%.

Implementing Organisation

4.4.93 The implementing organisation would be CNADNR.

Implementation Year(s)

4.4.94 Bacau-Suceava Expressway will be delivered in the period 2021 to 2030, in both ‘ES’ and ‘EES’ scenarios.

Level 2 Schemes – OR7C - Suceava-Botosani Expressway

Brief Description of Proposal:

4.4.95 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Suceava and Botosani, thus improving regional connectivity.

4.4.96 The expressway alignment is shown in Figure 4.40.

Figure 4.40 Suceava-Botosani Expressway Indicative Alignment

4.4.97 The route connects to the node of Suceava on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.98 There are poor average travel times; typical average speeds for this route are around 69 kph.

4.4.99 The bulk of the infrastructure provision in the corridor is poor – 97% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

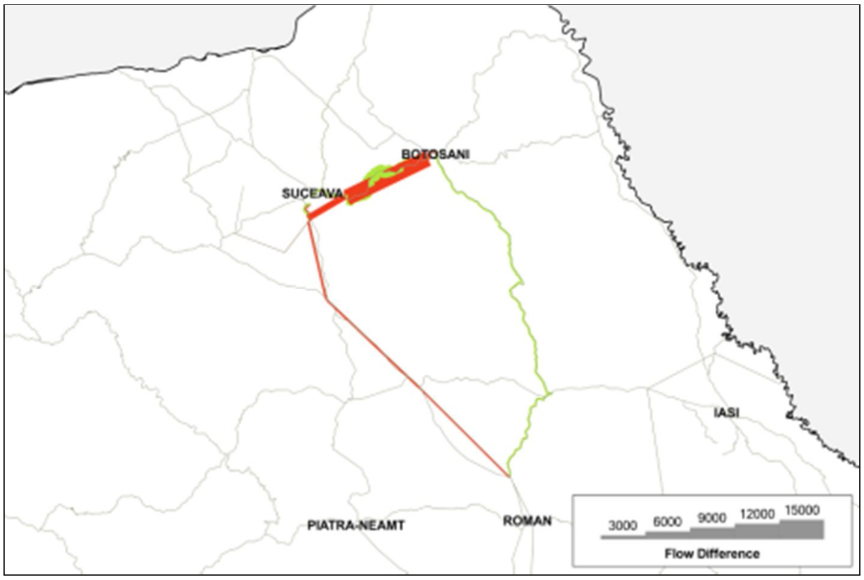
- CAPEX €346M

Outcome(s):

4.4.100 This project returns a value for money figure (BCR) of 1.83, and carries around 30,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (20,000 AADT).

4.4.101 The flow changes are illustrated in Figure 4.41.

Figure 4.41 Flow Changes Due to Suceava-Botosani Expressway Project



4.4.102 Average speeds increase to 98 kph as a consequence of the scheme. Peak time journey times are reduced by 29%.

4.4.103 The primary economic indicators for the project are as follows:

- NPV = €623M;
- BCR = 1.83; and
- EIRR = 8.9%.

Implementing Organisation :

4.4.104 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.105 Suceava-Botosani Expressway will be delivered will be delivered post 2030 in the ES scenario and in the implementation period 2021 to 2030 in the EES scenario.

Level 2 Schemes – OR9B - Turda-Halmeu Expressway

Brief Description of Proposal:

4.4.106 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Turda and Halmeu, thus improving regional connectivity.

4.4.107 Figure 4.42 shows the alignment of the expressway.

Figure 4.42 Turda-Halmeu Expressway Indicative Alignment

4.4.108 The route connects to the node of Turda on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.109 There are poor average travel times; typical average speeds for this route are around 70 kph. The bulk of the infrastructure provision in the corridor is poor – 89% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

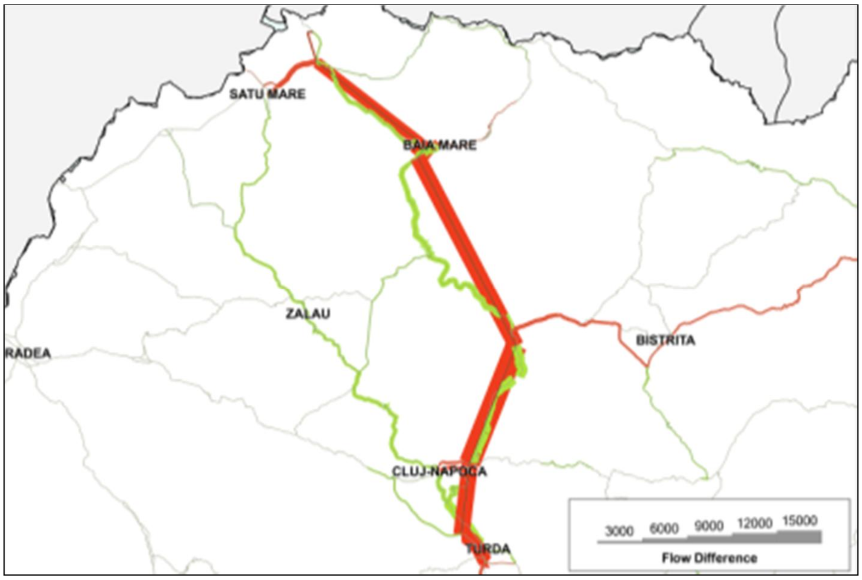
- CAPEX €991M

Outcome(s):

4.4.110 This project returns excellent value for money (BCR of 3.29), and carries around 29,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (12,000 AADT).

4.4.111 The flow changes are illustrated in Figure 4.43.

Figure 4.43 Flow Changes Due to Turda-Halmeu Expressway Project



4.4.112 Average speeds increase to 109 kph as a consequence of the scheme. Peak time journey times are reduced by 45%.

4.4.113 The primary economic indicators for the project are as follows:

- NPV = €1,766M;
- BCR = 3.29; and
- EIRR = 13.5%.

Implementing Organisation:

4.4.114 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.115 Turda-Halmeu Expressway will be delivered in the period 2021 to 2030, in both implementation scenarios.

Level 2 Schemes – OR10 - Lugoj- Craiova Expressway

Brief Description of Proposal

4.4.116 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Lugoj and Craiova, thus improving regional connectivity.

4.4.117 Figure 4.44 shows the indicative alignment.

Figure 4.44 Lugoj – Craiova Expressway Indicative Alignment

4.4.118 The route connects to the node of Craiova on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.119 There are poor average travel times; typical average speeds for this route are around 71 kph. The bulk of the infrastructure provision in the corridor is poor – 84% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

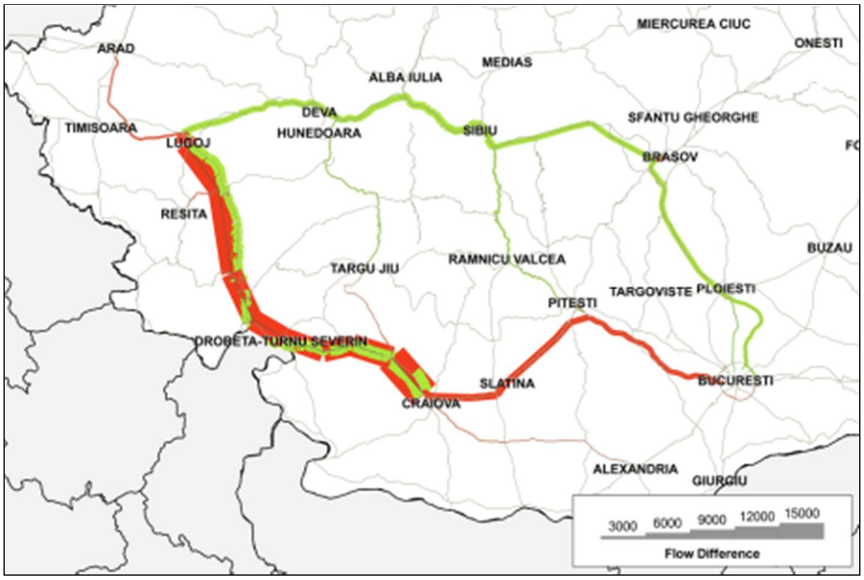
- CAPEX €1,764M

Outcome(s):

4.4.120 This project returns excellent value for money (BCR of 2.23), and carries around 30,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (15,000 AADT).

4.4.121 The flow changes are illustrated in Figure 4.45.

Figure 4.45 Flow Changes Due to Lugoj – Craiova Expressway Project



4.4.122 Average speeds increase to 98 kph as a consequence of the scheme. Peak time journey times are reduced by 32%.

4.4.123 The primary economic indicators for the project are as follows:

- NPV = €1,654M;
- BCR = 2.23; and
- EIRR = 10.0%.

Implementing Organisation:

4.4.124 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.125 In both scenarios this project would be delivered in the period 2021 to 2030.

Level 2 Schemes – OR13 – Campia Turzii -Targa Mures- Iasi Expressway

Brief Description of Proposal

4.4.126 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds in the corridor thus improving regional connectivity.

4.4.127 Figure 4.46 shows the route alignment.

Figure 4.46 Campia Turzii -Targa Mures- Iasi Expressway Indicative Alignment

4.4.128 The route connects to the node of Turda on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.129 There are poor average travel times; typical average speeds for this route are around 61 kph. The bulk of the infrastructure provision in the corridor is poor – 100% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

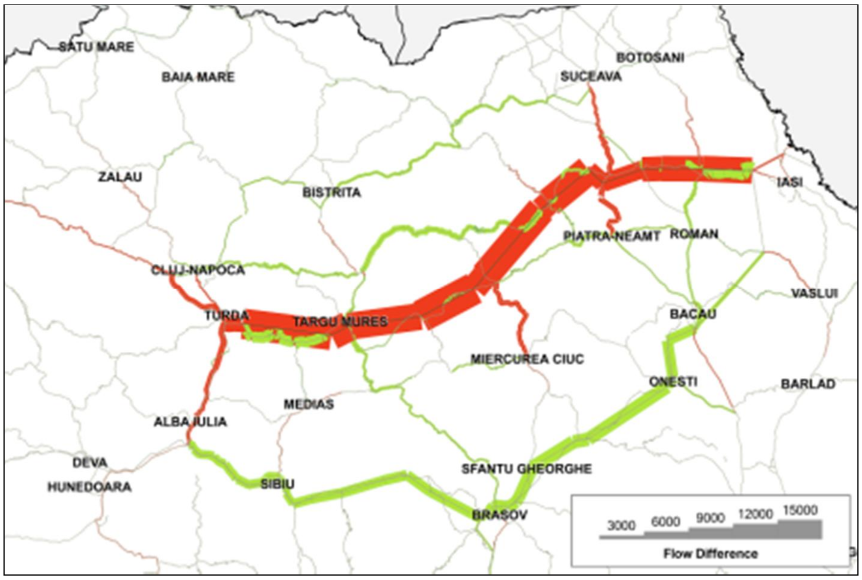
- CAPEX €4,049M

Outcome(s):

4.4.130 This project returns a BCR of 1.74, and carries around 31,000 vehicles (AADT). Over half of all of the existing traffic in the immediate corridor switches to the new route (6,000 AADT).

4.4.131 The flow changes are illustrated in Figure 4.47.

Figure 4.47 Flow Changes Due to Campia Turzii -Targa Mures- Iasi Expressway Project



4.4.132 Average speeds increase to 100 kph as a consequence of the scheme. Peak time journey times are reduced by 42%.

4.4.133 The primary economic indicators for the project are as follows:

- NPV = €2,213M;
- BCR = 1.74; and
- EIRR = 8.4%.

Implementing Organisation

4.4.134 The implementing organisation would be CNADNR.

Implementation Year(s)

4.4.135 The Campia Turzii -Targa Mures- Iasi Expressway will be partially delivered in the period 2021 to 2030 in both implementation scenarios.

Level 2 Schemes – OR17 - Gaesti-Ploiesti-Buzau-Braila Expressway

Brief Description of Proposal

4.4.136 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Gaesti and Braila, thus improving regional connectivity.

4.4.137 Figure 4.48 shows the alignment of the route.

Figure 4.48 Gaesti-Ploiesti-Buzau-Braila Expressway Indicative Alignment

Brief Description of Problem(s) Addressed:

4.4.138 There are poor average travel times; typical average speeds for this route are around 87 kph.

Undiscounted costs (Million €, 2014 prices):

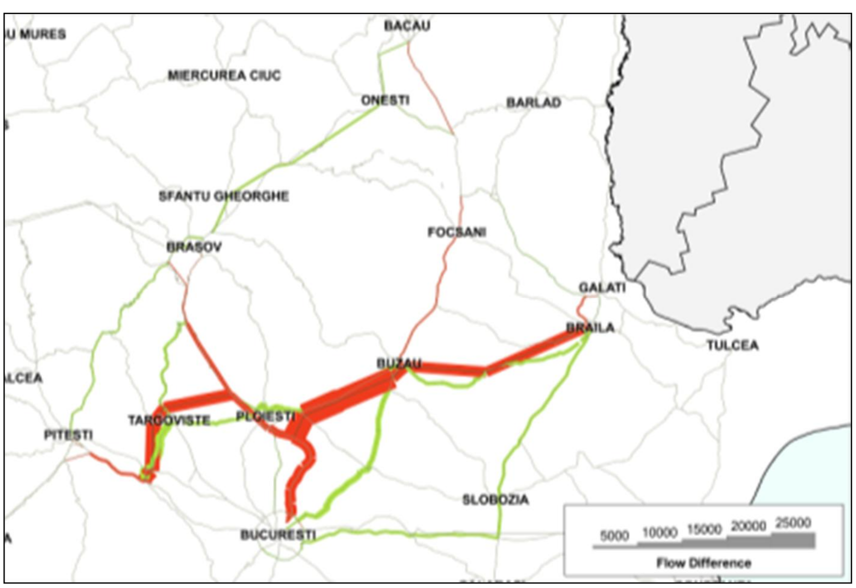
- CAPEX €1,176M

Outcome(s):

4.4.139 This project returns excellent value for money (BCR of 2.87), and carries around 41,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (15,000 AADT).

4.4.140 The flow changes are illustrated in Figure 4.49.

Figure 4.49 Flow Changes Due to Gaesti-Ploiesti-Buzau-Braila Expressway Project



4.4.141 Average speeds increase to 101 kph as a consequence of the scheme. Peak time journey times are reduced by 17%.

4.4.142 The primary economic indicators for the project are as follows:

- NPV = €1,754M;
- BCR = 2.87; and
- EIRR = 11.9%.

Implementing Organisation:

4.4.143 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.144 Gaesti-Ploiesti-Buzau-Braila Expressway would be delivered in the period 2021 to 2030 in both implementation scenarios.

Level 2 Schemes – OR7B – Suceava-Siret Expressway

Brief Description of Proposal:

4.4.145 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Suceava and Siret, thus improving regional connectivity.

4.4.146 The indicative alignment is shown in Figure 4.50

Figure 4.50 Suceava-Siret Expressway Indicative Alignment

4.4.147 The route connects to the node of Suceava on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.148 There are poor average travel times; typical average speeds for this route are around 69 kph

4.4.149 The bulk of the infrastructure provision in the corridor is poor – 97% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

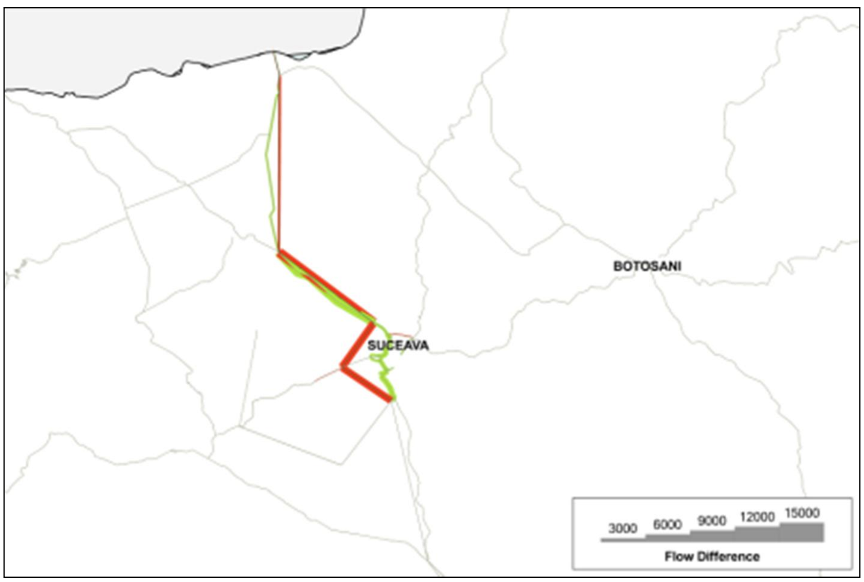
- CAPEX €186M

Outcome(s):

4.4.150 This project returns excellent value for money (BCR of 2.84), and carries around 24,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (17,000 AADT).

4.4.151 The flow changes are illustrated in Figure 4.51

Figure 4.51 Flow Changes Due to Suceava-Siret Expressway Project



4.4.152 Average speeds increase to 114 kph as a consequence of the scheme. Peak time journey times are reduced by 38%.

4.4.153 The primary economic indicators for the project are as follows:

- NPV = €1,172M;
- BCR = 2.84; and
- EIRR = 11.7%

Implementing Organisation:

4.4.154 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.155 Suceava-Siret Expressway will be delivered between 2021 and 2030, in both implementation scenarios.

Level 2 Schemes – OR8 – Bacau-Piatra Neamt Expressway

Brief Description of Proposal

4.4.156 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Bacau and Piatra Neamt, thus improving regional connectivity.

4.4.157 The expressway alignment is shown in Figure 4.52.

Figure 4.52 Bacau-Piatra Neamt Expressway Indicative Alignment

4.4.158 The route connects to the node of Bacau on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.159 There are poor average travel times; typical average speeds for this route are around 52 kph

4.4.160 The bulk of the infrastructure provision in the corridor is poor – 92% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

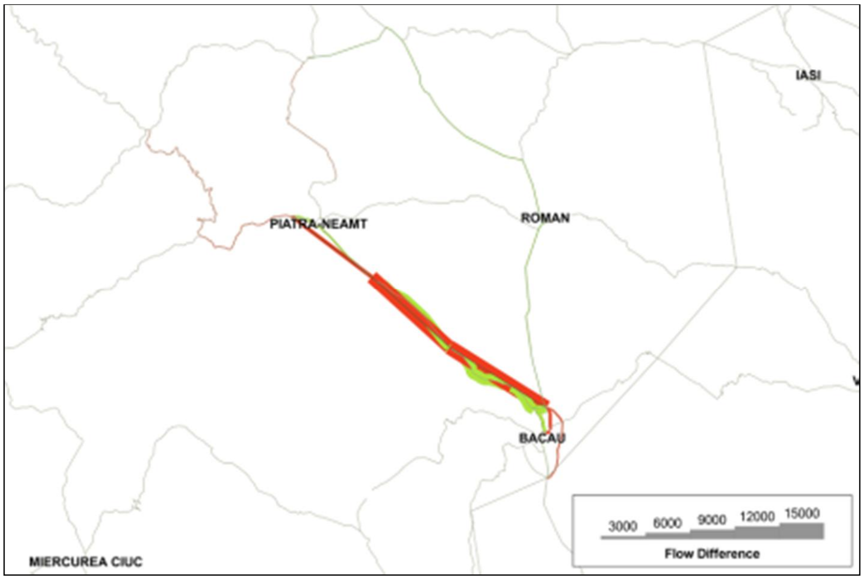
- CAPEX €308M

Outcome(s):

4.4.161 This project returns excellent value for money (BCR of 2.45), and carries around 15,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (11,000 AADT).

4.4.162 The flow changes are illustrated in Figure 4.53.

Figure 4.53 Flow Changes Due to Bacau-Piatra Neamt Expressway Project



4.4.163 Average speeds increase to 83 kph as a consequence of the scheme. Peak time journey times are reduced by 32%.

4.4.164 The primary economic indicators for the project are as follows:

- NPV = €350M;
- BCR = 2.45; and
- EIRR = 10.6%.

Implementing Organisation:

4.4.165 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.166 Bacau-Piatra Neamt Expressway will be delivered post 2030 in both implementation scenarios.

Level 2 Schemes – OR11 – Constanta-Tulcea-Braila Expressway (including Braila Bridge)

Brief Description of Proposal

4.4.167 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Constanta and Tulcea, thus improving regional connectivity.

4.4.168 Figure 4.54 shows the route alignment.

Figure 4.54 Constanta-Tulcea-Braila Expressway (including Braila Bridge) Indicative Alignment

4.4.169 The route connects to the nodes of Constanta, Tulcea and Braila on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.170 There are poor average travel times; typical average speeds for this route are around 71 kph. The bulk of the infrastructure provision in the corridor is poor – 60% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

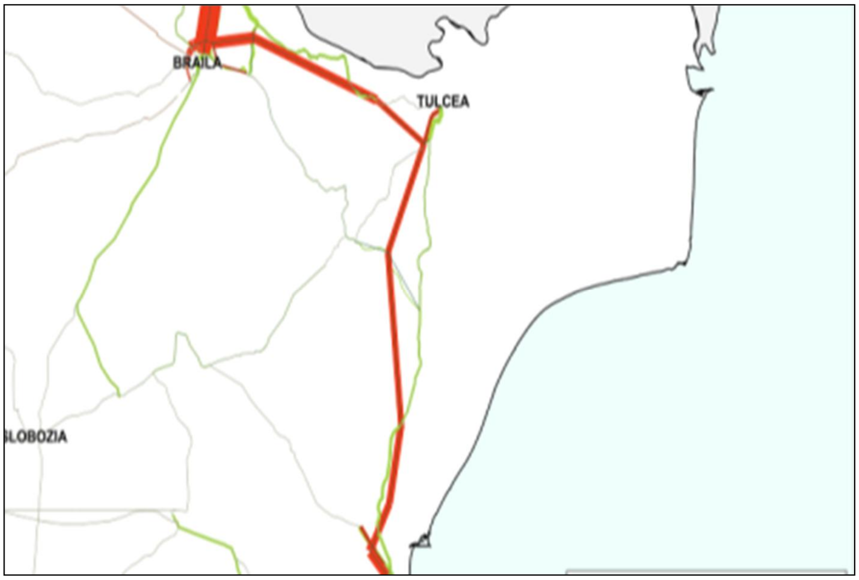
- CAPEX €1,259M

Outcome(s):

4.4.171 This has project a BCR of 1.07, and carries around 16,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (4,000 AADT).

4.4.172 The flow changes are illustrated in Figure 4.55.

Figure 4.55 Flow Changes Due to Constanta-Tulcea-Braila Expressway (including Braila Bridge)



4.4.173 Average speeds increase to 90 kph as a consequence of the scheme. Peak time journey times are reduced by 28%.

4.4.174 The primary economic indicators for the project are as follows:

- NPV = €66M;
- BCR = 1.07; and
- EIRR = 5.4%.

Implementing Organisation:

4.4.175 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.176 Constanta-Tulcea-Braila Expressway (including Braila Bridge) will be delivered post 2030 in both implementation scenarios.

Level 2 Schemes – OR12 – Gilau-Bors Expressway

Brief Description of Proposal

4.4.177 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Gilau and Bors, thus improving regional connectivity.

4.4.178 Figure 4.56 shows the expressway alignment.

Figure 4.56 Gilau-Bors Expressway Indicative Alignment

Brief Description of Problem(s) Addressed:

4.4.179 There are poor average travel times; typical average speeds for this route are around 63 kph

4.4.180 The bulk of the infrastructure provision in the corridor is poor – 100% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

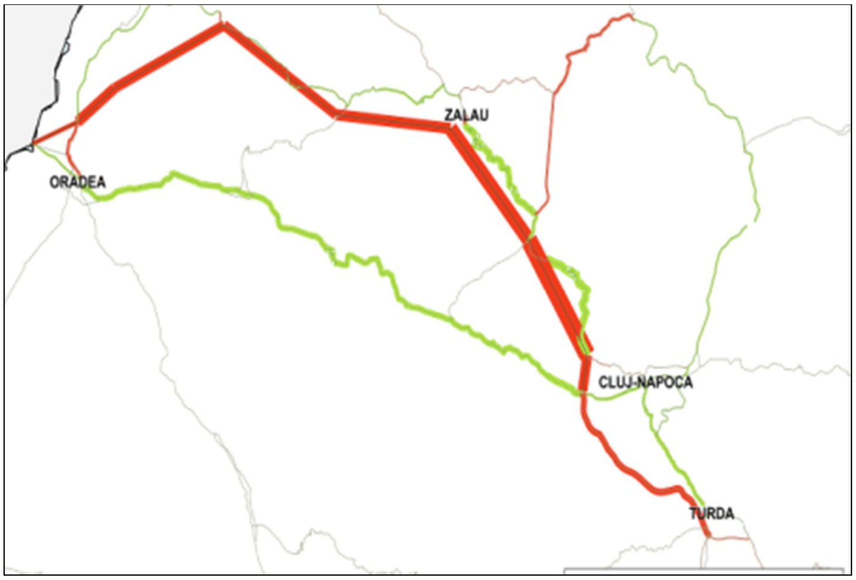
- CAPEX €1,128M

Outcome(s):

4.4.181 This project returns a BCR of 2.41, and carries around 24,000 vehicles (AADT). Around half of the existing traffic in the immediate corridor switches to the new route (4,000 AADT).

4.4.182 The flow changes are illustrated in Figure 4.57.

Figure 4.57 Flow Changes Due to Gilau-Bors Expressway



4.4.183 Average speeds increase to 103 kph as a consequence of the scheme. Peak time journey times are reduced by 30%.

4.4.184 The primary economic indicators for the project are as follows:

- NPV = €1,219M;
- BCR = 2.41; and
- EIRR = 10.7%.

Implementing Organisation:

4.4.185 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.186 Nadaselu-Bors Expressway will be delivered post 2030 in the ES scenario and between 2021 and 2030 in the EES scenario

Level 2 Schemes – OR14 – Brasov-Pitesti Expressway

Brief Description of Proposal

4.4.187 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Brasov and Pitesti, thus improving regional connectivity.

4.4.188 The indicative alignment is shown in Figure 4.58.

Figure 4.58 Brasov-Pitesti Expressway Indicative Alignment

4.4.189 The route connects to the node of Brasov on the T-NET network.

Brief Description of Problem(s) Addressed:

4.4.190 There are poor average travel times; typical average speeds for this route are around 63 kph.

4.4.191 The bulk of the infrastructure provision in the corridor is poor – 85% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

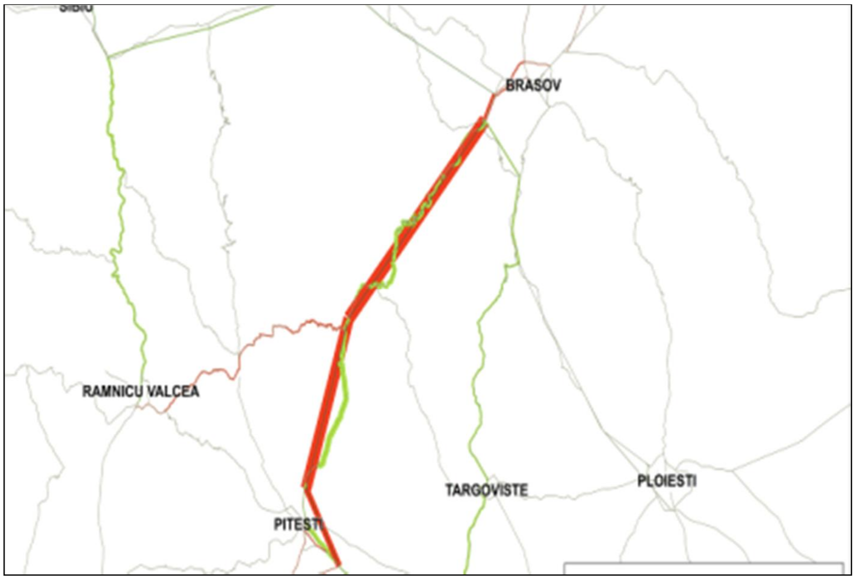
- CAPEX €1,694M

Outcome(s):

4.4.192 This project returns a BCR of 1.97, and carries around 21,000 vehicles (AADT). 7,000 vehicles (AADT) using the immediate corridor switches to the new route.

4.4.193 The flow changes are illustrated in Figure 4.59.

Figure 4.59 Flow Changes Due to Brasov-Pitesti Expressway



4.4.194 Average speeds increase to 93 kph as a consequence of the scheme. Peak time journey times are reduced by 37%.

4.4.195 The primary economic indicators for the project are as follows:

- NPV = €1,222M;
- BCR = 1.97 and
- EIRR = 9.1%.

Implementing Organisation:

4.4.196 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.197 Brasov-Pitesti Expressway will be delivered post 2030 in both implementation scenarios.

Level 2 Schemes – OR15 – Sibiu-Pitesti Expressway

Brief Description of Proposal

4.4.198 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Sibiu and Pitesti, thus improving regional connectivity.

4.4.199 The indicative alignment is shown in Figure 4.60.

Figure 4.60 Sibiu-Pitesti Expressway Indicative Alignment

4.4.200 The route connects to the node of Sibiu on the T-NET network.

Brief Description of Problem(s) Addressed

4.4.201 There are poor average travel times; typical average speeds for this route are around 72 kph

4.4.202 The bulk of the infrastructure provision in the corridor is poor – 94% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

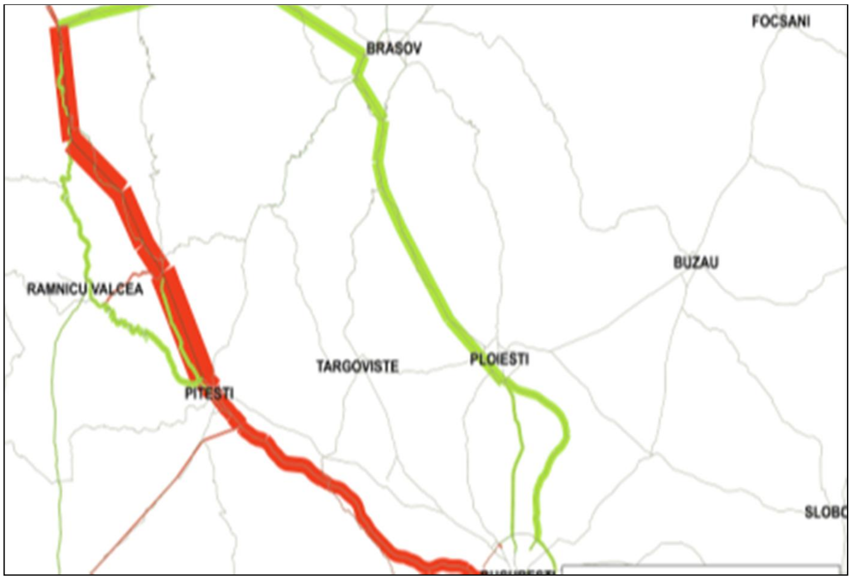
- CAPEX €1,817M

Outcome(s):

4.4.203 This project returns excellent value for money (BCR of 2.01), and carries around 58,000 vehicles (AADT). 8,000 vehicle (AADT) switch to the new route from the immediate corridor.

4.4.204 The flow changes are illustrated in Figure 4.61.

Figure 4.61 Flow Changes Due to Sibiu-Pitesti Expressway



4.4.205 Average speeds increase to 89 kph as a consequence of the scheme. Peak time journey times are reduced by 27%.

- NPV = €1,358M;
- BCR = 2.01; and
- EIRR = 9.3%.

Implementing Organisation:

4.4.206 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.207 Sibiu-Pitesti Expressway will be delivered in the period 2021 to 2030 in both scenarios.

Level 2 Schemes – OR16 – Slatina-Curtea de Arges Expressway

Brief Description of Proposal:

4.4.208 The high level objective for the project is to increase the economic efficiency of the transport network in Romania. The particular operational objective is to improve travel speeds between Slatina and Curtea de Arges, thus improving regional connectivity.

4.4.209 Figure 4.62 shows the indicative expressway alignment

Figure 4.62 Slatina-Curtea de Arges Expressway Indicative Alignment

Brief Description of Problem(s) Addressed:

4.4.210 There are poor average travel times; typical average speeds for this route are around 63 kph. The bulk of the infrastructure provision in the corridor is poor – 80% of the route is only single carriageway standard.

Undiscounted costs (Million €, 2014 prices):

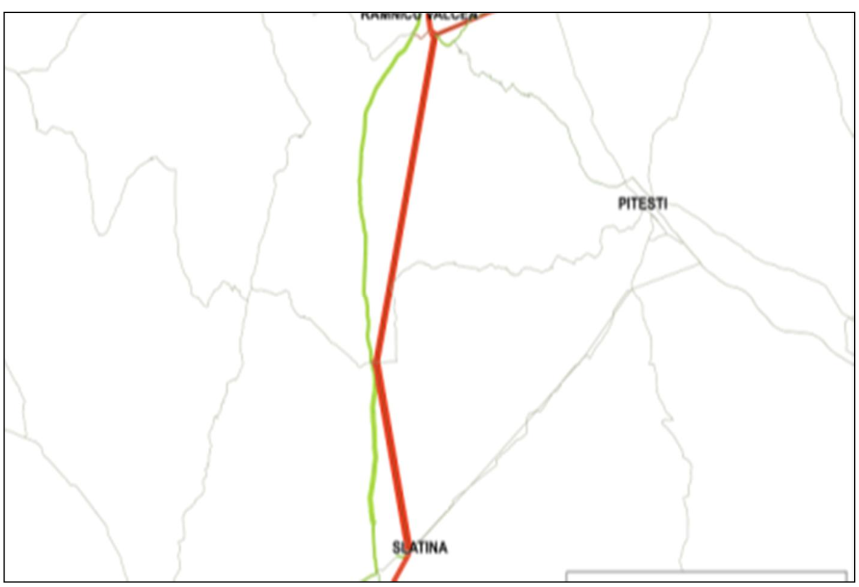
- CAPEX €762M

Outcome(s):

4.4.211 This project returns a BCR of 1.11, and carries around 15,000 vehicles (AADT). Almost all of the existing traffic in the immediate corridor switches to the new route (8,000 AADT).

4.4.212 The flow changes are illustrated in Figure 4.63.

Figure 4.63 Flow Changes Due to Slatina-Curtea de Arges Expressway



4.4.213 Average speeds increase to 83 kph as a consequence of the scheme. Peak time journey times are reduced by 21%.

- NPV = €62M;
- BCR = 1.11; and
- EIRR = 5.6%.

Implementing Organisation :

4.4.214 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.215 Slatina-Curtea de Arges Expressway will be delivered post 2030 in both implementation scenarios.

Level 3 Schemes

Brief Description of Proposal:

4.4.216 To support the Level 1 and Level 2 schemes, there are further infrastructure improvements at a local level. The locations of the bypass schemes were determined by the volume and type of through traffic, together with the settlement size. 10 bypass schemes are recommended, which form the Level 3 network.

4.4.217 These have been determined taking account of linkages with the higher tier (Level 1 and Level 2) schemes.

Economic Indicators:

4.4.218 Economic indicators for each scheme have been determined, and are presented in the following table.

Table 4.20 Summary of Bypass Scheme Economic Indicators

Ref	Location	Undiscounted cost (Million €, 2014 prices)	NPV (Million €)	BCR	EIRR
BP3	Sighisoara	48	92	3.84	15.8%
BP4	Roman	62	129	4.11	15.9%
BP9	Ramnicu Valcea	195	31	1.23	6.2%
BP10	Targoviste	78	358	7.83	22.7%
BP11	Filiasi	28	68	4.40	15.6%
BP12	Adjud	46	170	5.96	19.0%
BP14	Ludus	103	113	2.53	11.2%
BP15	Falticeni	41	70	3.34	13.2%
BP16	Caransebes	81	7	1.13	5.7%
BP17	Beclean	42	24	1.81	8.4%

Implementing Organisation:

4.4.219 The implementing organisation would be CNADNR.

Implementation Year(s):

4.4.220 The table below shows the implementation time frames for each scheme in both the ES and EES delivery scenarios. Certain bypass schemes have differing delivery timescales, depending on the implementation scenario.

Table 4.21 Summary of Bypass Scheme Implementation Timetable

Ref	Location	Delivery ES	Delivery EES
BP3	Sighisoara	2021-2030	2021-2030
BP4	Roman	2021-2030	2021-2030
BP9	Ramnicu Valcea	2021-2030	2021-2030
BP10	Targoviste	2014-2020	2014-2020
BP11	Filiasi	2021-2030	2021-2030
BP12	Adjud	2014-2020	2014-2020
BP14	Ludus	2021-2030	2021-2030
BP15	Falticeni	2021-2030	2021-2030
BP16	Caransebes	2021-2030	2021-2030
BP17	Beclean	2021-2030	2021-2030

4.5 MCA Analysis

4.5.1 The overall approach to project selection and the way in which projects are combined to form the final scenarios was set out in Section 2.6.

4.5.2 The previous sections in this chapter have dealt with the derivation of the preferred Level 1, Level 2 and Bypass schemes and the MCA now brings these together into a coherent strategy taking on board the funding allocations per sector.

4.5.3 The funding allocations are discussed fully in Section 11.3 but are summarised here for the road network in Table 4.22.

Table 4.22 Funding Allocation for Roads (€M)

Type	Period		
	2014-2020	2021-2030	2014-2030
Motorways and expressways	4,502	11,556	16,058
BPs	145	834	979

4.5.4 Whilst the final grouping of schemes is informed by the model and financial analysis, it is not a purely mechanistic process. At each stage, the masterplan team undertook reality and sense checks to ensure the process did not result in a poorly connected network or one that brought schemes forward for implementation in an illogical manner.

4.5.5 There was also regular dialogue with the Ministry, and its advisors, JASPERS, in order to ensure the process was subject to independent scrutiny. Some particular issues of note are covered in the following.

4.5.6 Bacau - Iasi Motorway was excluded from the list for the following reasons:

- o Land configuration was identified as being very difficult and there would be considerable uncertainty over the investment costs as a result;
- o Economic performance indicators and MCA have very low values for a Level 1 project; and
- o Connections between Iasi-West of Romania and Iasi-Bucuresti could be covered by other means.

4.5.7 An express road linking Buzau and Focsani was added and tested with a cost-benefit analysis in order to rectify a connectivity issue in that corridor.

4.5.8 With regard to the Campia Turzii - Targa Mures – Iasi scheme, it was agreed that the Iasi-Ungheni connection shall be included (which was initially included in the Bacau-Iasi motorway). Also, following discussions with CNADNR representatives on 21.08.2014, the elimination of Campia – Turzii - Targu Mures section was decided, as this is to be implemented as a motorway, under the current programming period.

4.5.9 The final ES and EES scenarios are shown in Table 4.23 and 5.24 which set out the designation (in TEN-T terms) of the section, the MCA score, the EIRR, the cost (together with a cumulative cost) and the implementation period.The networks are also illustrated in Figures 5.64 to 5.67

4.5.10 Recognising the importance of the TEN-T network definition, it was agreed to also undertake a further comparator test based on only those identified schemes which were on the Core TEN-T.

4.5.11 Table 4.25 shows a similar breakdown in terms of TEN-T schemes and how they could be accommodated within the financial constraints discussed earlier.

4.5.12 With the TEN-T comparator, fewer individual schemes are achievable within the period up to 2020.

4.5.13 In terms of economic efficiency, or value for money, the ES and EES scenarios perform very similarly with BCRs of the order of 2.1. The Core TEN-T comparator fares considerably less well at around 1.7.

Table 4.23 ES Scenario – Schemes and Implementation Period

	Code		Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1	Selected Level 1	H7	Sibiu-Brasov Motorway	Comprehensive TEN-T link	74.3	17.3%	689.8	689.8	2014-2020
2		H13a	Campia Turzii - Targu Mures Motorway	Core TEN-T link	54.0	9.5%	450.0	1,139.8	2014-2020
3		H8	Ploiesti-Comarnic Motorway	Comprehensive TEN-T link	48.7	12.5%	310.4	1,450.3	2014-2020
4		H6	Craiova-Pitesti Motorway	Comprehensive TEN-T link	47.3	12.2%	870.3	2,320.6	2014-2020
5		H1	Comarnic-Brasov Motorway	Comprehensive TEN-T link	29.3	8.8%	1,117.0	3,437.5	2014-2020
6		H12	Brasov-Bacau Motorway	Comprehensive TEN-T link	20.1	7.1%	2,067.6	5,505.2	2021-2030
1	Level 2	OR18B	Bucharest Southern Ring Road Upgrade	Core TEN-T link	100.0	14.5%	175.7	5,680.9	2014-2020
2		OR7A	Bacau-Suceava Expressway	Core TEN-T link	86.3	12.6%	645.4	6,326.3	2021-2030
3		OR13C	Buzau-Focsani Expressway	Core TEN-T link	81.6	12.0%	500.0	6,826.3	2021-2030
4		OR7B	Suceava-Siret Expressway	Core TEN-T link	79.1	11.7%	186.1	7,012.4	2021-2030
5		OR10	Lugoj- Craiova Expressway	Core TEN-T link	66.6	10.0%	1,810.9	8,823.3	2021-2030
6		OR9B	Turda-Halmeu Expressway	Other links	63.0	13.5%	975.4	9,798.7	2021-2030
7		OR15	Sibiu-Pitesti Expressway	Core TEN-T link	61.4	9.3%	1,976.9	11,775.6	2021-2030
8		OR13	Targu Mures-Iasi-Ungheni Expressway	Core TEN-T link	55.0	8.4%	4,100.0	15,875.6	2021-2030
9		OR17	Gaesti-Ploiesti-Buzau-Braila Expressway	Comprehensive TEN-T link	60.0	11.9%	1,279.6	17,155.2	After 2030
10		OR6B	Bacau-Focsani-Braila-Galati Expressway	Comprehensive TEN-T link	54.4	11.2%	1,024.2	18,179.4	After 2030
11		OR12	Gilau-Bors Expressway	Comprehensive TEN-T link	51.3	10.7%	1,226.9	19,406.2	After 2030
12		OR8	Bacau-Piatra Neamt Expressway	Other links	41.2	10.6%	335.1	19,741.3	After 2030

	Code		Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
13		OR14	Brasov-Pitesti Expressway	Comprehensive TEN-T link	39.0	9.1%	1,842.6	21,584.0	After 2030
14		OR7C	Suceava-Botosani Expressway	Other links	28.4	8.9%	345.8	21,929.8	After 2030
15		OR11	Constanta-Tulcea-Braila Expressway (including Braila Bridge)	Comprehensive TEN-T link	11.9	5.4%	1,369.3	23,299.1	After 2030
1	Bypasses	BP12	Adjud	Core TEN-T link	85.4	19.0%	46.2	46.2	2014-2020
2		BP10	Targoviste	Comprehensive TEN-T link	79.0	22.7%	78.0	124.2	2014-2020
3		BP4	Roman	Core TEN-T link	73.2	15.9%	62.0	186.1	2021-2030
4		BP11	Filiasi	Core TEN-T link	71.8	15.6%	27.7	213.8	2021-2030
5		BP15	Falticeni	Core TEN-T link	62.4	13.2%	41.3	255.1	2021-2030
6		BP3	Sighisoara	Comprehensive TEN-T link	51.8	15.8%	47.7	302.7	2021-2030
7		BP9	Ramnicu Valcea	Core TEN-T link	34.8	6.2%	195.4	498.1	2021-2030
8		BP14	Ludus	Comprehensive TEN-T link	33.5	11.2%	102.5	600.6	2021-2030
9		BP16	Caransebes	Core TEN-T link	32.6	5.7%	80.8	681.4	2021-2030
10		BP17	Beclean	Comprehensive TEN-T link	22.6	8.4%	42.2	723.7	2021-2030

Table 4.24 EES Scenario – Schemes and Implementation Period

		Code	Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1	Selected Level 1	H7	Sibiu-Brasov Motorway	Comprehensive TEN-T link	57.6	17.3%	689.8	689.8	2014-2020
2		H8	Ploiesti-Comarnic Motorway	Comprehensive TEN-T link	39.4	12.5%	310.4	1,000.3	2014-2020
3		H6	Craiova-Pitesti Motorway	Comprehensive TEN-T link	34.4	12.2%	870.3	1,870.6	2014-2020
4		H13a	Campia Turzii - Targu Mures Motorway	Core TEN-T link	34.1	9.5%	450.0	2,320.6	2014-2020
5		H1	Comarnic-Brasov Motorway	Comprehensive TEN-T link	15.5	8.8%	1,117.0	3,437.5	2014-2020
6		H12	Brasov-Bacau Motorway	Comprehensive TEN-T link	14.9	7.1%	2,067.6	5,505.2	2021-2030
1	Level 2	OR18B	Bucharest Southern Ring Road Upgrade	Core TEN-T link	71.0	14.5%	175.7	5,680.9	2014-2020
2		OR7A	Bacau-Suceava Expressway	Core TEN-T link	70.2	12.6%	645.4	6,326.3	2021-2030
3		OR7B	Suceava-Siret Expressway	Core TEN-T link	65.1	11.7%	186.1	6,512.4	2021-2030
4		OR13C	Buzau-Focsani Expressway	Core TEN-T link	60.8	12.0%	500.0	7,012.4	2021-2030
5		OR6B	Bacau-Focsani-Braila-Galati Expressway	Comprehensive TEN-T link	46.5	11.2%	1,024.2	8,036.5	2021-2030
6		OR12	Gilau-Bors Expressway	Comprehensive TEN-T link	44.2	10.7%	1,226.9	9,263.4	2021-2030
7		OR9B	Turda-Halmeu Expressway	Other links	44.0	13.5%	975.4	10,238.8	2021-2030
8		OR17	Gaesti-Ploiesti-Buzau-Braila Expressway	Comprehensive TEN-T link	43.4	11.9%	1,279.6	11,518.4	2021-2030
9		OR10	Lugoj- Craiova Expressway	Core TEN-T link	40.1	10.0%	1,810.9	13,329.3	2021-2030
10		OR15	Sibiu-Pitesti Expressway	Core TEN-T link	36.4	9.3%	1,976.9	15,306.2	2021-2030
11		OR7C	Suceava-Botosani Expressway	Secondary connectivity with TEN-T	32.3	8.9%	345.8	15,652.0	2021-2030
11a		OR13a	Pascani-Iasi-Ungheni	Core TEN-T link	31.9	8.4%	450.0	16,102.0	2021-2030

		Code	Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
			Expressway						
12		OR13	Targu Mures-Pascani Expressway	Core TEN-T link	31.9	8.4%	3,650.0	19,752.0	After 2030
13		OR14	Brasov-Pitesti Expressway	Comprehensive TEN-T link	25.4	9.1%	1,842.6	21,594.7	After 2030
14		OR8	Bacau-Piatra Neamt Expressway	Other links	19.4	10.6%	335.1	21,929.8	After 2030
15		OR11	Constanta-Tulcea-Braila Expressway (including Braila Bridge)	Comprehensive TEN-T link	17.1	5.4%	1,369.3	23,299.1	After 2030
1	Bypasses	BP10	Targoviste	Comprehensive TEN-T link	57.0	22.7%	78.0	78.0	2014-2020
2		BP12	Adjud	Core TEN-T link	56.6	19.0%	46.2	124.2	2014-2020
3		BP4	Roman	Core TEN-T link	47.9	15.9%	62.0	186.1	2021-2030
4		BP11	Filiasi	Core TEN-T link	46.9	15.6%	27.7	213.8	2021-2030
5		BP15	Falticeni	Core TEN-T link	40.1	13.2%	41.3	255.1	2021-2030
6		BP3	Sighisoara	Comprehensive TEN-T link	37.6	15.8%	47.7	302.7	2021-2030
7		BP14	Ludus	Comprehensive TEN-T link	24.5	11.2%	102.5	405.2	2021-2030
8		BP9	Ramnicu Valcea	Core TEN-T link	20.5	6.2%	195.4	600.6	2021-2030
9		BP17	Beclean	Comprehensive TEN-T link	19.7	8.4%	42.2	642.9	2021-2030
10		BP16	Caransebes	Core TEN-T link	18.9	5.7%	80.8	723.7	2021-2030

Table 4.25 TEN-T Comparator Scenario – Schemes and Implementation Period

	Code		Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1	Completion of Core TEN-T	OR18B	Bucharest Southern Ring Road Upgrade	Core TEN-T link	100.0	14.5%	175.7	175.7	2014-2020
2		H2	Sibiu-Pitesti Motorway	Core TEN-T link	74.7	12.1%	2,471.2	2,646.9	2014-2020
2a		H11a	Ploiesti-Bacau Motorway	Core TEN-T link	63.6	11.0%	1,700.0	4,346.9	2014-2020
3		H11	Bacau-Suceava-Siret Motorway	Core TEN-T link	63.6	11.0%	1,781.3	6,128.1	2021-2030
4		H13a	Campia Turzii - Targu Mures Motorway	Core TEN-T link	47.4	9.5%	450.0	6,578.1	2021-2030
5		H15	Targu Mures-Iasi-Ungheni Motorway	Core TEN-T link	39.4	8.7%	5,056.3	11,634.4	2021-2030
6		H28	Lugoj - Craiova Motorway	Core TEN-T link	28.5	7.7%	2,399.2	14,033.6	2021-2030
7		H9	Bucharest-Alexandria-Craiova Motorway	Core TEN-T link	23.0	7.2%	1,189.8	15,223.4	2021-2030
8		H10	Craiova-Calafat Motorway	Core TEN-T link	2.3	5.2%	419.2	15,642.6	2021-2030
9		H29	Drobeta - Calafat Motorway (including H28)	Core TEN-T link	0.0	4.5%	482.0	16,124.6	2021-2030
10		H27	Timisoara - Moravita Motorway	Core TEN-T link	0.0	3.7%	470.4	16,595.1	After 2030

Figure 4.64 EES Final Strategy (2020) Highway Network

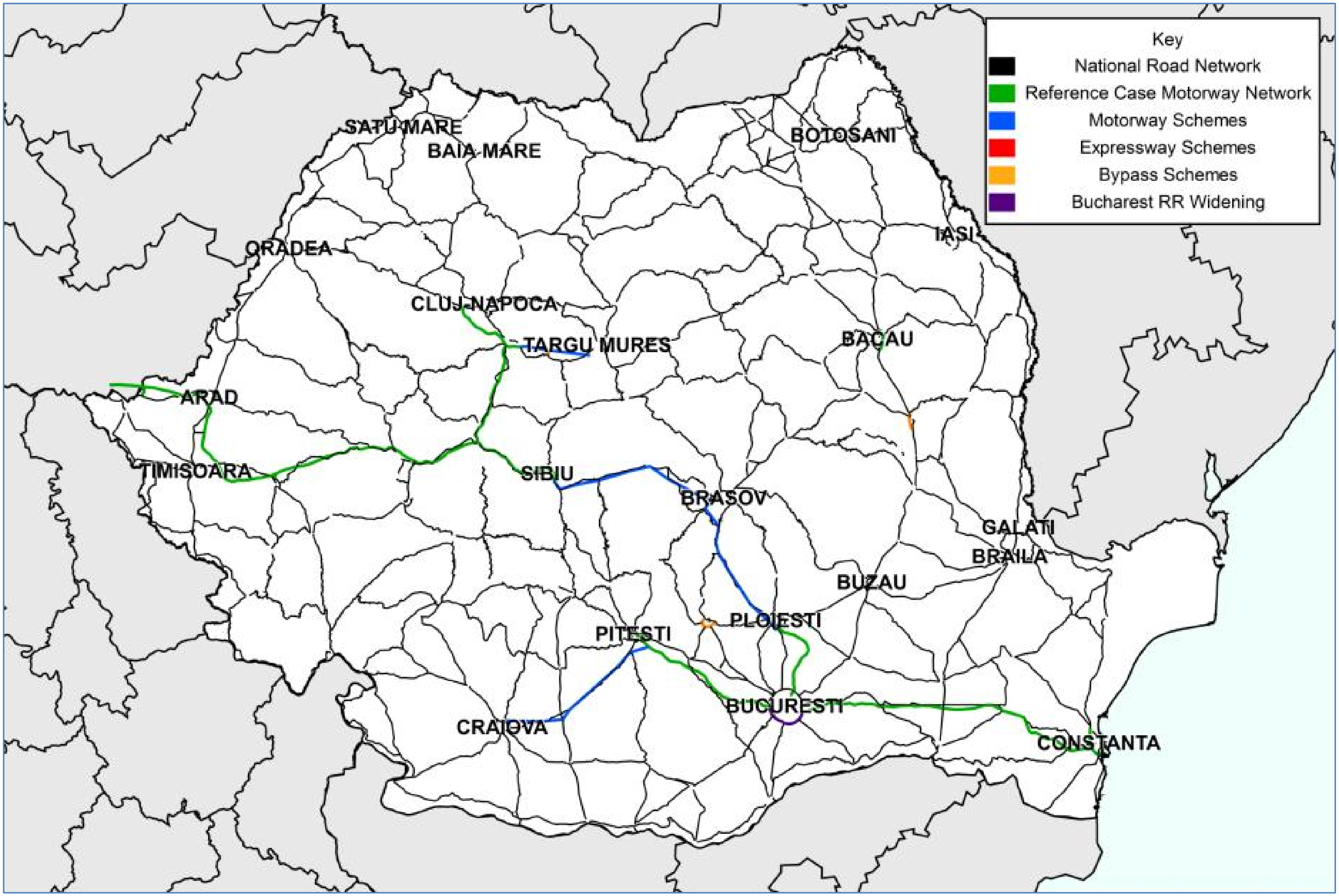


Figure 4.65 EES Final Strategy (2030) Highway Network

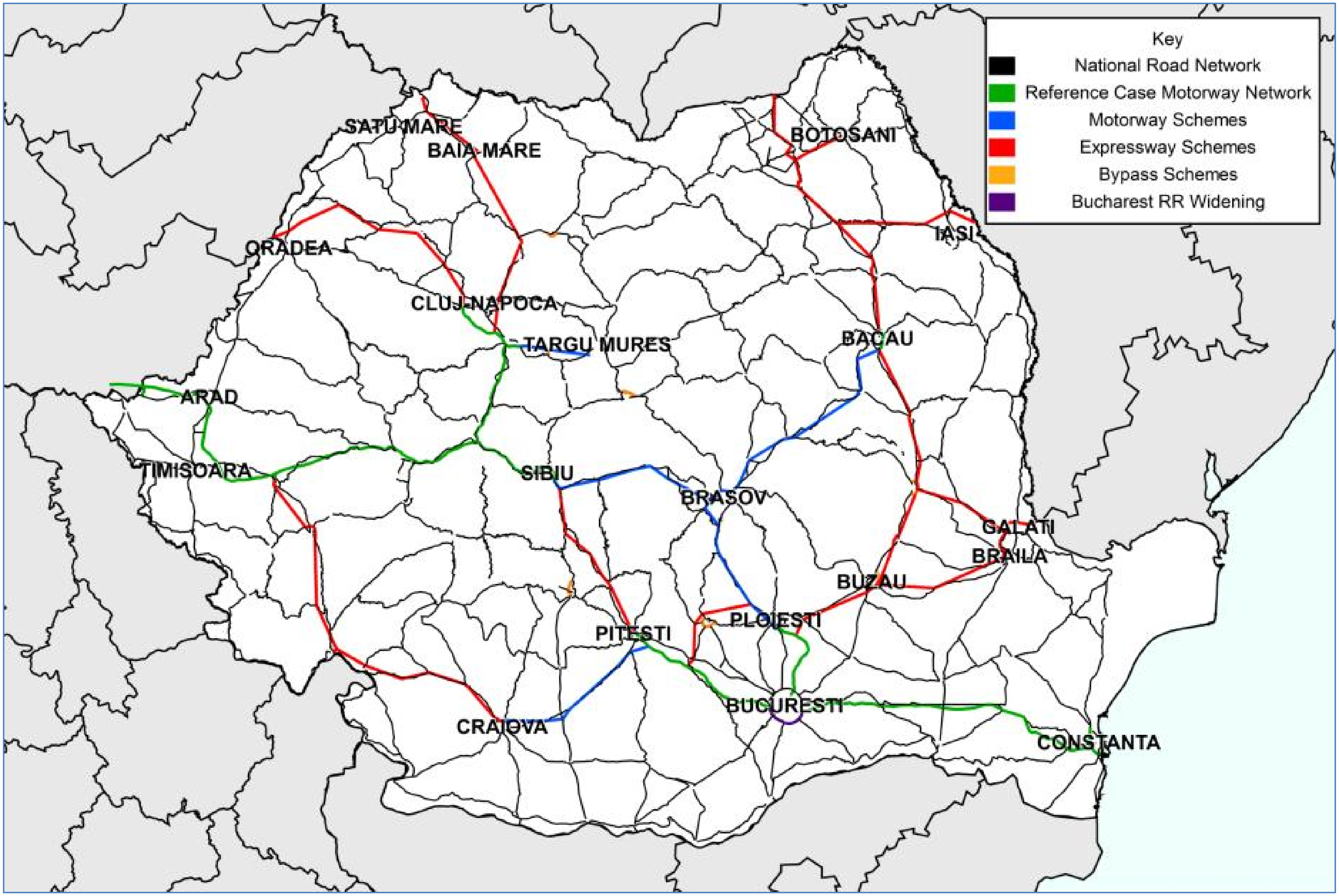


Figure 4.66 ES Final Strategy (2020) Highway Network

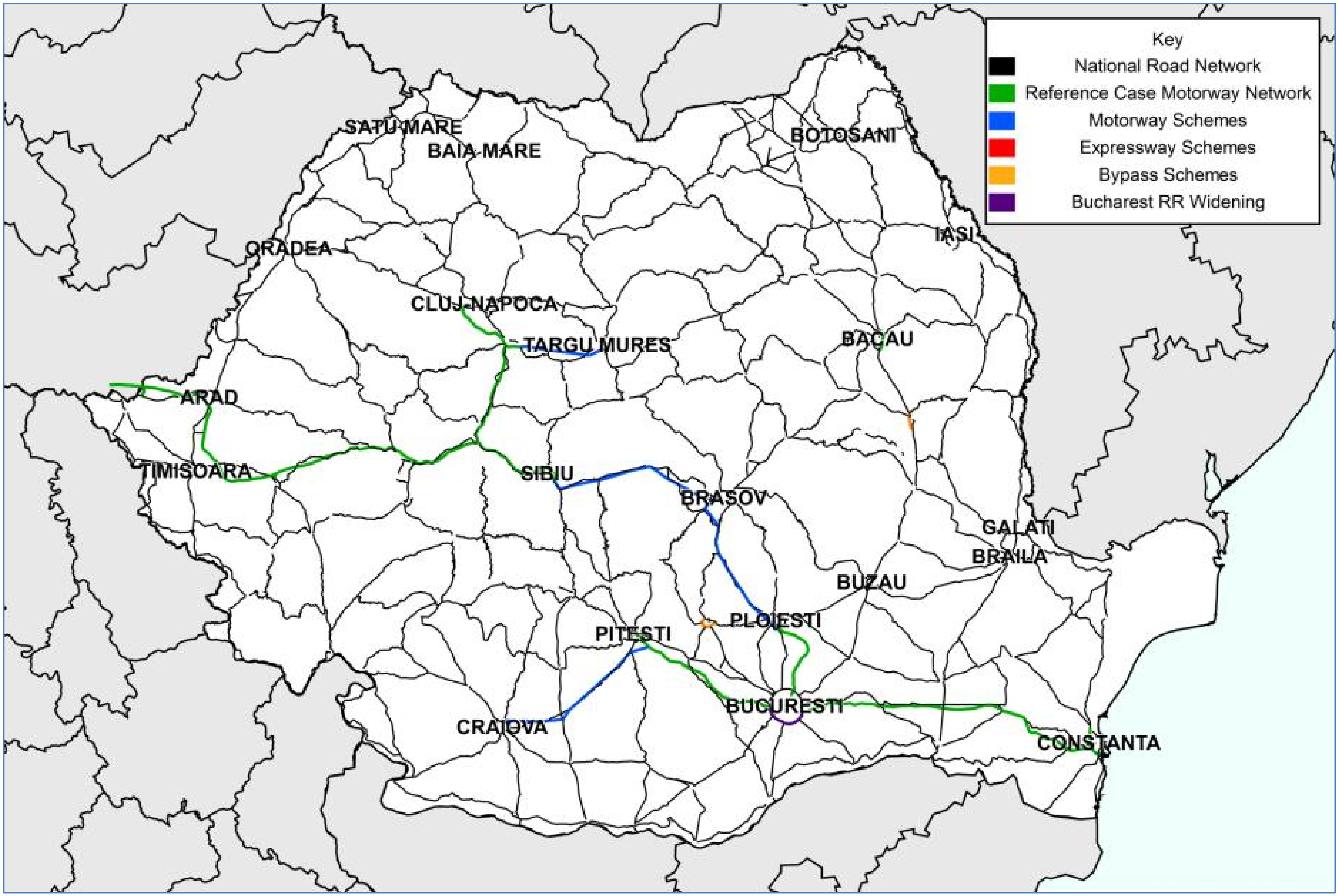
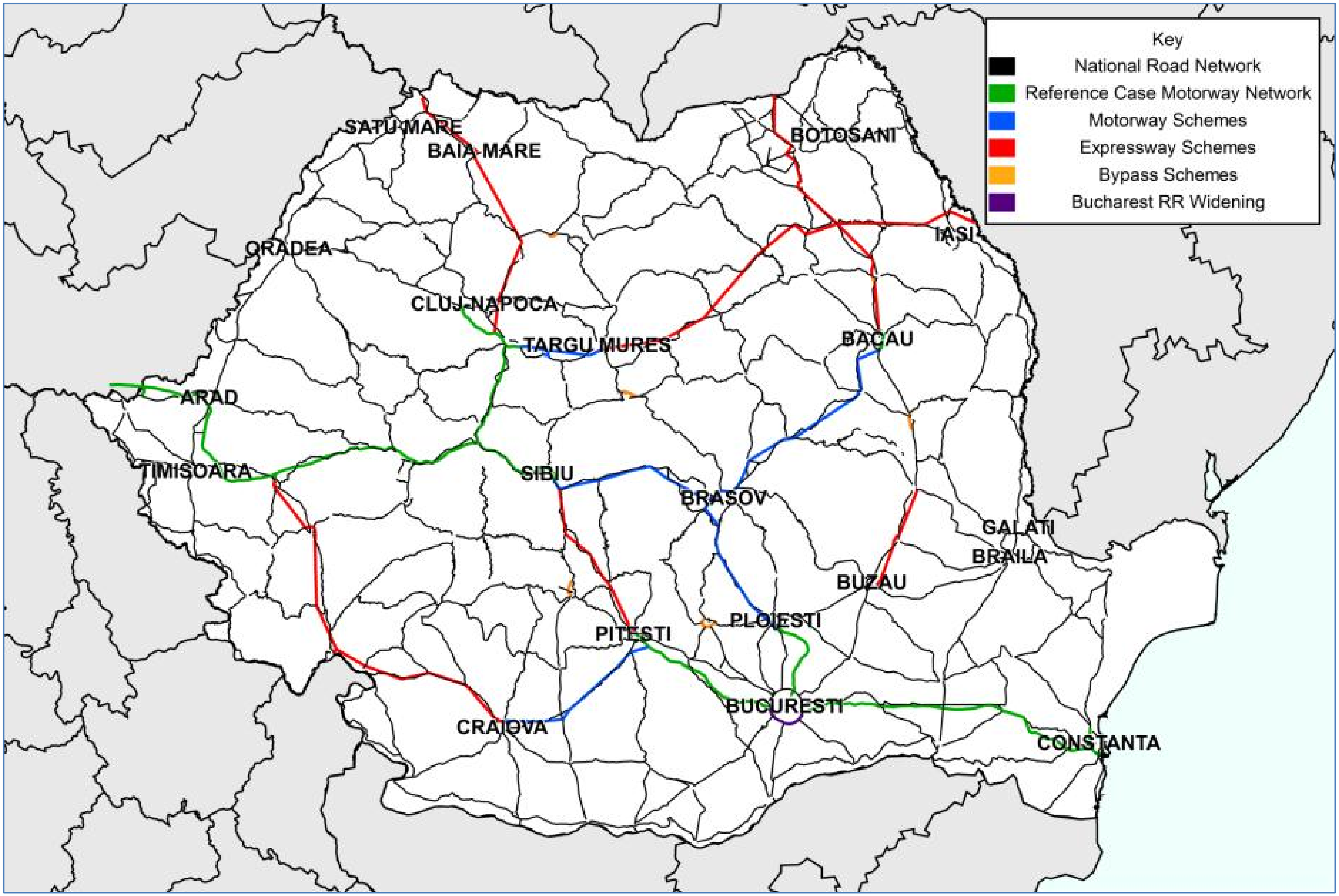


Figure 4.67 ES Final Strategy (2030) Highway Network



4.6 Summary of Interventions

4.6.1 In addition to the infrastructure measures which have been discussed in this Chapter, there are a number of other proposed measures which seek to address the overall objectives of the Masterplan.

Maintenance Related

4.6.2 As set out in Table 4.4 earlier in this chapter, only just over 50% of the national network is classified as good with a further 30% average and 20% poor. The expectation should be that the national network should be at the top end of the standard for any country. Figure 4.4 also provided information in respect of the proportion of the national road network for which the design life has expired.

4.6.3 Furthermore, 48% of all routes have some element classified poor. Of these the average proportion, by length, is 24%. There is no distinction by topography, thereby suggesting a network wide issue.

4.6.4 The World Economic Forum, in their report on “Global Competitiveness (2011–2012)”, places Romania 137th out of 142 countries considered with regard to the quality of the road infrastructure.

4.6.5 It is evident that at least part of the problem revolves around maintenance activities, the way they are undertaken and managed as well as the way in which they are prioritised. It is proposed that the following measures are implemented to help improve the maintenance regime in Romania and meet the goal of a safe and operational road transport network:

- Adopt ‘Best Practice’ Pavement Management System (PMS);
- Undertake an Asset Management Review;
- Detailed Analysis of Operation and Management Funding Requirements;
- Operation and Management Prioritisation and Allocation;
- Define Quality of Service Parameters; and
- Longer Term Contractual Arrangements.

4.6.6 A PMS will:

- Evaluate the road condition;
- Assess priorities; and
- Optimise interventions.

4.6.7 The outcome will be a more transparent, evidence-based approach to maintenance activities. Whilst there will always be limits on the amount of funding available, a best practice PMS will optimise the use of what funds are available and ensure best value is obtained by applying whole life costing approaches.

4.6.8 The PMS will form the basis for planning and prioritising all future road maintenance activities in Romania.

4.6.9 The Asset Management Review proposal will involve carrying out a detailed study review of the existing road assets data and systems in order to establish accuracy, completeness and appropriateness of the currently available inventory, inspection and maintenance records data and functionality of the associated asset management systems such as PMS, BMS etc. together with appropriate improvements measures.

4.6.10 A detailed analysis of operation and management funding requirements (both for backlog removal and on-going routine & planned maintenance activities for all current and planned assets) and historic allocations will identify appropriate annual operation and management funding needs and their earmarking.

4.6.11 This should be ensured in long-term by government commitments, supported by appropriate additional revenue sources e.g. increased vignette levels.

4.6.12 Operation and Management Prioritisation and Allocation involves introducing an efficient and effective system for prioritisation and allocation of operation and management expenditures on a multi-year basis. Furthermore, developing dedicated backlog removal plans for all major assets (roads and bridges). This will lead to a structured approach to operation and maintenance, thus ensuring schemes are prioritised effectively.

4.6.13 In order to define Quality of Service Parameters, a review of the existing relevant operation and management standards and specifications, in terms of their appropriateness and affordability, will be required. The result will lead to a standardised level of service provision.

4.6.14 A move towards longer term contracts for maintenance operations will improve the service provided with better consistency at a regional level. These will become more effective given that the contracts will be performance related. It is proposed that these contracts are regionally based.

4.6.15 The proposal will reform the current maintenance practice of around 50 contracts, lasting a maximum of two years, by proceeding systematically with longer term (5-7 years) performance based contracts at regional scale, more in line with best practice elsewhere in the EU.

Project Management Reform

4.6.16 A high level objective for the project is to improve the management and operation of the infrastructure in Romania. Improved institutional & organisation stability and capacity will ensure efficient and effective management of activities in the road sector during all project phases.

4.6.17 We recommend a full audit and review of the existing situation followed by identification of relevant measures and recommendations in terms of the organisation of the departments to be in charge of all stages of a project cycle. This would include a Training Needs Assessment for all key staff.

4.6.18 Furthermore we would recommend that the Ministry appoint and retain management staff, based on longer term performance-based contracts. These reforms in project management will make the delivery of schemes more effective.

Goods Vehicle Related

4.6.19 There are a number of proposals associated with goods vehicles:

- Monitoring of Axle Loading;
- Network Charging;
- Parking Areas for Good Vehicles; and
- ITS (Border Delays).

4.6.20 Reviewing and reforming legislation around the monitoring of axle loading, and the subsequent enforcement of regulations, will reduce the instances of asset damage, therefore reducing maintenance requirements.

4.6.21 The high level objective for the project is to improve the management and operation of the infrastructure in Romania. In particular, the operational objective is to limit damage to roads caused by excessive overloading of trucks. The proposal is to review the appropriateness of axle load legislation and ensure its effective enforcement via regular spot-checks and fines for non-compliance.

4.6.22 There will also be a requirement to ensure sufficient monitoring and checking procedures / facilities in place.

4.6.23 Currently, there is a lack of a co-ordinated charging regime for goods vehicles with county and municipal authorities charging additional fees over and above national vignette. This leads to high administrative costs on local and national hauliers from complex and uncoordinated charging regimes. These vignettes are not co-ordinated or easily payable by international or regional hauliers.

4.6.24 A national charging system for goods vehicles will standardise the current local arrangements and provide a mechanism to ease the administration for international hauliers.

4.6.25 There is currently no secure truck parking provision in Romania, even on new highway schemes. This presents a security and safety problem for hauliers and other road users and imposes unnecessary costs on the system.

4.6.26 EC Regulation 1315/2013 requires for TEN-T appropriate parking areas every 100 km. As the entire TEN-T network (core and comprehensive) comprises approximately 4,900 km, this implies 49 such facilities or 27 for the core only. Unit costs for a service area are approximately €20M so the total cost would be €540M for the core and €980M for the core and comprehensive.

4.6.27 Secure parking locations will adhere to EU requirements, and best practice, and reduce the cost of haulage operations through improved security during journeys.

4.6.28 Using ITS to provide alternative route information and improved management of border crossing arrangements will help to reduce delays. The European Standard, as set out in the Trade and Transport Facilitation in Southeast Europe Program (TTFSE), is that the maximum waiting time for any vehicle is 40 minutes at the border crossing points.

Rail Transport

5 Rail Transport

5.1 Existing Situation and Historic Trends

Passenger usage

5.1.1 The first part of this section reviews the recent trends in passenger numbers, as well as assessing the pattern of rail trips between the main population centres using 2011 data. The Figure 5.1 illustrates the number of journeys declined between 2004 and 2012 from about 100m per annum to 58m. The 28% decline in patronage experienced in Romania between 2004 and 2009 is the largest decrease across all the EU Member states.

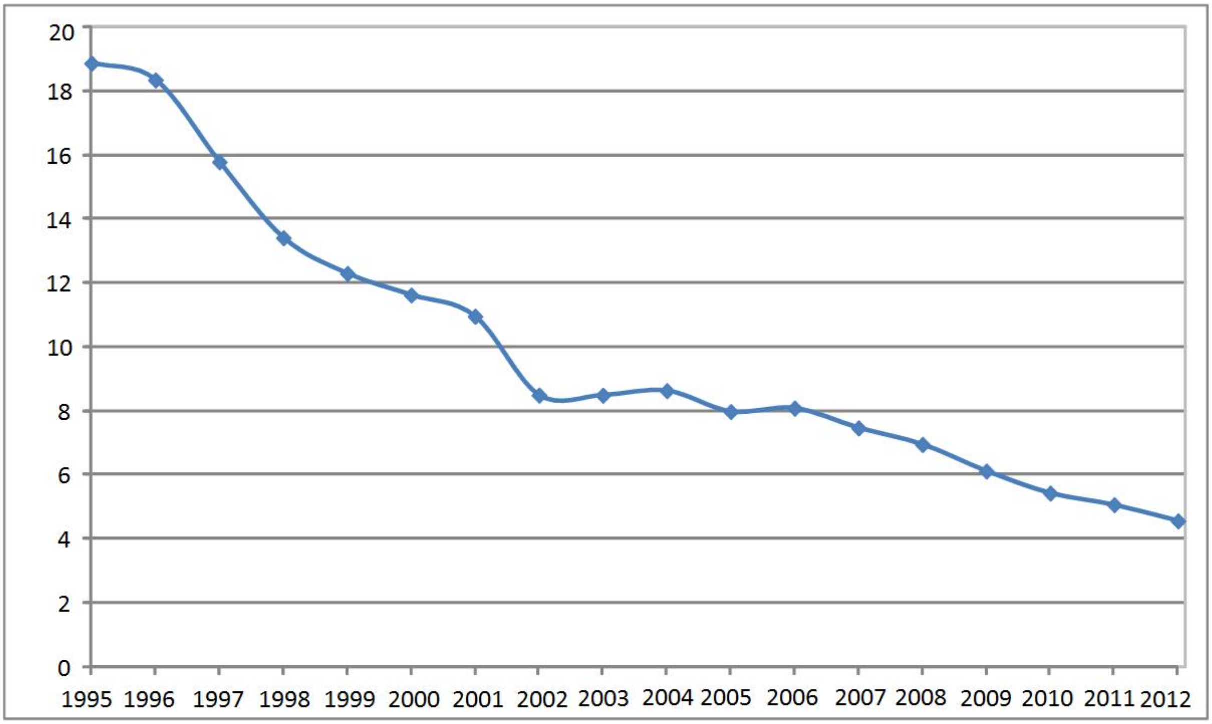


Figure 5.1 Number of Rail Passenger Journeys per annum in Romania (2004-2012)

Source: AECOM analysis of CFR Calatori data

5.1.2 Rail demand in Romania, measured by kilometres travelled per person, is two to three times lower compared with other countries. The EU27 average is 650km per passenger per year while the equivalent figure for Romania is 66% lower. The relationship between passenger kilometres per person has also been benchmarked for Romania against other EU countries. The ratio for Romania (239 passenger kilometres / person) is lower than other EU countries except Estonia (172), Greece (118) and Lithuania (34). The results for Romania are lower than Bulgaria (270 passenger kilometres / person) or Hungary (731), as shown in Figure 5.2. Compared with countries with a similar level of rail network provision per head of population, the rate of railway use in Romania is low.

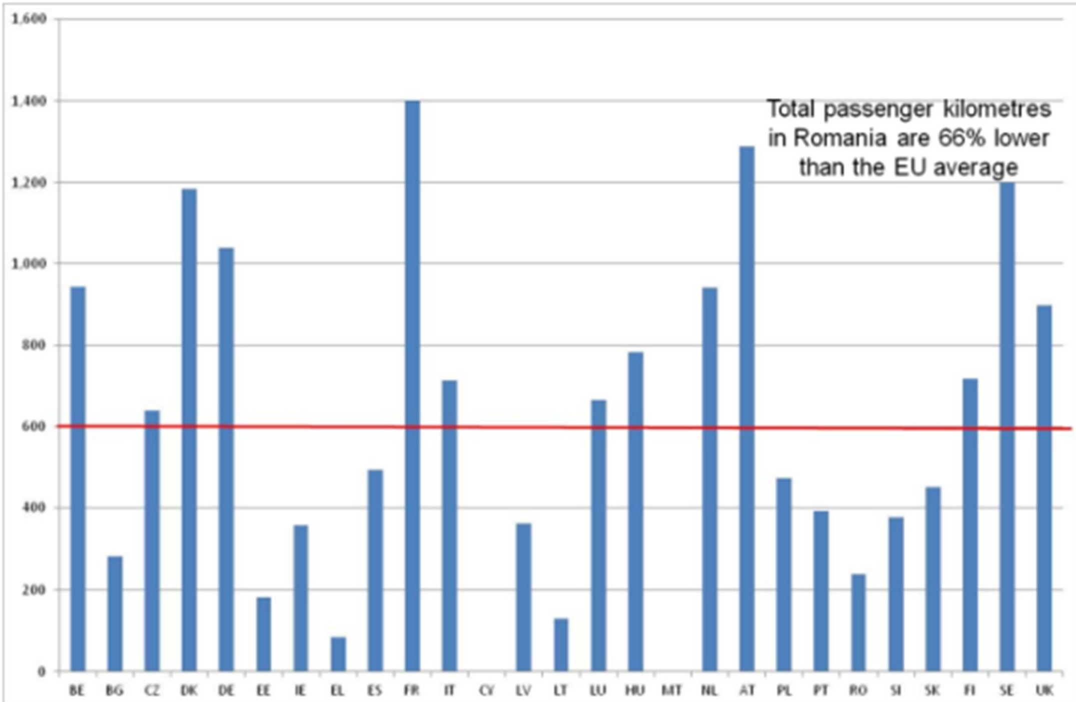


Figure 5.2: Comparison of Total Rail Passenger Kilometres – Romania and Other EU Countries

Source: http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2013_en.htm

5.1.3 Figure 5.3 shows the magnitude of the network reductions experienced between 1970 and 2011 in most of the EU counties, with an average reduction of 13% across EU, including Germany (-23%), Belgium (-23%), France (-18%), UK (-17%), Poland (-26%), and Portugal (-22%)[24]. There were also substantial reductions before 1970, in countries such as Ireland (-60%), UK (-36%), Sweden (-28%) and significant also in France or Germany (around -10%). Overall it can be concluded that reductions in the range of 30% or even more of the network are quite common in Europe, including in some of the richest Member States like Germany, France and UK. Compared to these, the reductions put in place in Romania by 2011 (-5% since 1990 or -2% since 1970) are insignificant.

[24] *Source: European Commission, EU Transport in Figures Statistical PocketBook, 2013*

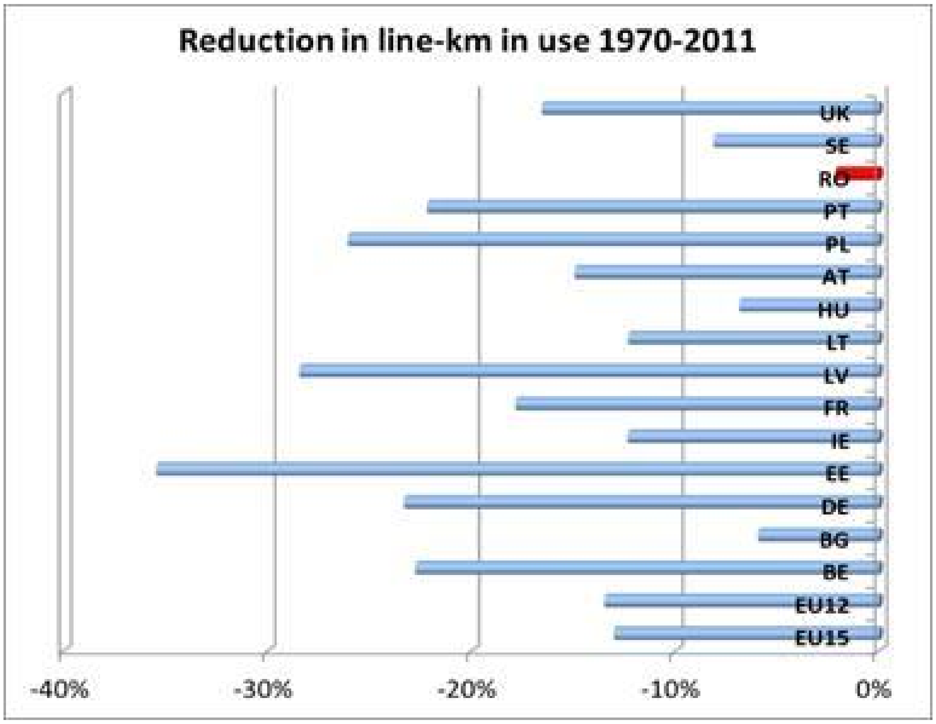


Figure 5.3: Reduction in Network Size (1970-2011)

Source: Eurostats

Overall Mode Share Statistics

5.1.4 Table 5.1 illustrates the change in the proportion of trips by rail, road and other modes between 2004 and 2012. Data supplied by CFR Calatori indicates rail mode share has dropped from almost one-third in 2004 to about one-sixth by 2012. The percentage of trips by road has increased by over 10% over the same period, with the domestic air market accounting for the remaining trips.

Table 5.1: Mode Share Comparison for Rail and Road – 2004 to 2012

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Rail	31.3%	27.8%	29.1%	27.4%	20.7%	20.6%	20.1%	19.7%	17.8%
Road	68.2%	71.6%	70.2%	71.6%	78.4%	76.7%	76.7%	76.7%	78.7%
Other	0.5%	0.5%	0.7%	1.1%	1.0%	2.8%	3.2%	3.6%	3.4%

Source: CFR Calatori

5.1.5 These statistics indicate rail is capturing a good percentage of the total trips, albeit recognising the actual trip rate per person is significantly lower. The comparison of passenger kilometres per person for Romania against other EU countries indicates there is significant scope to grow the market if service improvements were delivered.

5.1.6 Travel data for 2011 has been examined to identify the most prominent travel patterns. The following sectors cover a much larger geographic area compared with the individual zones in the National Model. Table 5.2 illustrates the total number of trips between the sectors, plus the intra-sector demand

1. Bucharest
2. Constanta / Bacau / Iasi / Suceava
3. Galati / Focsani / Buzau
4. Bacau / Iasi / Suceava
5. Brasov / Sibiu / Targu Mures
6. Craiova
7. Timisoara / Arad
8. Oradea / Cluj Napoca / Satu Mare / Baia Mare

Table 5.2 Summary of Daily Rail Trips – Sector to Sector Demand

Sector	1	2	3	4	5	6	7	8	Total
1 Bucharest	15,562	1,618	2,757	2,015	1,908	3,370	1,178	1,223	**29,631**
2 Constanta	1,755	3,900	394	577	302	360	597	241	**8,126**
3 Galati / Focsani / Buzau	2,873	376	10,890	850	787	357	242	305	**16,680**
4 Bacau / Iasi / Suceava	2,103	570	871	14,673	552	590	1,040	1,358	**21,757**
5 Brasov / Sibiu / Targu Mures	1,944	292	596	525	17,927	623	1,123	1,349	**24,379**
6 Craiova	3,446	364	360	590	652	9,805	1,165	357	**16,739**
7 Timisoara / Arad	1,256	670	257	1,228	1,158	1,229	17,873	1,026	**24,697**
8 Oradea / Cluj / S Mare / B Mare	1,252	254	307	1,492	1,330	357	983	15,787	**21,762**

Source: AECOM analysis of National Transport Model

5.1.7 The main conclusions are:

o Bucharest generates the highest number of trips, with almost 30,000 journeys per day. About 36% of all rail journeys start or finish in this sector, which covers a wide area including Ploiesti. There is some evidence of longer distance travel from Bucharest, with about 3,400 trips to Craiova, 2,750 to Galati / Focsani / Buzau and 2,000 to Bacau / Iasi / Suceava and Brasov / Sibiu / Targu Mures;

o There are two other sectors which generate over 24,000 daily trips. In contrast to Bucharest, the Brasov / Sibiu / Targu Mures and Timisoara / Arad sectors have a much higher percentage of trips that start / finish within the same sector (about 70% in both cases). These results indicate the relatively self-contained nature of these sectors, and the extent of the local rail networks around Brasov and Timisoara. In the case of the Timisoara / Arad sector, the long distance to Bucharest is a contributory factor;

o Although Galati / Focsani / Buzau, Craiova, Oradea / Cluj Napoca / Satu Mare / Baia Mare generate a smaller number of daily trips compared with the other sectors described above (typically 16,500 to 22,000), there is also a relatively high percentage of internal journeys. Again, this illustrates the self-contained nature of the rail trips generated from the population catchments within these sectors. The Constanta sector generates the smallest total number of trips, with less than 8,200 per day. Less than 50% of trips have an origin and destination within this sector. The relative proximity to Bucharest and the lack of other major catchments adjacent to Constanta has contributed to this outcome.

o The high percentage of trips that start / finish within the same sector indicate rail is only used for longer distance journeys by a relatively small percentage of passengers. This reflects historic journey patterns which are a product of relatively slow connections between the major cities, but it also indicates that an important market for rail are inter-city journeys of between 2-4 hours duration.

5.1.8 The rail market share for some of the largest travel flows in Romania is shown below. The corridors with the highest rail flows attract rail mode shares of up to 25%, particularly if the road based alternatives are less convenient, for example, Craiova to Bucharest. Other short distance flows affected by strong competition from road based modes attract just 2% of journeys by rail, for example, Timisoara to Arad.

o Bucuresti to Craiova: 19% mode share;

o Bucuresti to Arad: 25% mode share;

o Bucuresti to Cluj Napoca: 10% mode share;

o Bucuresti to Brasov: 5% mode share;

o Bucuresti to Iasi: 9% mode share;

o Bucuresti to Galati: 9% mode share;

o Bucuresti to Constanta: 4% mode share;

o Craiova to Timisoara: 1% rail mode share

o Timisoara to Arad: 2% mode share;

5.1.9 The journey patterns summarised have also been presented graphically in Figure 5.4. There is some overlap with the busiest network sections in terms of the service frequencies also attracting the highest passenger numbers. The principal flows are summarised below:

o The approach to Bucuresti Nord attracts up to 70,000 passengers per day;

o Bucuresti Nord to Focsani, plus the sections to Brasov and Craiova attract over 9,000 trips per day with up to 27,500 using the busiest sections;

o The number of passengers using the rail network towards Timisoara, Arad, Oradea, Cluj Napoca, Iasi and Suceava exceeds 3,500 per day, although there are generally fewer trains compared with the frequencies towards Bucuresti Nord;

o There are numerous branch lines which attract fewer than 1,200 services per day, although this is generally consistent with the lower service frequencies (typically less than 8 trains per day).

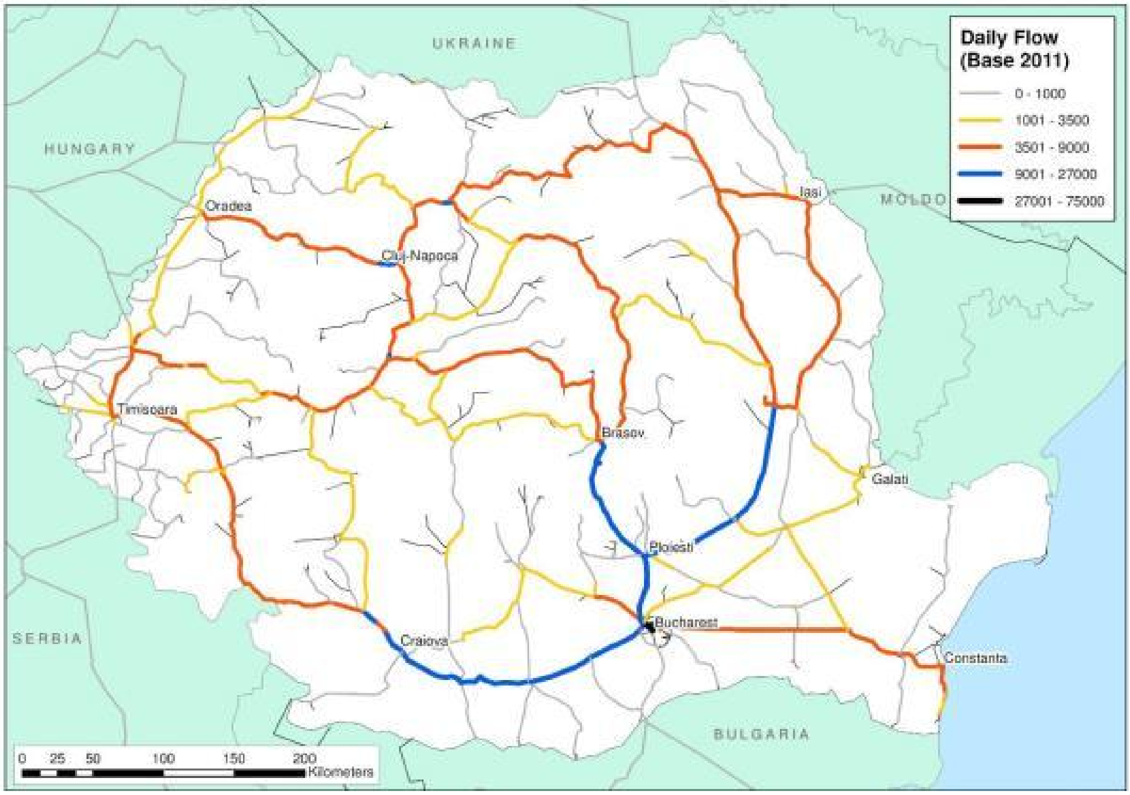


Figure 5.4: Summary of Daily Rail Passenger Trip Patterns (2011)

Source: AECOM analysis

Station Usage

5.1.10 An analysis of demand shows that approximately 23% of stations are generating 90% of railway demand, which includes 1% of stations that generate 42% of trips. This suggests that there are a large number of stations with negligible demand, but which nevertheless continue to be served, albeit with relatively low frequencies. For example, nearly 1,000 stations in Romania generate fewer than 50 trips per day, no service calls at some of these stations. This has implications on the cost required to operate services, given the limited revenue generated by these stations;

Table 5.3 Station Boarding Patterns

Number of Daily Boardings	Number of stations
>1,000 boardings	42
500-1,000 boardings	42
251-500 boardings	71
101-250 boardings	188
51-100 boardings	175
11-50 boardings	435
<10 boardings	535

Source: AECOM analysis

o A review of the detailed station loading data from other countries indicates the following trends:Romania: 1% of stations generate 42% of demand, with 23% of stations generating 90%;

o England: 1% of stations generate 35% of demand, with 33% of stations generating 90%;

- Scotland: 1% of stations generate 44% of demand, with 37% of stations generating 90%;
- Wales: 1% of stations generate 35% of demand, with 31% of stations generating 90%.

5.1.11 This comparison highlights there is a higher percentage of stations which only generate 10% of demand versus England, Scotland or Wales. These results indicate there are a much larger percentage of stations in Romania that generate very limited demand compared with the UK examples. Figure 5.5 illustrates the cumulative distribution.

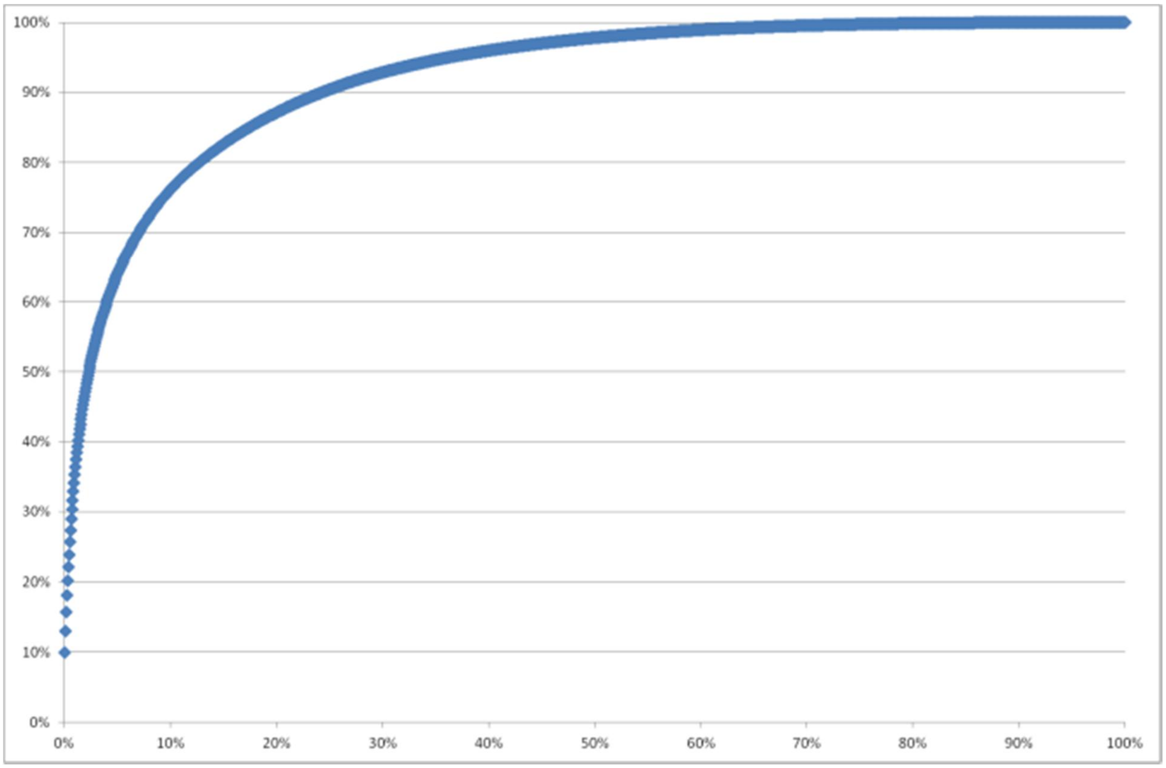


Figure 5.5: Cumulative Distribution of Passenger Numbers using Stations

Source: AECOM analysis of data from the Romanian National Transport Model

Ticketless Travel

5.1.12 There is a range of evidence which illustrates the level of ticketless travel. For example, CFR Calatori has previously estimated that the percentage of passengers travelling without tickets is about 5% which would be comparable to the some other European railways. However, there is alternative evidence which suggests that ticketless travel is significantly higher, with almost one-third of passengers travelling without a ticket. Anecdotal evidence suggests that the proportion affected may be closer to the higher estimate. In any event, measures which seek to minimise the proportion of ticketless travel should form the basis of a future proposals since the incremental revenue will help to strengthen the financial case for investment. The estimated revenue loss is about €50m per annum. Lines operated by CFR Calatori generally have the highest levels of fare evasion which reflects the revenue increases private operators are now achieving.

Ticket Prices

5.1.13 A benchmarking exercise indicates that Romanian rail fares are relatively high compared with other countries when they are normalised to take account of comparative spending power of other European economies. This constraint is particularly relevant for advance purchase tickets. The high *fares restrict the opportunities to attract new passengers and reduces the net economic benefit of the railway system, as shown in Figure 5.6.*

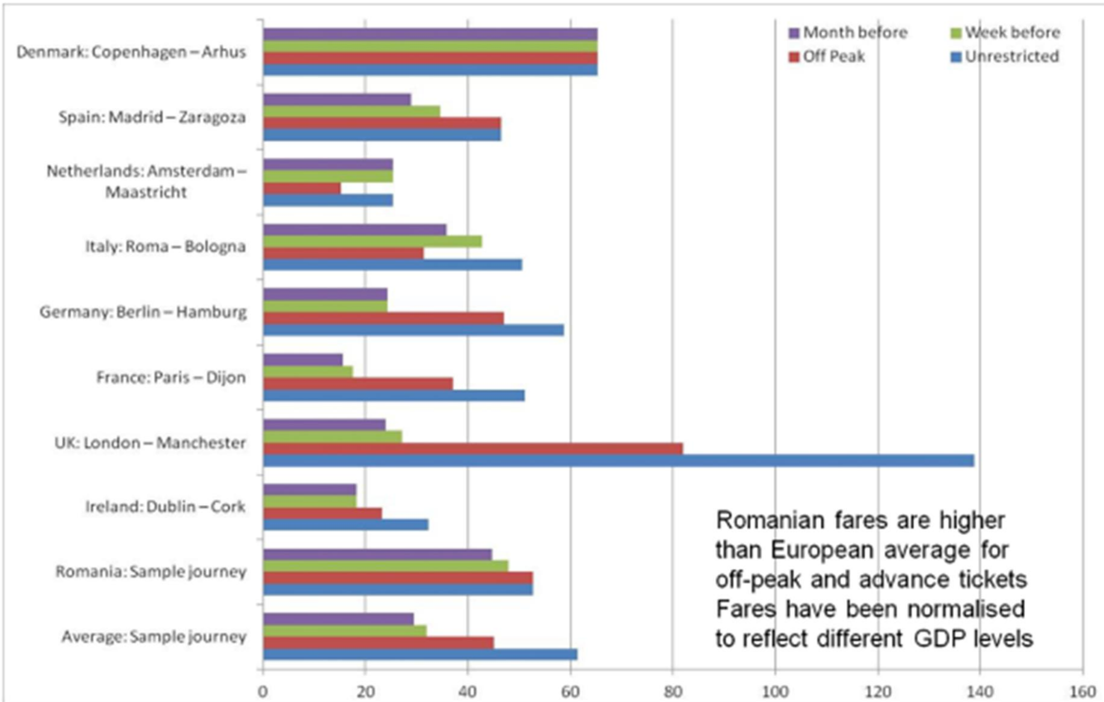


Figure 5.6: Comparison of Romanian Fares with Selected EU Examples

Source: AECOM analysis of a selection of fares per 100 km of journey. Fares are adjusted to take account of differences in GDP

Freight Usage

5.1.14 Romania is relatively large and hence is suited to rail. Although it is not universally the case, goods that have to be transported large distances can be transported more economically by rail due to the better economies of scale that rail offers over road. However, Romania's rail freight sector is in a long term decline. Rail still achieved an 18% market share in 2012 which represented a 1% fall from 2011

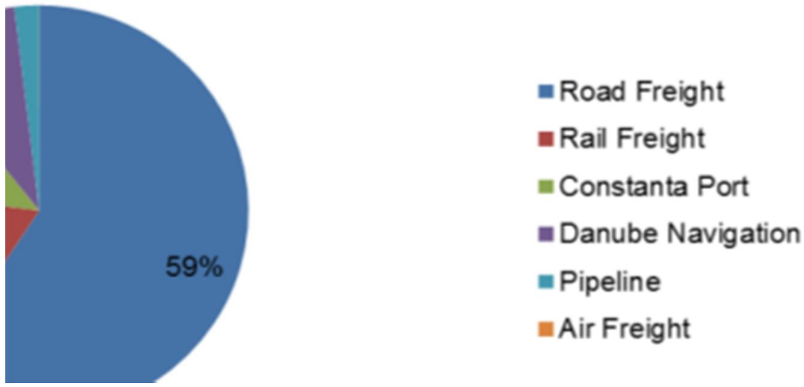


Figure 5.7: Freight Market Share

Freight Market Share in Romania 2012 Source: http://www.insse.ro/cms/files/publicatii/Romania%20in%20cifre%202013_ro.pdf

5.1.15 With about 28% of goods moved by rail, Romania is ranked 6th compared with other countries. This proportion was about 10% higher compared with the EU27 average of 18.4% (2011 data was the most recent year for a full countrywide comparison available on Eurostat at the time of writing). This proportion could reduce if roads are improved, hauliers become more efficient or if the rail industry is not modernised. Data for Romania in 2012 showed a significant downward trend in market share in tonne kilometres from 28% to 21% by 2011. The decline of the traditional heavy industries has also contributed to the contraction of the rail freight market including a decline from 72m tonnes in 2008 to 56m tonnes in 2012. This reduction in core business reduces the revenue to the railway network, and has not been replaced by demand from newer markets. Figure 5.8 demonstrates that the volume of goods transported by rail has decreased since 2006, with the market share held by CFR Marfa declining from 75% to 60%. This trend has continued and the state operator had just 50% of the market in 2012.

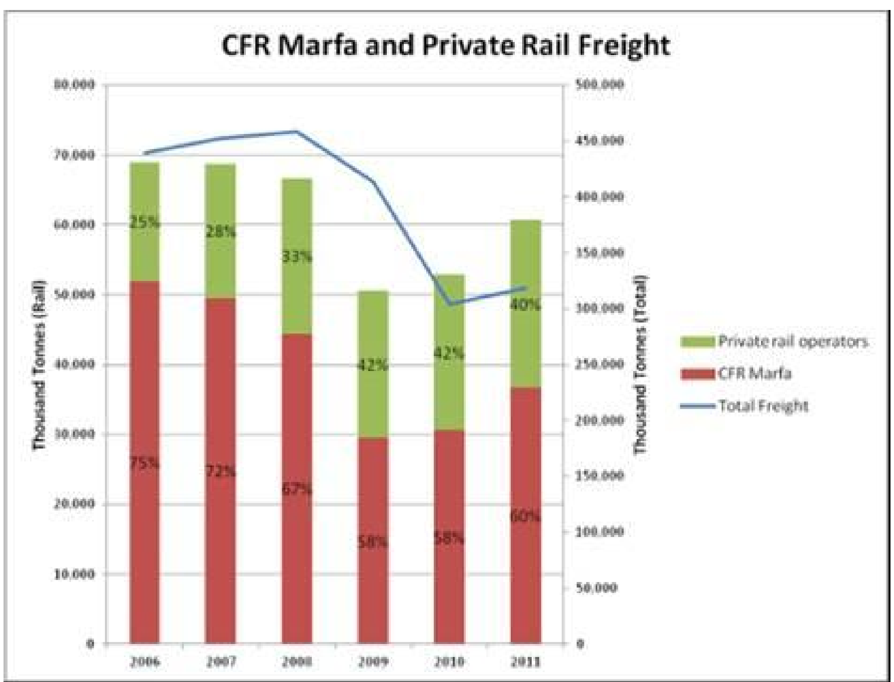


Figure 5.8: Change in Rail Freight Tonnes (2006-2011)

Source: Thousands of tonnes of goods moved by rail in Romania (Source: Eurostat)

Service Level

5.1.16 The passenger rail network in Romania is designated as either "interoperable" or non-interoperable". Trains on interoperable lines are operated either by the state-owned operator CFR Calatori or private operators and maintained by the state-owned infrastructure company CFR SA. To provide context, Figure 5.8 illustrates the extent of the inter-operable and non inter-operable lines. The inter-operable lines account for 85% of the network. In contrast, the non inter-operable routes have been transferred to the private sector, following competitive tendering.

5.1.17 Most single lines are closed for maintenance during the morning (typically between 08.00 and 13.00), or only open 16 hours a day. Closures also apply to some freight terminals and customs facilities. Trains may need to be stabled to await the section being re-opened or be timetabled to avoid such closures. This constraint also applies to passenger services, with gaps of up to seven hours between some trains that call at local stations between Bucharest and Brasov or Craiova. As a consequence these routes fail to offer timetables that are aligned with customer requirements.

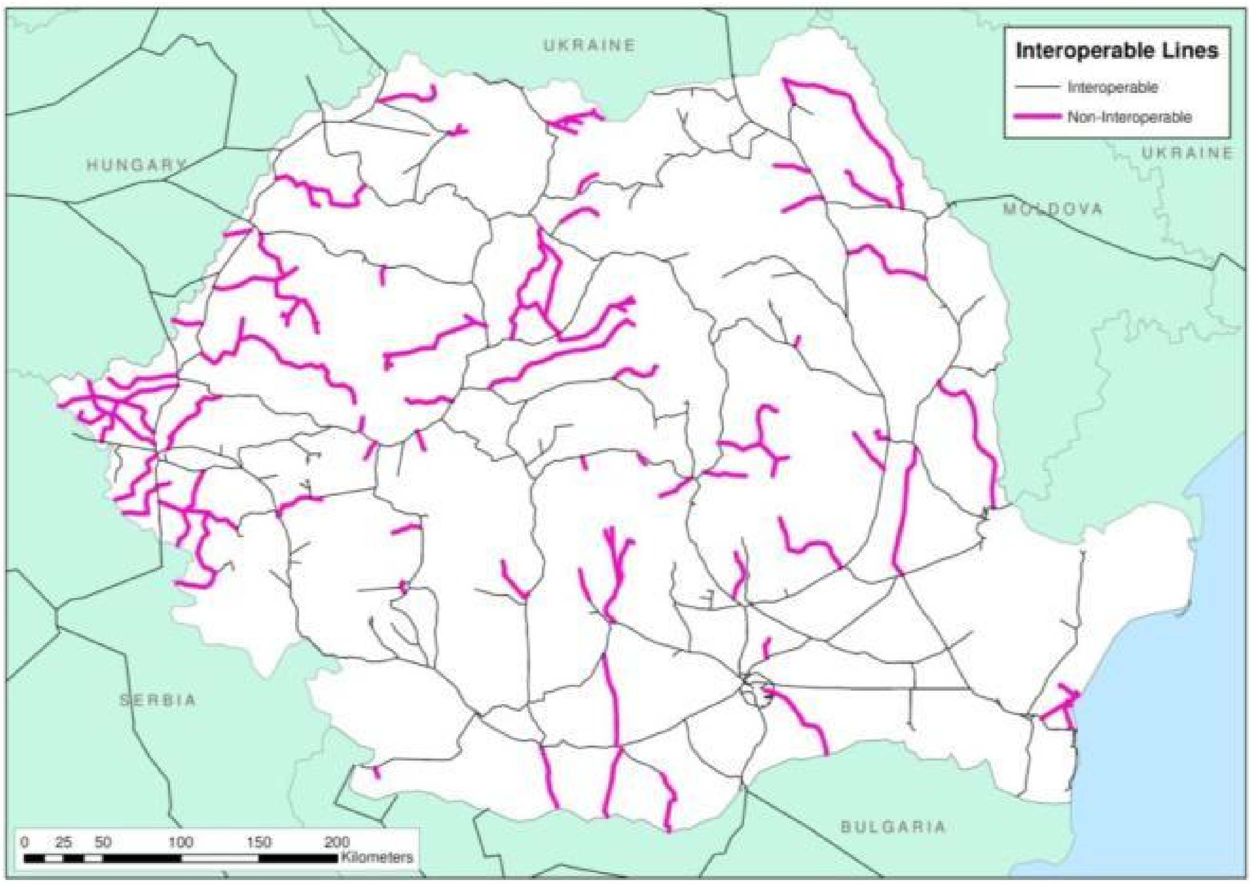


Figure 5.9 Inter-operable and Non interoperable Lines

Source: AECOM analysis of National Transport Model data

Network Performance

5.1.18 Network performance has been summarised in terms of the suitability of the timetable and the pattern of services. Figure 5.10 illustrates the median service frequency for passenger services using each corridor, but also highlights significant gaps in the timetable affecting selected routes.

Departure times along the busiest sections of the railway network, such as services between Bucharest and Craiova, Constanta, Brasov and Focsani/Suceava, have irregular headways, which results in complex timetable patterns for passengers. This reduces the convenience of the rail travel. Furthermore, the frequency from smaller local stations is very constrained, with a low number of departures at irregular times. For example, there are gaps of 7 hours between Ploiesti to Brasov, Arad to Oradea, whilst the sections between Brasov to Alba Iulia via Sibiu, Caracal to Sibiu via Ramnicu Valcea, plus Suceava to Dej are predominantly single track. Numerous overnight services also compensate for the low number of daytime trains.

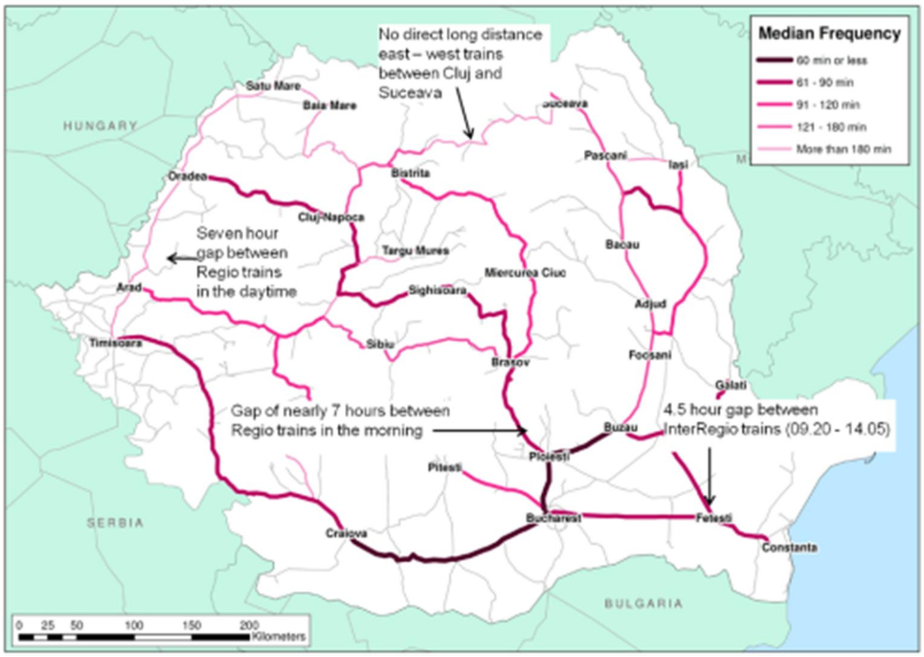


Figure 5.10 Summary of the Median Rail Frequencies

Source: AECOM analysis of the CFR Calatori timetable

Rail Speeds

5.1.19 Figure 5.11 compares operating and design rail network speeds, highlighting the parts of the network impacted by a particularly low speed. Much of the network approaching Bucharest has a ratio of between 0.4-0.6, highlighting the relatively slow speeds compared with the theoretical maximum. Only limited parts of the network have a ratio of above 0.8. The removal of many intercity services from the timetable and their subsequent replacement with slower InterRegio trains, which typically feature additional intermediate stops, is likely to have contributed to this outcome.

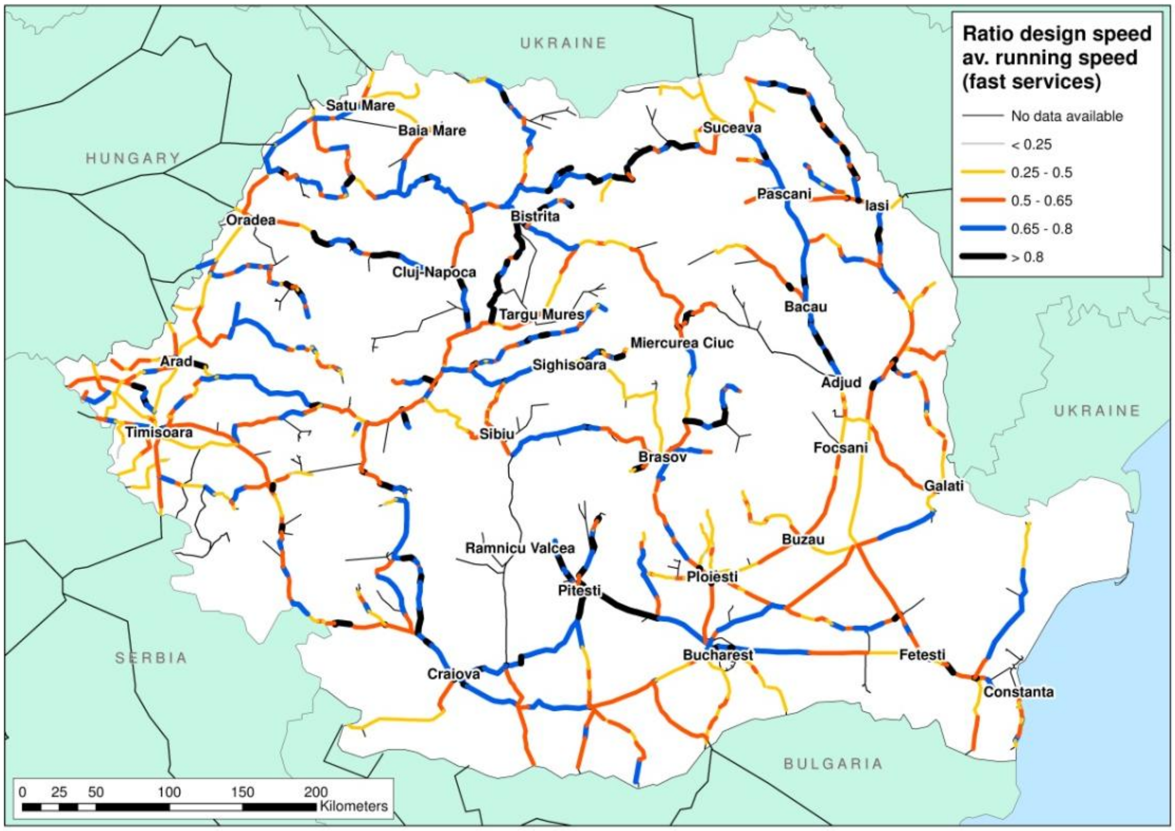


Figure 5.11 Comparison of Average and Design Speeds

Source: AECOM analysis of CFR Calatori timetables and data from CFR Infrastructure[25]

5.1.20 Selected rail journey speeds in Romania have been compared with a sample of European services as shown in Figure 5.12. For example, the average speeds in Romania are about 65-70km/h, yet a comparison with the UK and Germany indicates rail journey speeds in Romania are about twice as slow as the examples. Furthermore, timings in Romania are 40% slower compared with Hungary and Poland. The topography in Romania is a partial factor for some journeys, for example, the hilly terrain between Bucharest and Cluj, but there are other contributory factors including the numerous intermediate stops, lengthy dwell times and various technical reasons described below.

[25] Maximum speed data is not available for some links, so these are shown as blank

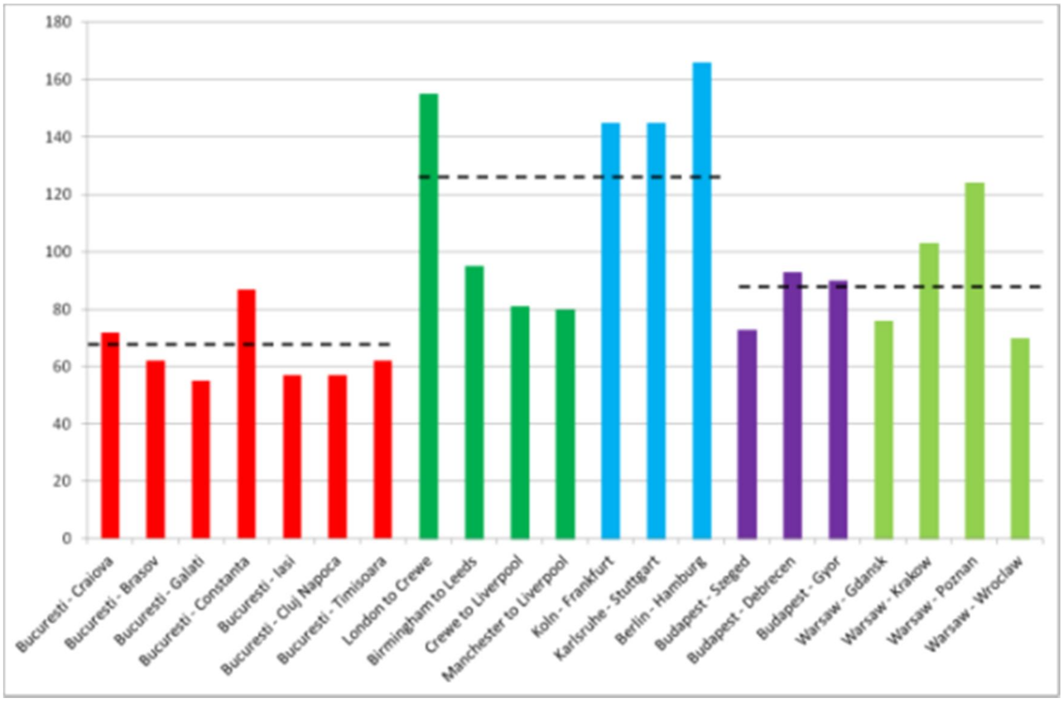


Figure 5.12 Comparison of Rail Journey Times – Romanian versus European Examples (km/h)

Source: AECOM analysis of CFR Calatori timetables and DB website

5.1.21 There are several factors that contribute to the slow journey speeds described above. These include extended journey times at stations including:

- o changes from electric to diesel traction;
- o the requirement to reverse at some stations which is exacerbated by the operation of loco-hauled sets rather than deploying electric or diesel multiple units or push/pull units for longer distance services,
- o delays when awaiting train paths at single track sections; and
- o the requirement for periodic inspections of old rolling stock.

5.1.22 The current border control procedures also contribute to lengthy delays are not conducive to encouraging cross-border trade. This includes border control delays at fellow EU Member States. At the Hungarian border typical freight train delays are typically up to 30 hours on the Hungarian side and 4–5 hours on the Romanian side. This makes cross-border rail freight very uncompetitive. Extended delays at border controls also impact on passenger services, although their duration is significantly shorter than freight.

5.1.23 CFR has recently obtained funding for the installation of overheated axle boxes and brakes detectors, although the introduction of newer rolling stock with better braking systems would also address this issue. Passenger services with numerous intermediate stops also incur significant boarding delays at stations, although the scope to address this issue is limited unless the stopping pattern is revised or stations closed. Figure 5.13 illustrates the total dwell time as a proportion of the overall travel time for selected services and Figure 5.14 presents the average dwell time for all stations. The latter illustrates the locations where the highest average delays occur

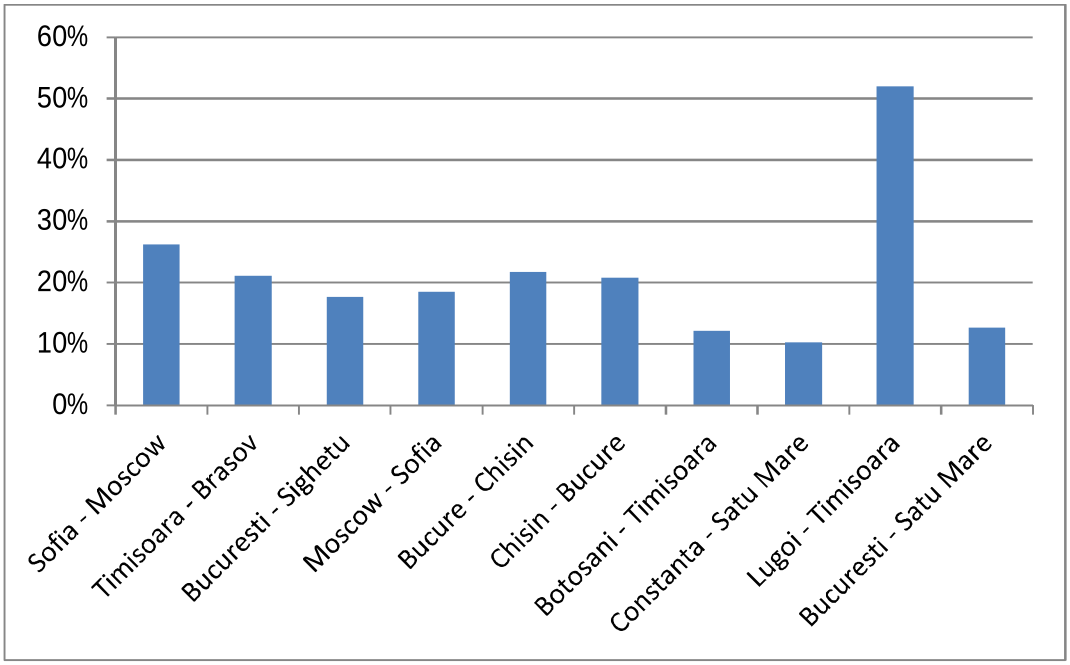


Figure 5.13 Overall Dwell Time as a Percentage of the Total Travel Time

Source: AECOM analysis of CFR Calatori timetables

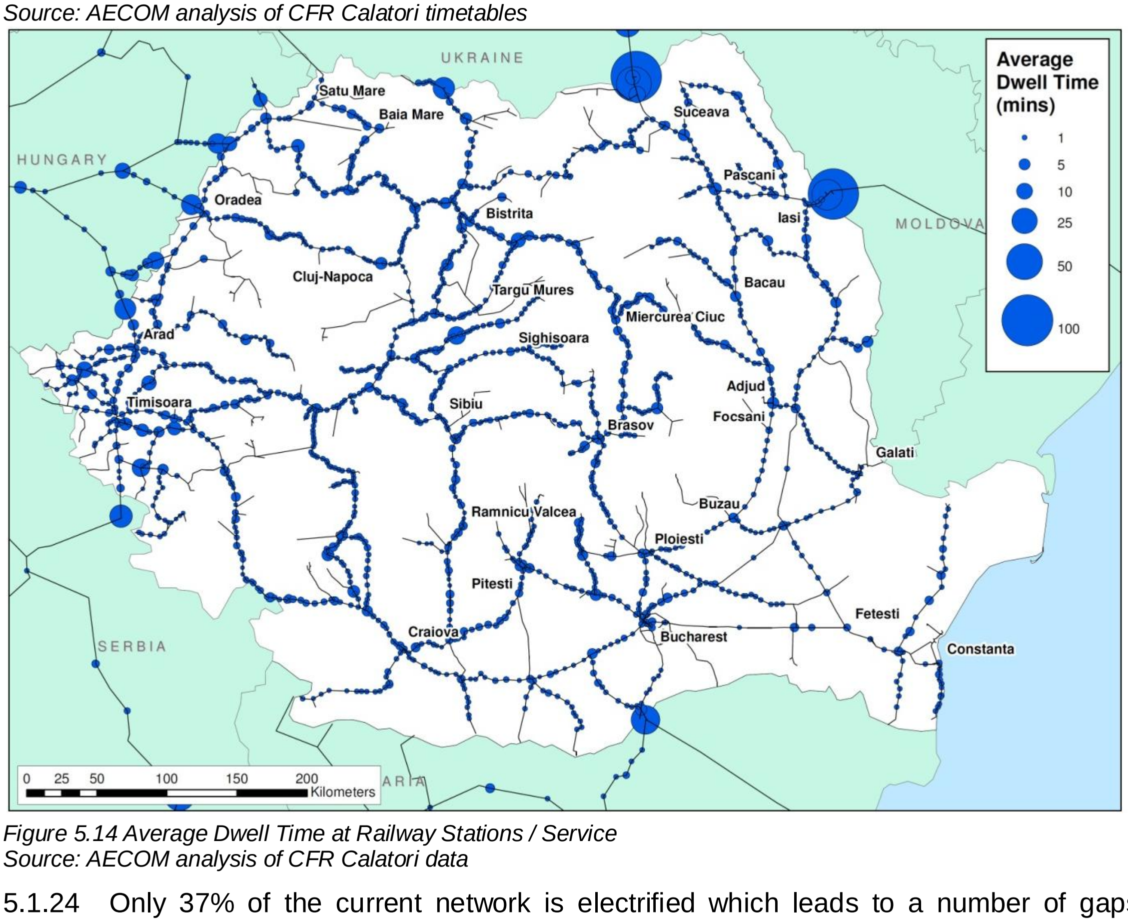


Figure 5.14 Average Dwell Time at Railway Stations / Service
Source: AECOM analysis of CFR Calatori data

5.1.24 Only 37% of the current network is electrified which leads to a number of gaps resulting in traction changes and means journey times are extended. One of the main gaps is Cluj Napoca to Oradea, whilst other gaps include Caracal to Craiova, Iasi to Barlad, plus the line serving Botosani, Piatra Neamt, Baia Mare and Satu Mare.

Rail Journey Times

5.1.25 Figure 5.15 illustrates the generalised rail journey time contours to Bucharest. This dataset represents travel time spent on the train, as well as the impact of the irregular frequencies discussed earlier. Craiova, Pitesti, Buzau and Predeal have a GJT less than 400 minutes to Bucharest. The GJT from Cluj to Bucharest is over 1,000 minutes, whilst the time period from Satu Mare, Baia Mare, Oradea and Arad is over 1,200 minutes.

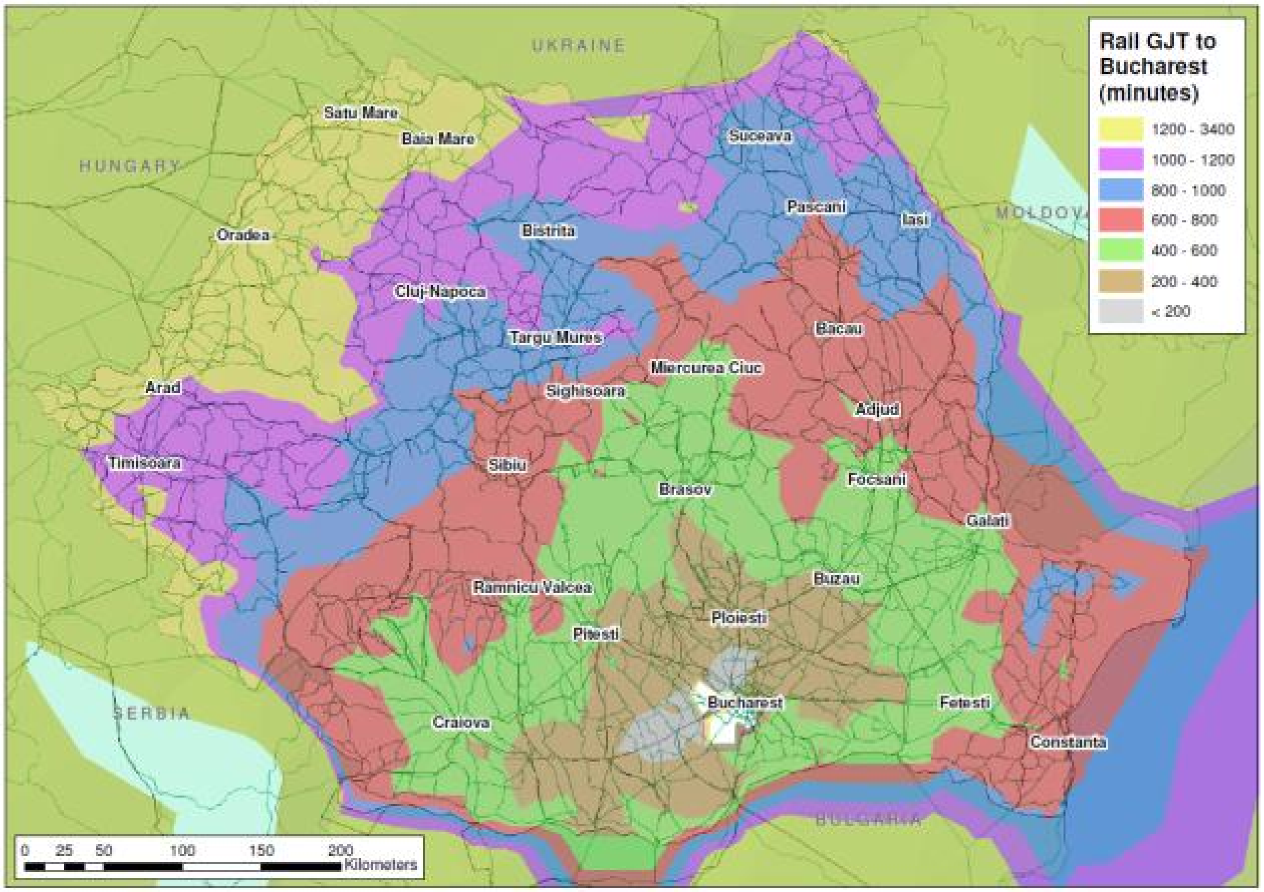


Figure 5.15 Generalised Rail Journey Times to Bucharest

Source: AECOM analysis of Romanian National Transport Model

Passenger Rolling Stock

5.1.26 There are two key issues affecting rolling stock. Firstly, the deployment of units is generally inefficient, for example the Bucharest - Constanta trains layover for up to five hours between services. This reduces the utilisation of rolling stock and means a larger fleet size is required. Large gaps between passenger services results in the relatively inefficient deployment of rolling stock. There are substantial scope to improve the operating efficiencies of both train sets and the crew, thus creating opportunities to generate additional revenue. Figure 5.16 compares the turnaround times for the Bucharest to Constanta route with other European examples

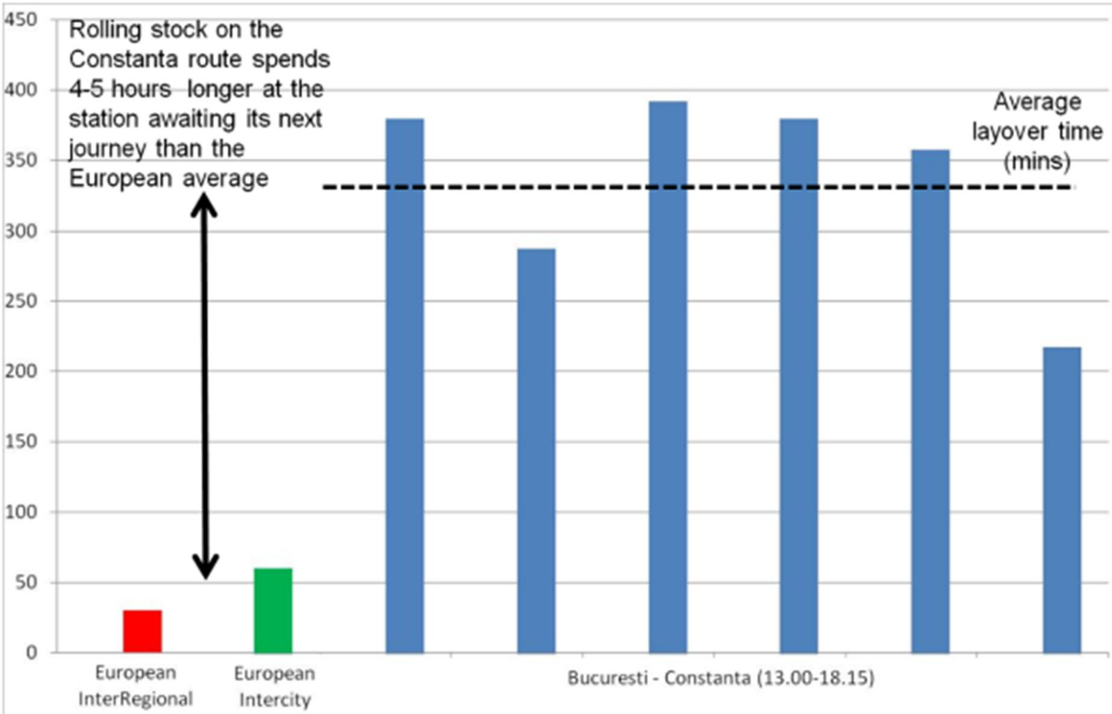


Figure 5.16 Comparison of Turnaround Times (minutes)

Source: AECOM analysis of CFR Calatori data

5.1.27 The second issue is the age of the rolling stock fleet. The average age of the units is about 35 years, although some units are over 60 years old. Although the Romanian diesel multiple unit units have an average age of over 60 years, less than one-third are required for daily service. Several other types of unit including loco-diesel electric, loco-diesel, and EMUs have an average age greater than 30 years, yet have an utilisation rate less than 60%. Table 5.4 summarises the information.

Table 5.4 Summary of Passenger Rolling Stock Availability (2013)

Type	Inventory	Necessary	% in use	...of which new / refurbished	Averag e age	Speed range (km/h)
Loco-electric	363	282	78%			
Loco-diesel electric	244	133	55%	59	36	100-120
Loco-diesel	185	103	56%	18	36	100
DMU (Desiro)	120	89	74%	120	8	120
EMU	19	19	100%	19	42	120
DMU	143	74	52%	30	64	70-120
Total	1066	700	66%	295	35.4	

Source: Information from CFR Calatori.

5.1.28 The relative age of the rolling stock contributes to the low utilisation. Older fleets are generally less reliable, and require higher maintenance inputs to deliver a similar service compared with an operation using a more modern fleet and means a surplus is retained. Old rolling stock is less attractive to passengers. It is understood that a lack of spare parts and low levels of investment in maintenance have also contributed to this outcome. The utilisation of passenger rolling stock is about 65%, compared with the 85-90% which is normally achieved in other European countries. In the case of the newer, eight year old, Desiro trains less than 80% of the fleet is required to operate the currently scheduled services. It is understood that a programme of wheel modifications is currently underway, and this has reduced the number of units available. Once these have been completed, fleet productivity should increase.

5.1.29 It is notable that the railway network in Romania has experienced a reduction in the total train kilometres of 10% since 2008 while, over the same period, there has been a rise in the number of units of 10% required to operate the network. This is mainly due to the increased rolling stock average age, and additional speed restrictions which have been imposed following maintenance issues. Both factors constrain the productivity of the fleet. The high average age of units, with high maintenance requirements and thus low utilisation, explains the requirement for an increased fleet size. The low utilisation rates mean almost 240 extra units are required to operate the current timetable.

5.1.30 The use of loco-hauled passenger trains composed of just 3-4 carriages is very cost-inefficient when compared with DMU or EMU operation. Loco-hauled services also create inefficiencies at terminal stations where incoming locos are ‘trapped’, and therefore inactive, at the head of incoming trains.

Freight Rolling Stock

5.1.31 A high proportion of CFR Marfă’s stock is in poor condition although it is understood from interviews that relatively few units held by private rail operators are obsolete. The average age of a CFR Marfă locomotive was around 33 years and 30 years for wagons. Only 370 out of the 907 locomotives were active in 2012, with just less than 60% of wagons used. Much of the operational fleet is not suited to the emerging markets, including the expanding intermodal sector. There is a large monetary value associated with both the scrap metal of abandoned rolling stock and the track it’s stored on. The rolling stock fleet is shown in Table 5.5.

Table 5.5 Summary of Freight Rolling Stock Availability (2013)

Rolling stock for CFR Marfa		***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Rolling stock CFR Marfă	Locomotives	991	956	907	907	907	907
	Wagons	50,151	42,925	41,754	39,741	39,149	38,498
Active rolling stock CFR Marfă %	Locomotives	44.9%	40.1%	26.8%	24.8%	42.2%	40.8%
	Wagons	*	*	*	*	*	59.9%

Source: Rail Directorate - MT

5.1.32 Old rolling stock will invariably require more maintenance, be less reliable with unscheduled maintenance required. Furthermore, the availability of spare parts has been reduced. There is also a shortage of open hopper wagons. A further constraint is the axle weight limit which is just 20.5 tonnes and less than many other EU countries (22.5 tonnes). As a result, payload per wagon is reduced and means it requires a greater number of wagons to move the equivalent quantity of goods. This is problematic for trains crossing borders or using other routes in Romania, which have to use the lowest weight limit in order to remain legal throughout their journey. Although some rehabilitated lines have been upgraded to 22.7 tonnes, a train in Romania that uses non-rehabilitated routes or makes cross border journeys will travel for much of its journey using the lower weight limits.

Maintenance and Renewals Regime

5.1.33 The spending required to keep the railway network in a good condition are categorised under two headings: maintenance and renewals. These terms are defined in this section, together with an assessment of the current and forecast spending under these two categories. Maintenance is ongoing expenditure to ensure the safe use of an infrastructure item. The 'steady state' level of maintenance ensures that the infrastructure item continues to be used to the standard it was built, for example ensuring trains are able to travel safely at the design speed of the network. If maintenance falls below the steady state level, its condition will deteriorate leading to less efficient use and operation, commonly the imposition of speed restrictions, either at specific points or over longer sections of track, or in extreme cases, line closures.

5.1.34 Recent investment in railway infrastructure has not yielded journey time improvements along the main routes. For example, journey times between Bucharest and Constanta remained relatively static between 2001 and 2012 despite significant investment to rehabilitate the line. This calls into question the value of infrastructure investment, and highlights that there are other institutional and organisational barriers that exist which do not allow rail to fulfil its potential. For example, in 2001 freight trains were allowed to run at a maximum speed of 120km/hour where the track was suitable, but a safety-related blanket restriction has been imposed at 80km/hour on all freight on all routes including rehabilitated lines. This is currently being reviewed for the 2013/14 timetable and may, under certain operating circumstances, facilitate increases in line speeds. Figure 5.17 illustrates the 'before' and 'after' situation for a corridor which has benefited from a rehabilitated route.

Figure 5.17 Example of Pre and Post Rehabilitated Networks

5.1.35 Recent information from CFR Infrastructure indicates maintenance expenditure was €342.72m (2010), €320.90m (2011), €314.99m (2012) and €324.32m (2013). It is uncertain whether this level of funding will be continued. For example, CFR SA previously produced data which implies that the maintenance budget between 2013 and 2020 would be €958m, an average of €137m per year. Between 2020 and 2030, a maintenance budget of €1,368m is assumed, equating to €137m per year.

5.1.36 All infrastructure items have a defined life expectancy (for example: a bridge may be 60 years) and require replacement. A long-term programme of ongoing renewals of infrastructure items each year is also required in order to ensure that the amount of infrastructure that is life-expired is reduced and eventually removed. This, combined with the steady state maintenance and repair programme, will ensure that speed restrictions do not start to materialise again and trains operate and continue to do so at the maximum possible operating speeds. Recent information from CFR Infrastructure indicated the following expenditure in €17.55m (2010), €9.97m (2011), €8.34m (2012) and €12.36m (2013).

5.1.37 The condition of the infrastructure has deteriorated with the combination of a lengthening backlog of maintenance and renewal, resulting in lifetime expired assets, speed restrictions and decreasing average speeds over the network. By 2012, about 65% of the track, 80% of the turnouts, 85% of the overhead catenary, 66% of the embankments and 40% of the bridges appear to be life expired and require renewal (“capital repairs”). This reinforces the conclusion that recent renewals expenditure has been completely inadequate. Locally controlled signalling systems are in place across much of the network. This results in high staff and maintenance costs to operate services with high fixed costs, even if service frequencies are low.

5.1.38 The lack of current funding for maintenance has resulted in 1,800 temporary speed restrictions being imposed, which in turn result in slower overall journey times. There were 3.18 million delay minutes in 2012, with speed restrictions accounting for over one-third of this total. These restrictions particularly impact on passenger services. Figure 5.18 presents the annual delay minutes affecting passenger services and the contributory factors between 2005 and 2010.

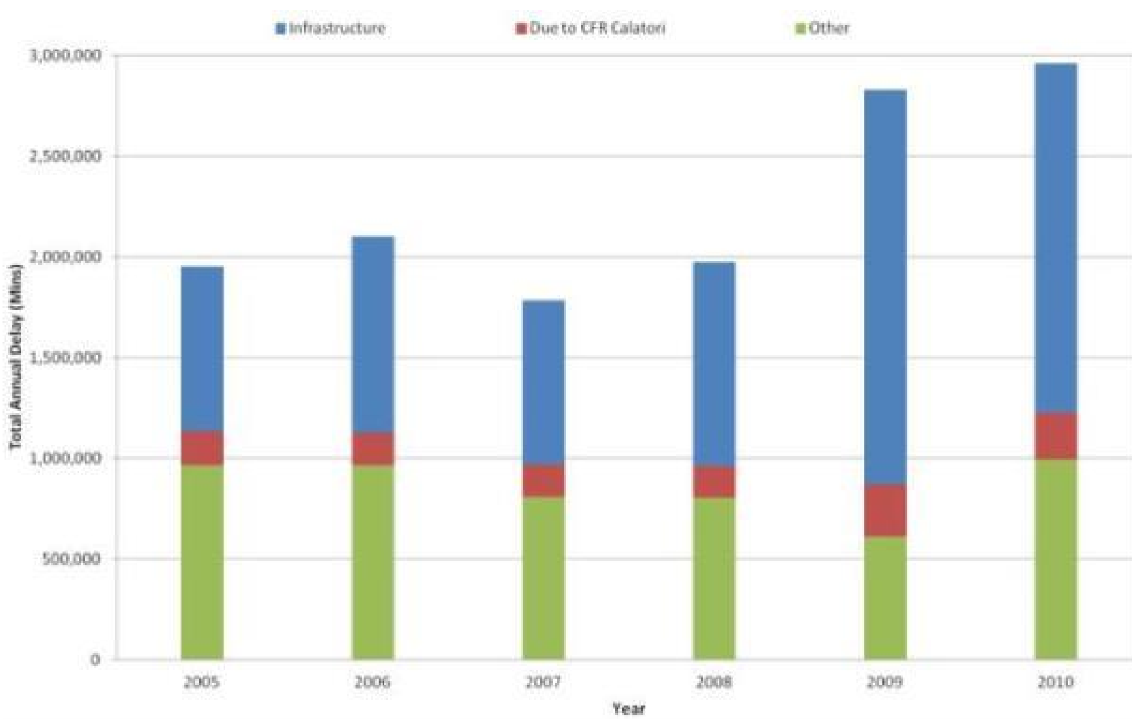


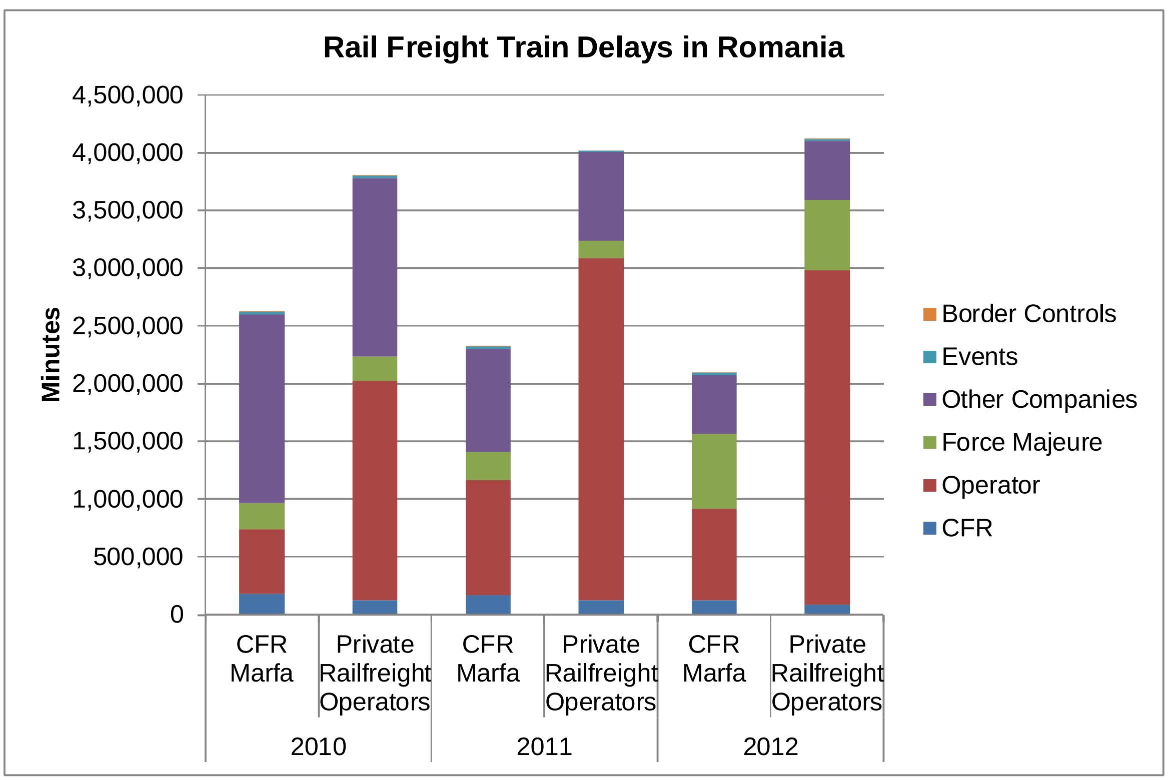
Figure 5.18 Summary of Total Annual Delay Minutes and the Contributory Factors – Passenger Services

Source: AECOM analysis of CFR Infrastructure and Calatori data

5.1.39 The delay minutes shown in Figure 5.16 are sub-divided into three categories, infrastructure related, CFR Calatori and other factors. There was some evidence of a reduction in delay minutes during 2011. However, although there was a 45% drop in delays, there is evidence that these reductions are due the introduction of revised timetables that featured extended journey times. At present, single track sections can be closed during the morning from 08.00 to about 13.00 for maintenance, whilst there is a requirement for single track working on double track routes for similar reasons. This either results in lengthy gaps in services that use single line sections, or longer journey times on other parts of the network as a result of single line working. A review operating practice in Hungary and Poland as case studies26 demonstrates that routes do not close for an extended period during the morning for maintenance. Furthermore, these lines are generally served by a higher frequency than five trains per day.

5.1.40 Selected parts of the network are impacted by regular and ongoing theft of cables and other equipment, particularly on the Constanta corridor. This has had a significant adverse impact on service reliability. Furthermore, the response has been a reduction in the operating speed, or inclusion of additional time in the timetable to take account of the repairs to the signalling systems.

5.1.41 Despite this, Figure 5.19 demonstrates that CFR Marfa experiences fewer delays than private operators and that the most significant cause of delays associated with the state operator is other operators. Private operators experience over twice as many delays as the state operator, with the most significant primary cause being the operator itself. The figures also show that delays associated with CFR Marfa are in decline, whilst those associated with private operators have risen between 2010 and 2012.



[26] Polish examples were Gdansk to Szczecin, Wolow to Glogow and Gorzow to Pila. The Hungarian examples were Debrechen to Puspokladany, Hodmezovasarhely to Bekesasaba and Pecs to Szekszard

Figure 5.19 Summary of Total Annual Delay Minutes and the Contributory Factors – Freight Services

Figure 5.20 demonstrates the average delays at Constanta compared with other locations in Romania. This indicates delays are much more significant in the area around the port than other parts of the country.

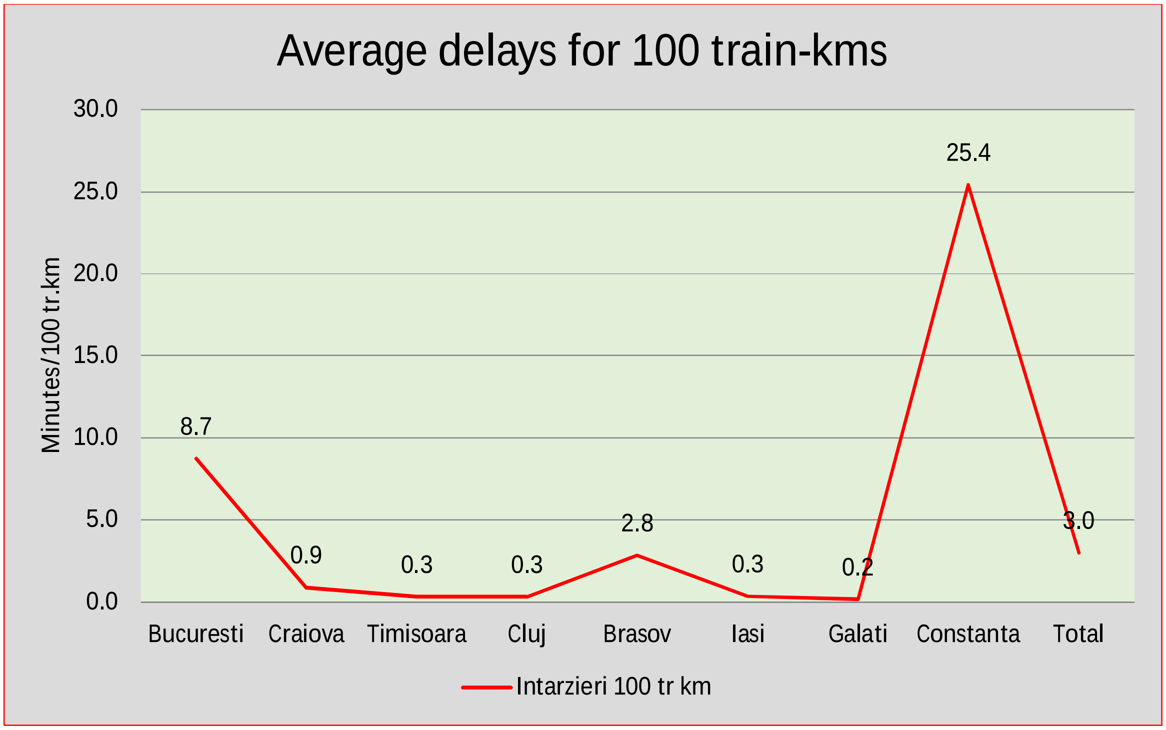


Figure 5.20 Average Minutes Delays per 100 train / kilometres

Labour Efficiency

5.1.42 In the last decade there has been a considerable improvement in labour efficiency. However the ratio the ratio of operating costs per employee has risen by around 20% during the last 5 years, whereas the ratio of passenger kilometres and freight tonne kilometres is significantly lower compared with examples in Western Europe.

5.1.43 Staff numbers employed by CFR Calatori have reduced by 20% between 2005 and 2012. The ratio of passenger trips to staff numbers has dropped by 10% between 2009 and 2013, the ratio of passenger kilometres to total staff has dropped by 24%.

5.1.44 There is considerable scope to further improve efficiencies if staff numbers were rationalised and alternative methods of train control delivered. A progression towards centralised signalling for the main lines, with radio controlled operations on branch lines, would enable staff to control services over a larger geographic area would help to address the current constraints.

5.1.45 On an average day, there were about 223,000 train kilometres (2012). This comprises 80% of services operated by CFR Calatori, with the remainder operated by private operators. Of the latter, Regiotrans is the largest private operator which provides a wide range of services, mainly on branch lines, though some services are also operated on the other routes. Based on a network covering 10,820 kilometres, and 70.7m train kilometres per annum, this equates to about 20.9 trains per route kilometre each day. Whilst this total is broadly comparable to the statistics for the Hungarian network, it is much lower than the totals for the Netherlands (134 trains/route-km), UK (95 trains/route-km) and France (47 trains/route-km)27.

5.1.46 In the last decade there has been a significant improvement in labour efficiency affecting CFR SA as shown in Table 5.6. The number of CFR SA employees has almost halved between 2002 and 2011, whereas the size of the network is virtually unchanged. This implies that the ratio of employees per route kilometre which could be used as a measure of labour productivity, demonstrates a reduction from 4.12 employees per route kilometre in 2002 to 2.21 in 2011. This equates to a 46% improvement in labour productivity. There may be further scope to achieve efficiency savings if other changes are introduced, for example, centralised signalling control.

Table 5.6: CFR SA Employees per Route Km

Year	Number of Employees	Route km	Employees / Route km
2002	45,337	11,002	4.12
2003	35,896	11,077	3.24
2004	33,003	11,053	2.98
2005	28,006	10,948	2.56
2006	28,189	10,789	2.61
2007	27,951	10,777	2.59
2008	27,610	10,785	2.56
2009	26,830	10,784	2.49
2010	24,993	10,785	2.32
2011	23,839	10,777	2.21

Source: Eurostat, CFR Consolidated Financial Accounts 2002-11

Public Service Contracts

5.1.47 Public Service Contracts are awarded to CFR Calatori and to organisations to operate rail services which CFR Calatori has recently declined to operate. A number of private bidders are then invited to submit proposals to operate trains based on a minimum service specification. These contracts tend to be described in a relatively prescriptive manner. The private sector operators receive a payment based on the train kilometres operated. If services are cancelled, the operator is not paid for running these trains. The Ministry of Transport has recently announced changes to the payments to private sector operators, with the 20% of the compensation linked to the total passenger kilometres, and the remaining 80% based on train kilometres. Furthermore, the payment rates for passenger kilometres have been significantly reduced, although this impact has been partially offset by a rise in payments for train kilometres. This approach applies to services both on secondary branch lines, and trains using the main lines. Private sector operators pay track access charges to CFR SA if their trains run on the interoperable lines but receive no compensation for delays caused by infrastructure or other operator's defects. On non-interoperable routes, these private companies maintain the track themselves (via a sister company).

[27] IRG – Rail Marketing Monitoring Report February 2013

5.1.48 The payment of public subsidy is dependent on a specified number of trains being operated. With the closure of some routes during the morning for maintenance requirements, this necessitates a requirement to run some trains overnight to ensure the train mileages are met. This means many services attract very few passengers.

Availability of Redundant Land

5.1.49 The number of train services previously operated in Romania required significant amounts of land for stabling rolling stock and conducting maintenance activities. The reduction in train services and other efficiency savings mean the land requirements are significantly reduced and hence there is considerable scope to re-use this now redundant land for other purposes, for example, office development or retail. This opportunity is particularly relevant in the larger population centres if the parcels of land are located adjacent to the city centre or the main road network since the value of these sites would be greater. This proximity to the major office developments in the city centre or the principal road network for retail activity would improve the attractiveness of the site to be sold for such uses. Similarly, it may also be possible to sell an existing stabling area adjacent to the city centre for commercial activities if an alternative site elsewhere could be identified which would offer a positive financial case. It is understood that the ownership of railway land is relatively complex, involving the State, CFR-SA and private owners. Land has been gifted to the State by CFR-SA to help re-pay former debts, but this arrangement means the infrastructure operator has little or no commercial incentive to identify potential schemes.

Safety

5.1.50 The final topic examined in this problem identification section is the overall levels of safety, since this forms an overarching theme. Although the number of fatalities involving passengers or railway employees is relatively low when expressed in terms of numbers per billion passenger kilometres, there are still a relatively high number of deaths due to suicides and other incidents at level crossings. There were 79 rail-related fatalities (all deaths occurring on railway property) per billion train kilometres between 2007 and 2011. This is almost four times higher than the EU average, and the 4th highest rate overall, as demonstrated in Figure 5.21.

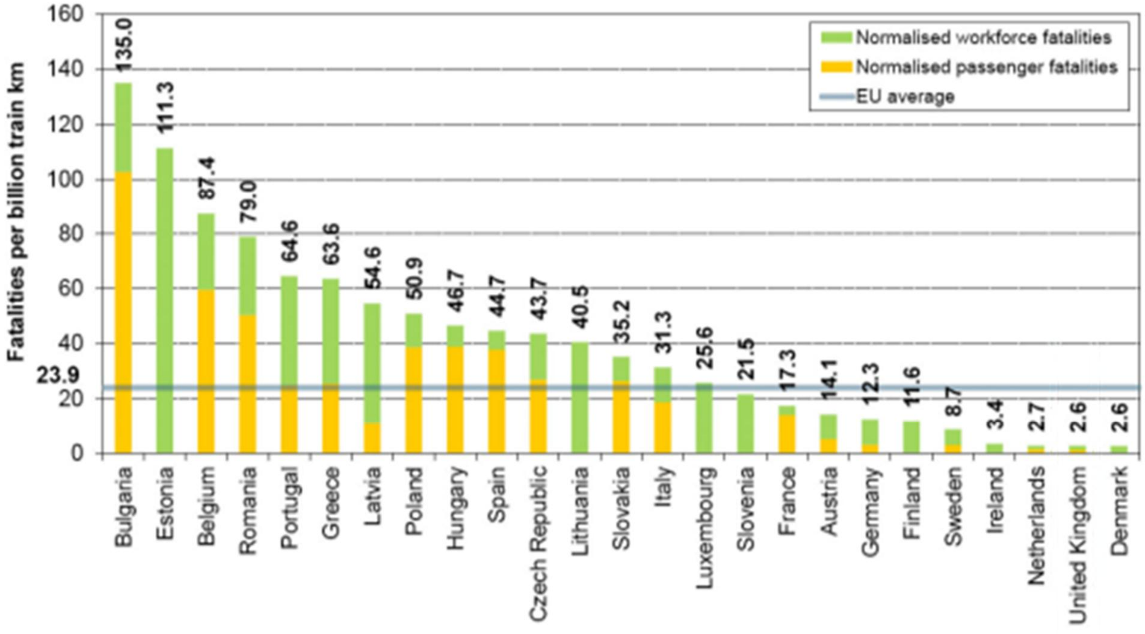


Figure 5.21: Comparative Number of Fatalities (per billion train kilometres)

Source: European Union information, printed in the Guardian 13 May 2013

5.2 Road Competition

5.2.1 The rail journey times have been compared with road to assess the relative competitiveness of each mode to Bucharest. The results are presented in terms of a journey time contour. There are very few areas of Romania where the difference in journey time between rail and car is less than 50% as shown in Figure 5.22. Furthermore, large areas of Romania have a rail GJT to Bucharest which is at least double compared with the equivalent by car. The corridor to Craiova from Bucharest, plus parts of Corridor IX towards Suceava, has rail journey times which are only 50% slower than car. The relatively slow parallel road corridors have influenced this outcome, rather than these rail services being notably faster than in other parts of the country. This analysis also highlights network gaps which necessitate a longer journey by rail, for example, the route from Bucharest to Ramnicu Valcea and Sibiu is currently via Brașov, when the actual crow-fly distance is much shorter. In summary, rail journey times to a number of cities from Bucharest to a number of cities, such as Sibiu, Cluj-Napoca, Oradea, Baia Mare, Satu Mare and Timisoara are significantly higher than road which is the main competing mode. A combination of factors contributes to this outcome. These are:

- o the numerous intermediate stops which result from rail trying to fulfil multiple functions, as well as linking the largest towns and cities in Romania, these trains serve smaller catchments, and also provide connections to the nearest regional centre;
- o the extended dwell times at some intermediate stations; and
- o the inadequate maintenance regime also contribute to the slower rail journey times.

5.2.2 The overall impact is that, for those travellers with a choice, rail is less convenient for accessing job opportunities, visiting friends and relatives or leisure trips including holiday travel.

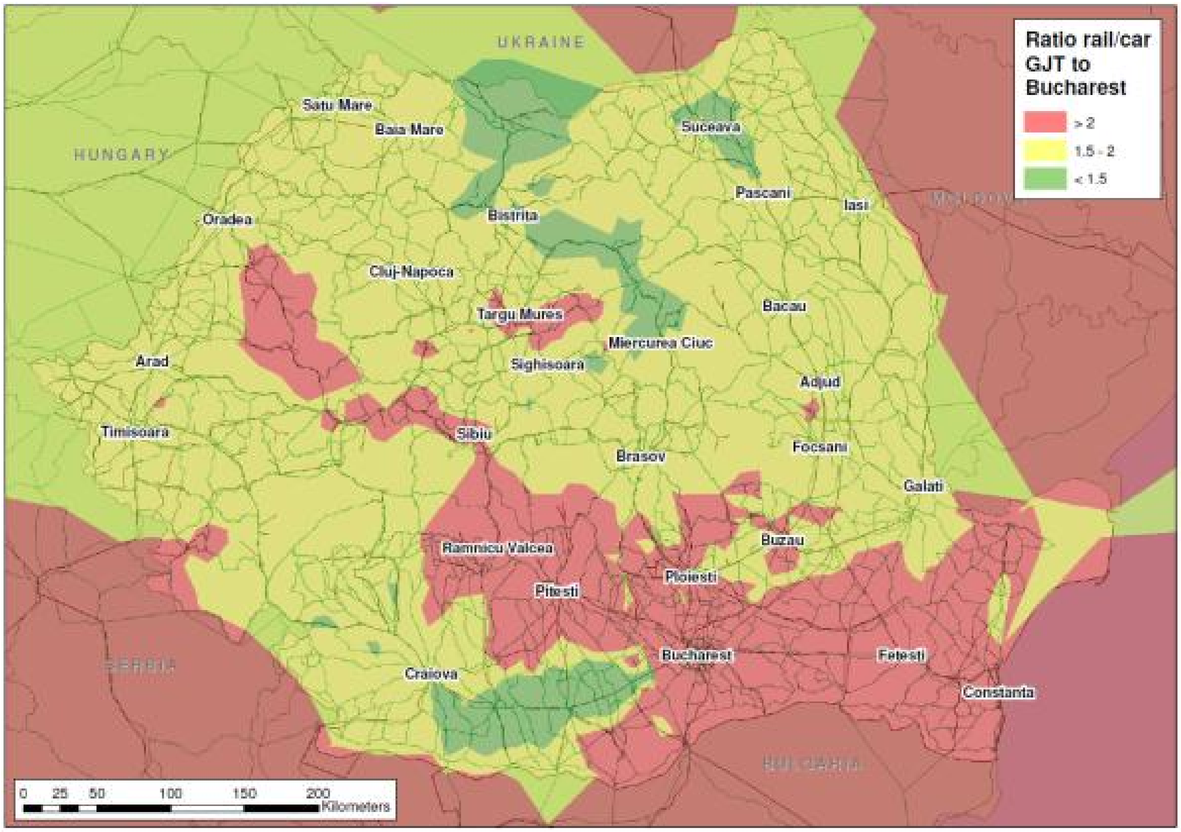


Figure 5.22 Comparison of Generalised Journey Times by Rail and Road to Bucharest

Source: AECOM analysis of Romanian National Transport Model

5.2.3 Figure 5.23 presents the rail mode share, the total number of daily non-rail trips, the ratio of rail journey time versus car, the average rail speed and the average rail headway for the main corridors. Link flows are also illustrated.

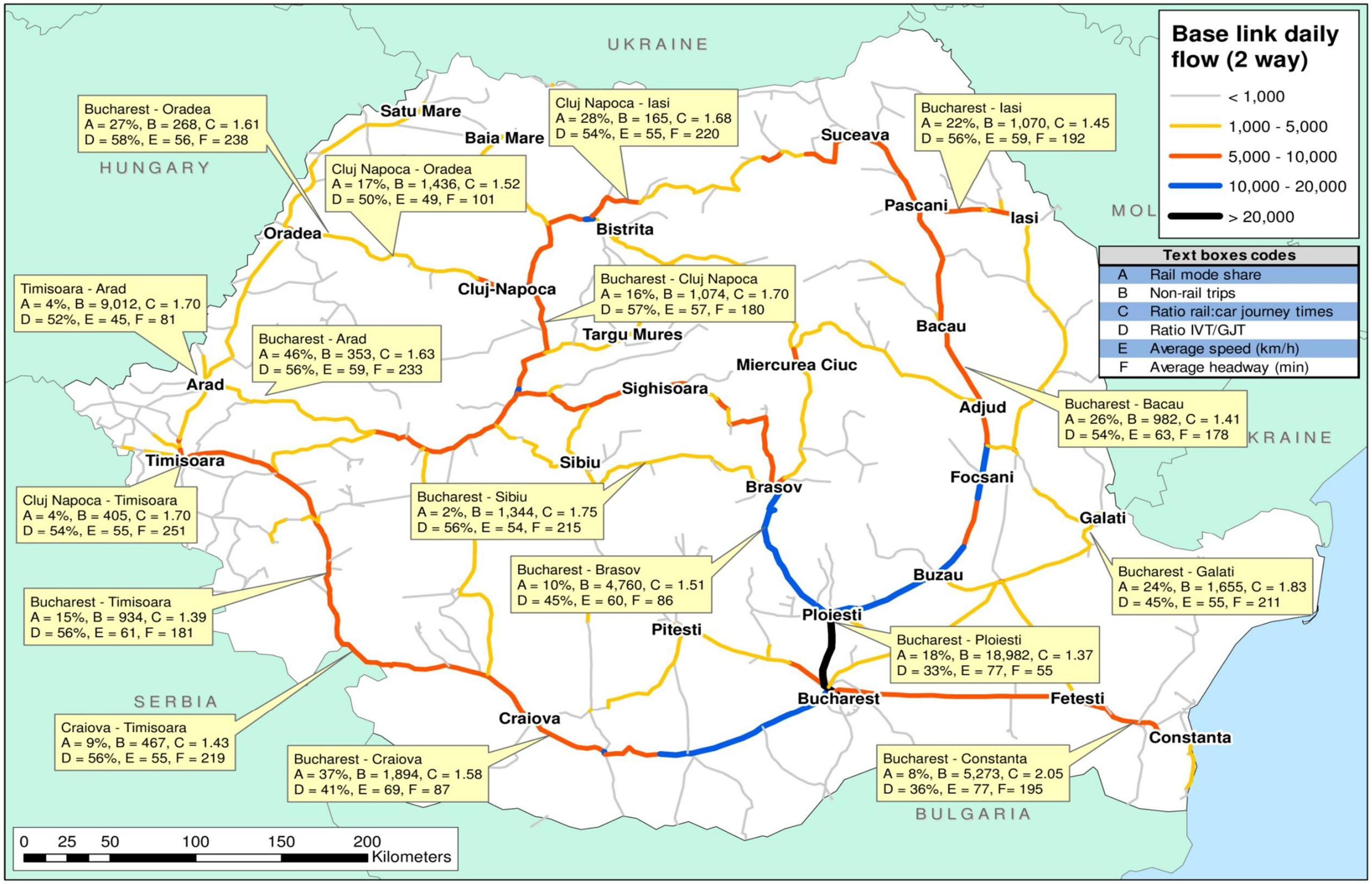


Figure 5.23 Summary of Baseline Data for Selected Corridors

5.3 Strategic objectives

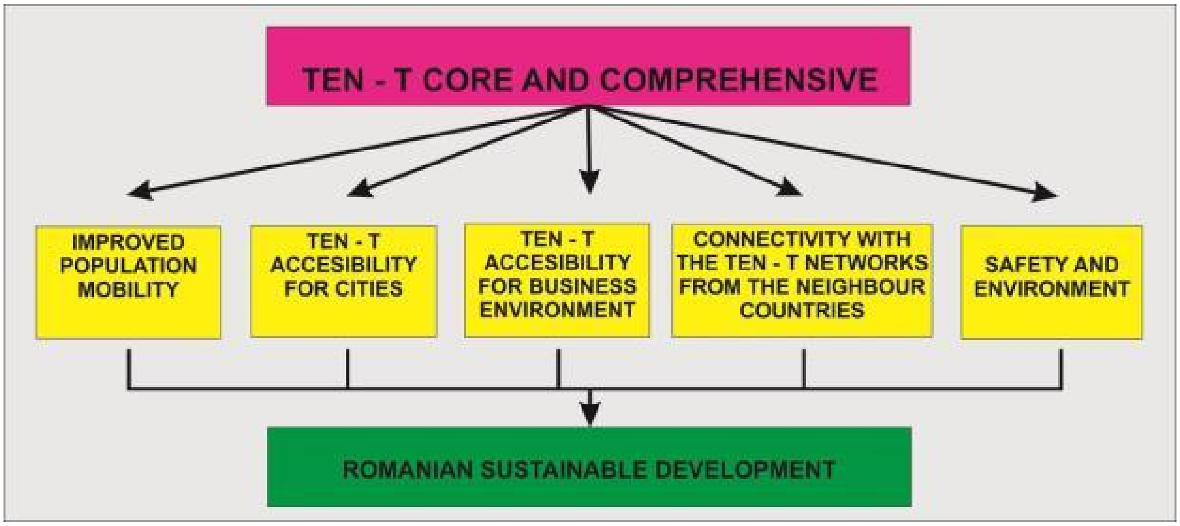


Figure 5.24 summarises the overarching objectives for the TEN – T Core and Comprehensive networks

5.3.1 Ensuring a sustainable, economically efficient, flexible, environmental friendly, safe and balanced rail network that integrates with other modes and is compatible with TEN–T Core and Comprehensive networks plus other EU strategies and regulations is an overarching objective. The General Objective will be achieved through the following ways:

- Common Objectives setting for all modes;
- Specific Objectives setting for each mode.

5.3.2 Five more detailed objectives have also been defined including:

- Economic Efficiency: a transport system that generates benefits that are greater than its costs;
- Equity: the costs and benefits of the transport system should be distributed fairly among citizens, industries and geographic areas;
- Safety: the transport infrastructure and services should be provided in a manner that protects people from death and injury;
- Integration: the transport system should enable people to travel conveniently and reliably using a combination of different modes of transport, and to minimise the costs of transporting goods;
- Environment**:** the transport system should protect the environment and by so doing should support social and economic development for the benefit of today's and future generations.

5.3.3 In addition to the strategic objectives identified, a number of operational objectives were also collated. These objectives were informed by the problems identified by the baseline analysis. These operational objectives were grouped into themes:

- OR1: Reform radically the system as to establish a sustainable framework for development;
- OR 2: Focus the scarce maintenance and development resources on a reduced sustainable network;
- OR 3: Establish a competitive and commercial framework for passengers operations;

- o OR 4: Establish a sound performance accountability system;
- o OR 5: Improve the management efficiency of the rail companies and thus the financial sustainability of the system.

5.3.4 As well as the generic operational objectives, the following corridor specific operational objectives have also been identified to improve the competitiveness of passenger rail services:

- o OR 6 Bucharest to Arad/Cluj via Brasov and Teius;
- o OR 7: Bucharest to Constanta;
- o OR 8: Bucharest to Arad via Craiova and Timisoara;
- o OR 9: Bucharest to Iasi via Bacau, and Buzau to Galati;
- o OR 10: Bucharest to Sibiu via Pitesti and Ramnicu Valcea;
- o OR 11: Cluj-Napoca to Iasi;
- o OR 12: Cluj-Napoca to Oradea: including electrification and line doubling;
- o OR 13: Oradea to Timisoara;
- o OR 14: Oradea to Baia Mare, and Satu Mare to Cluj-Napoca via Baia Mare.

5.3.5 The selection of the corridors described above reflects current traffic levels as well as taking account of the requirements of Regulation no 1315/2013 of the European Parliament on the development of the trans-European transport network. The components of the projects takes account of the mandatory elements of the legislation which include infrastructure enhancements, signalling improvements, electrification, and the operation of high quality rolling stock. If the economic assessment demonstrates that some components of each package are deemed to be uneconomic, exceptions will need to be sought from the Commission.

5.3.6 To address the uncompetitive rail services, the corridors were identified and analysed in terms of rail mode share, total travel market, understanding the components of overall generalised cost including journey time and headway.

5.3.7 Table 5.7 summarises the main problems using supporting evidence, with the operational objectives described above ‘mapped’ to the issues. The proposed interventions and their suitability for testing using the National Transport Model are also shown.

Table 5.7: High Level Objectives and Supporting Evidence for Passenger Rail and Freight

High level objective	Problem			Summary of supporting evidence / metrics	Operational objectives		Intervention(s)	Testing plan			Project intervention / reference number
	No.	Theme	Description		Description	Ref	Description / Alternatives	Suitable for testing	Type of project to be tested	Level of aggregation to be tested	
Sustainability	General		The railway sector in Romania is in crisis. Since 1990 there has been a severe and continuous decline in all the key performance indicators. Unless the system is radically reformed the investments in infrastructure upgrade have no actual benefits. There is a complex of problems behind the crisis, which are grouped under the following sub-themes.	See Existing Conditions Report and Problem Definition Report.	Reform radically the system as to establish a sustainable framework for development.	OR 01	A comprehensive reform package to be implemented as soon as possible (its key components being presented below). To this end a Rail Reform Agency should be established by 1/01/2015 under the authority of MoT to implement the radical reforms required and then evolve in a permanent rail public transport authority. The Rail Reform Agency should seek top international expertise support via TA and also possibly by an IFI advisory task force.	No	No	N/A	DS12A
Sustainability	(1)	Infrastructure sustainability	The current network size faces a substantial and growing disparity against both the demand and the financial resources available to maintain and operate it.	• 90% of the traffic is carried by some 54% of the routes (63% of track-km). • The resources actually spent annually in total for maintenance and renewals are less than 40% compared to what would be needed under a normal regime for the size of the network in operation and less than 20% as compared to what is actually required considering also the renewal backlog. • Whilst traffic volumes reduced by 93% since 1990 the network size reduced only by 5% over the same period. • The network reduction practice in Romania is actually ineffective as even after a line is cut from the "interoperable" network and classified as "non-interoperable", it does not stop being financed out of public funds.	Focus the scarce maintenance and development resources on a reduced sustainable network.	OR 02	1. The classification into "interoperable" and "non-interoperable" lines should be replaced (by modifying the relevant legislation) with a clearer structure based on: • A primary network defined as being of national public interest based on clear routes including both infrastructure and passengers operations. If a route is defined as being part of the public service it shall be subsidised/compensated both for infrastructure and (where relevant for passengers services) for operations. • A secondary network which is not of national public interest (which could however be of local interest and thus taken over partially or entirely and subsidised e.g. by county or municipal authorities). Once excluded from the national public service no state funding will be possible and in cases where the line cannot be transferred either to local authorities or to private operators it will be automatically closed and could not return to CFR Infrastructure ownership. 2. The primary network should be limited to approx. 60% of the current track-km size (as per indicative map annexed in the Rail Note), however this should be fine-tuned within a detailed closure programme (to be supported by a dedicated TA including more detailed market and financial sustainability analysis).	Yes	Proposed network following identification of optimal routes	Revised network	DS13A

High level objective	Problem			Summary of supporting evidence / metrics	Operational objectives		Intervention(s)	Testing plan			Project intervention / reference number
	No.	Theme	Description		Description	Ref	Description / Alternatives	Suitable for testing	Type of project to be tested	Level of aggregation to be tested	
							3. Increased budget spending from approximately 350 M€/year to some 500 M€/year for the regular maintenance and renewals regime of the primary network. On this basis a rolling renewal programme covering 200-250 track-km every year shall be initiated. This should be ensured through a long-term Government commitment.				
Sustainability	(2)	Passengers Operations	The passenger services rail business is uncompetitive and largely uncommercial. The services are generally not profitable, therefore services exist only through subsidies from the Ministry of Transport under public service contracts (PSC). The PSCs are not competitively tendered but directly awarded to the operators and CFR Calatori is awarded approx. 85% of the services (2011).	The lack of competitive environment combined with a lack of business/market orientation, which is not encouraged by the terms of the PSC, and the lack of performance accountability, has led to service levels even lower than the condition of the infrastructure allows. This is evidenced by: • Poor availability & irregular timetables with up to 7 hours gaps between services during daytime. • Significantly longer travel times generated by extraordinarily high stopping time in stations – up to 50% of the overall travel time. • Poor quality of rolling stock: 87% of the locomotives are older than 20 years and 82% of the coaches are older than 25 years. The in-house maintenance approach (employing some 7,000 staff) appears to be very inefficient; for example 40% of the new Desiro DMUs fleet went out of service in less than 10 years. • Poor utilisation of available rolling stock: turnaround times of up to 5 hours. • High train operating costs generated by (i) energy inefficient old large locomotives and (ii) the poor productivity of the rolling stock. • Relatively high fares - as	Establish a competitive and commercial framework for passengers operations	OR 03	1. Define clear level of service requirements - limited to the primary network above (including attractive frequency, performance indicators, etc.) and tender openly on this basis the public service contracts (for example by lines, service groups or regions, possibly including the operation of the stations on the respective lines). Review the scope for in-fill electrification for selected routes. There is potential for the proposed new enhanced service specification to be operated using fewer rolling stock units compared with the current timetable assumed improved rolling stock utilisation. The target for tendering the PSC is 2016, in view of starting the new services in 2017. The process should be managed by the Rail Reform Agency and supported by a dedicated TA. 2. Procure a set of high quality rolling stock (e.g. EMUs, including possibly tilting sets) to be made available to the operators as part of the tender for the public service contracts. Procurement to be possibly structured to include a long-term maintenance contract to avoid the bad experience with the Desiro DMUs fleet. 3. In order to ensure a level playing field for all bidders a rolling stock/assets leasing company (ROSCO) should be established under the ministry (or alternatively the Rail Reform Authority could undertake this role directly) which would procure the new rolling stock and take over the old assets upon expiration of the operation contracts (e.g. in 2016 from CFR Calatori) and make it available to the next coming operators resulting from the open tender.	Partially	Regular interval timetable, introduction of new rolling stock tested using the model. Impact of a revised ticket structure will not be testing using the model	Rolling stock / timetable interventions will be tested for individual corridors	DS14A

High level objective	Problem			Summary of supporting evidence / metrics	Operational objectives		Intervention(s)	Testing plan			Project intervention / reference number
	No.	Theme	Description		Description	Ref	Description / Alternatives	Suitable for testing	Type of project to be tested	Level of aggregation to be tested	
				compared with prices in France, Germany, Italy or Spain – and substantially higher than of the competing local bus services. • Poor services in stations – even the large stations rehabilitated/modernised under various financing programmes are passengers unfriendly, commercially unattractive and poorly maintained.							
Sustainability	(3)	System regulation & organisation	The regulatory, organisation and management systems currently in place fail to ensure any of the following fundamentals: (i) Accountability for performance in the system. (ii) Efficient allocation of the scarce public resources. (iii) Competitive environment for the passengers services, (iv) Efficient and commercially oriented management of the state-owned companies.	See Existing Conditions Report and Problem Definition Report.	Establish a sound performance accountability system	OR 04	The relations between the public transport authority, CFR Infrastructure and the operators shall be restructured by: • Defining sound performance indicators for the public service parameters – automatically linked with the payment terms such as penalties from compensation for delays compared to the travel times defined in the public service contract. • Extending the same system to the regime between operators and infrastructure – automatically linking the payment terms including penalties from track access charges for delays generated by infrastructure compared to the travel times defined in the public service contract. • Force majeure circumstances to be clearly defined and limited, and regulatory authority to effectively supervise the application of the system.	No	N/A	N/A	DS15A
	(4)	Management efficiency	The management of the public rail companies is inefficient.	See Ministry of Transport Strategic Plan prepared with World Bank support, 2013	Improve the management efficiency of the rail companies and thus the financial sustainability of the system	OR 05	Re-launch the private management process, with a proper selection process of an efficient business management profile, ideally with experience in reforming similar rail companies elsewhere. 2. Audit of assets, operations and costs of CFR Infrastructure and CFR Calatori. 3. Cost-cutting programme in particular as regards: • Non-core business and assets • Excess of sidings • Excess of stations (e.g. 533 stations with less than 10	No	N/A	N/A	DS16A

High level objective	Problem			Summary of supporting evidence / metrics	Operational objectives		Intervention(s)	Testing plan			Project intervention / reference number
	No.	Theme	Description		Description	Ref	Description / Alternatives	Suitable for testing	Type of project to be tested	Level of aggregation to be tested	
							passengers boarding per day).				
Economic efficiency	(5)	Poor infrastructure and train services	Uncompetitive passenger services between the main cities of Romania because of low commercial speeds and poor frequency timetable resulting in rail market share below its potential.	Average commercial speeds of mostly in the range of 50-60 km/h (which is typically between 40-60% of the initial design speed in result of lack of appropriate maintenance & renewals). Average headway of 3-4 hours on many important city to city routes. Generalised costs higher by 50-100% as compared to the competing road transport routes. Rail passengers market share on the lowest performing routes down to 2% (Bucharest-Sibiu) as compared to 37% on the better serviced lines (Bucharest-Craiova).	Improve the competitiveness of passengers rail services on the route between Bucharest and Hungary via Brasov, Teius / Cluj	OR 06	Enhance service frequency with a regular interval timetable operating every 2 hours to Cluj from Bucharest, 0.5tph from Bucharest to Deva and 1tph Bucharest to Brasov. Raise the speed of the line to the design parameters (Fiches 038 and 057) Examine the scope to improve the efficiency of border crossings to reduce delays	Yes	Combination of timetable, rolling stock & infrastructure enhancements	Individual corridor	DS01A, DS01B
					Improve the competitiveness of passengers rail services on the route between Bucharest and Constanta	OR 07	Enhance service frequency with 2tph	Yes	Combination of timetable, rolling stock & infrastructure enhancements	Individual corridor	DS02A
					Improve the competitiveness of passengers rail services on the route between Bucharest and Arad via Craiova and Timisoara	OR08	Enhance service frequency with a regular interval timetable operating every 2 hours to Arad via Timisoara from Bucharest, 0.5tph from Bucharest to Craiova (1tph) and 0.5tph to Simeria via Craiova and Targu Jiu. Rehabilitation to enhance design speed (Fiche 045)	Yes	Combination of timetable, rolling stock & infrastructure enhancements	Individual corridor	DS03A, DS03B
					Improve the competitiveness of passengers rail services on the route between Bucharest and Iasi / Suceava / Galati	OR 09	Enhance service frequency with a regular interval timetable operating every 2 hours to Marasesti, Suceava, Galati, and Iasi via Bacau Rehabilitation to design speed Examine the scope to improve the efficiency of border crossings to reduce delays	Yes	Combination of timetable, rolling stock & infrastructure enhancements	Individual corridor	DS04A,
					Improve the competitiveness of passengers rail services on the route between Bucharest and Sibiu via Pitesti and Ramnicu Valcea	OR10	Enhance service frequency with a regular interval timetable operating every hour from Bucharest to Pitesti with alternate trains extended to Sibiu via a new link to Ramnicu Valcea	Yes	Combination of timetable, rolling stock & infrastructure enhancements including electrification	Individual corridor	DS05A
					Improve the competitiveness of passengers rail services on the route between Cluj Napoca and Iasi	OR11	Enhance service frequency with a regular interval timetable operating every 2 hours from Cluj to Iasi Rehabilitation to design speed (Fiches 056 and 057)	Yes	Combination of timetable, rolling stock & infrastructure enhancements	Individual corridor	DS06A, DS06B
					Improve the competitiveness of passengers rail services on the route between Cluj Napoca and Oradea	OR12	Enhance service frequency with a regular interval timetable operating every hour from Cluj to Oradea Rehabilitation to design speed (Fiche 067)	Yes	Combination of timetable, rolling stock & infrastructure enhancements including electrification	Individual corridor	DS07A, DS07B, DS07C

High level objective	Problem No.	Problem Theme	Problem Description	Summary of supporting evidence / metrics	Operational objectives Description	Operational objectives Ref	Intervention(s) Description / Alternatives	Testing plan Suitable for testing	Testing plan Type of project to be tested	Testing plan Level of aggregation to be tested	Project intervention / reference number
					Improve the competitiveness of passengers rail services on the route between Oradea and Timisoara	OR13	Enhance service frequency with a regular interval timetable operating every 2 hours from Timisoara to Oradea	Yes	Combination of timetable, rolling stock & infrastructure enhancements including electrification	Individual corridor	DS08A
					Improve the competitiveness of passengers rail services on the route between Oradea and Cluj Napoca via Baia Mare and Satu Mare	OR14	Enhanced service frequency with a regular interval timetable operating every 2 hours between Baia Mare and Oradea, and Satu Mare to Cluj Napoca	Yes	Combination of timetable, rolling stock & infrastructure enhancements including electrification	Individual corridor	DS09A
					Improve the competitiveness of passengers rail services on the route between Bucharest and Giurgiu	OR15	Enhanced service frequency with a regular interval timetable operating every 2 hours between Bucharest and Giurgiu	Yes	Combination of timetable& infrastructure enhancements including electrification	Individual corridor	DS10A, DS10B
					Improve the competitiveness of passengers rail services on the route between Craiova and Calafat	OR16	Enhanced service frequency with a regular interval timetable operating every 2 hours between Craiova and Calafat	Yes	Combination of timetable& infrastructure enhancements including electrification	Individual corridor	DS11A
			Low Average Commercial Speed of Freight Trains	A safety-related blanket restriction has been imposed at 80km/hour on all freight on all routes including rehabilitated lines. The current average commercial speed is just 21/22kph. It can take about 28 hours to go 400kms. All passenger trains (including extremely slow local services) are currently given priority over even high-value freight services	Increase rail speeds to a level consistent with target design speeds	OR1	CFR Infrastructure to allow a higher top speed for certain freight trains on rehabilitated lines - 120kph instead of 80kph such as intermodal block trains.	No	N/A	N/A	R31
					Enhance the asset performance of the railway especially opportunities to achieve operational efficiencies	OR13	CFR Infrastructure to enable better train control by utilising a 2 Tier system to allow properly equipped and dedicated intermodal trains to be prioritised over other types of bulk freight and potentially local, stopping passenger services in order to lower journey times over the core network to compete with road journey times.	No	N/A	N/A	R33
							Establish a contract between infrastructure provider and train operators which requires compensation for delays.	No	N/A	N/A	R36
Economic efficiency	(6)	Management and Operations	Old systems and paperwork based ways of working coupled with a lack of training are hindering the development of a modern railway	Train sheets are filled in manually with every wagon number recorded in handwriting and then where each wagon needed to be moved to. There are some modern systems (e.g. ARGOS) but only limited numbers of trained operators.	Enhance the asset performance of the railway especially opportunities to achieve operational efficiencies	OR13	Ensure companies adopt modern best practice and technologies such as the use of GPS for rolling stock tracking. Modern training courses in rail operations, systems and technology should be phased in for both existing and new staff. It is important for the rail sector to have a good blend of experience with technology.	No	N/A	N/A	R27
Economic efficiency	(7)	Infrastructure Deficit	Old Freight Terminals are inefficient and/or poorly located particularly intermodal sites	Reducing handling times per tonne and other improved efficiencies could be achieved through containerisation and	Develop a network of “open user” freight terminals to serve Romania’s highest	OR16	Close Bucarestii Noi and create a new intermodal terminal with extra capacity in Bucharest, with possibilities for tri-modal capabilities in the future.	Yes	Intermodal Terminals	Bucharest Only	R42

High level objective	Problem			Summary of supporting evidence / metrics	Operational objectives		Intervention(s)	Testing plan			Project intervention / reference number
	No.	Theme	Description		Description	Ref	Description / Alternatives	Suitable for testing	Type of project to be tested	Level of aggregation to be tested	
				encourage modal shift.	demand potential regions, cities and major EU markets in Bulgaria and Hungary. See Supporting Data for full description of terminal requirements and location determinants.						
				Bucharest's terminals are small and do not have space to accommodate planned growth							
				Numerous terminals have been closed despite proximity to large numbers of potential customers and industries (e.g. Craoiva), or are poorly sited for current and predicted freight flows (e.g. Iasi).		OR13	Rehabilitate the intermodal terminal serving Iasi at Socola serving this fourth city that currently does not have its own facility and also to provide transhipment potential with Russian gauge railways.	Yes	Intermodal Terminals	Iasi Only	R38
							Safeguard the mothballed Semenic Terminal at Timisoara serving this second city that currently does not have its own facility	Yes	Intermodal Terminals	Timisoara Only	R41
							Build a new intermodal terminal at Craiova, serving the 6th largest city and an important industrial location currently without open user facilities.	Yes	Intermodal Terminals	Craiova Only	R43
							Rehabilitate existing terminals to provide a comprehensive and strategic network for international and domestic intermodal freight at: Cluj Napoca Est, Turdu, Suceava & Bacau.	Yes	Intermodal Terminals	Network-wide	R44
Economic efficiency	(8)	Infrastructure Deficit	The majority of the Romanian rail network has a low maximum axle weight of 20.5 tonnes	A 20.5 tonne axle limit is currently in force, but this is less than the EU rail network standard of 22.5t. For a 30 wagon train this equates to an additional 240 tonnes of product (a 15% productivity enhancement).	Enhance the asset performance of the railway especially opportunities to achieve operational efficiencies	OR13	To encourage international and transit traffic allow 22.5 tonne axle weights on rehabilitated routes. Clearly the whole route needs to be cleared for operators to use this productively. This feature should be integrated into all future route rehabilitation.	No	N/A	N/A	R35
			Old network infrastructure not taking advantage of modern benefits and opportunities, such as in energy efficiency	A substantial amount of the rail infrastructure in Romania is life-expired or does not enable modern technology to operate fully. There is currently no section of track, for example, where power recovery is possible.			Undertake a feasibility study with regard to introducing power systems with the capability to return energy generated from regenerative braking to the power network during all future rehabilitation work. Regenerative braking can save 5% on power use on freight but up to 17% on commuter passenger trains	No	N/A	N/A	R34
Economic efficiency	(9)	Management and Operations	CFR Marfă's delayed privatisation	The continued uncertainty and delays regarding CFR Marfă's privatisation mean that rail freight is locked into a cycle of under-investment and short-term contracts.	Increase revenue capture and efficiency by ensuring contracts are more commercially focussed	OR7	Remove uncertainty over the future of CFR Marfa and privatise as soon as possible. This would give the whole rail industry the opportunity to compete fairly in the freight sector	No	N/A	N/A	R32

5.4 Proposed Improvements

5.4.1 Using the information collated from the Problems and Issues report, the interventions to resolve these issues have been grouped into five main themes, as shown in Table 5.8.

Table 5.8: Summary of the Potential Improvements

Theme	Proposed improvements
Rehabilitation / Modernisation of the network	• Increase maintenance and renewals budget • Steady state maintenance of the core network • Repairs and renewals programmes • Line rehabilitation to design speed • Line rehabilitation to enhanced speed • Perform maintenance outside normal working hours
Management and Operations	• Station closures • Optimised rolling stock strategy including new units • Yield management • Fare evasion strategy • Sell redundant facilities to generate revenue • Revised concession system to encourage cost savings, improve performance and boost patronage • Rationalise staff numbers • Rationalise rail infrastructure
Safety and Regulation	• Improved signalling • ERTMS pilot test • Upgraded communications systems • Centralised control centres
Infrastructure Deficit and Inadequate Services	• Optimised regular interval timetable • Line electrification • Line doubling • New rail links • Increased frequency of passenger services

5.5 Rehabilitation / modernisation of the network

5.5.1 Rail infrastructure in Romania has experienced a steady deterioration over the past ten years with an increasing maintenance and renewals backlog. Furthermore, a greater number of assets including track, signals and overhead electrification have become life expired. This has resulted in speed restrictions being enforced, leading to a substantial increase in passenger travel times. Although significant funds have been invested to upgrade the rail network on selected corridors including Bucharest to Constanta and Brasov, these improvements have had limited impact on the journey times. Travel times after rehabilitation on the Bucharest to Constanta line are currently 9 minutes longer than before rehabilitation or about 40% slower than the target time of 2 hours. On other routes, journey times have deteriorated at even faster rate since 2000. Consequently, there is a clear need to identify realistic options to deliver a financially sustainable network that can properly serve the core rail markets to enable this mode to secure a long-term competitive advantage.

Affordability of Maintaining the Network

5.5.2 There are two key issues to highlight related to the requirement to prioritise the rail network. Firstly, maintaining the current size of the rail network to the required standard is unaffordable. Secondly, significant parts of the network carry very low volumes of passenger or freight traffic which absorb resources that could potentially be better deployed elsewhere. With low passenger and freight usage per track-km and limited funds available, an approach which focuses investment towards key corridors that serve a national public interest and carry most of the traffic is therefore required. This would be achieved by focussing on the definition of a primary network which covered a reduced size in terms of the track kilometres. The existing designation of interoperable and non-interoperable lines would instead be replaced by primary routes that fulfil a national interest. Secondary routes which serve a local function could be retained and managed by a local authority albeit with no state funding. If a secondary line was not transferred from CFR Infrastructure's ownership, it would be automatically closed. The size of the primary network should be dependent on passenger demand and financial resources available.

Calculating the Maintenance and Renewals Backlog

5.5.3 With a substantial shortfall in expenditure compared with the required levels, and low traffic densities using an under-utilised network, there are a number of possible measures which would produce a more sustainable situation, and cut the funding gap. These include:

- rationalising the network so the funding requirement for maintenance and renewals is smaller;
- introduction of various commercial initiatives to increase revenue; and
- Increased funding.

5.5.4 Other initiatives would include the introduction of more competitive passenger services, greater accountability and an improvement programme to deliver better efficiencies. An exercise to prioritise those links which generated the highest revenue (both from passenger farebox and freight track access charges) compared with the costs (train operating costs, and maintenance and renewals costs) was completed to generate cost to revenue ratios (CRR). The operable and non-interoperable network was treated in the same manner to ensure a sustainable network was identified regardless of ownership or the alternative funding mechanisms adopted. The main trends include:

- The routes generating the highest CRR include the Bucharest to Timisoara via Craiova and Caransebes, plus the branch line used by coal trains north west of Strehaia. Many of these routes have a CRR above 0.6;
- Bucharest to Constanta has a range of 0.4 which reflects the mixture of freight and passenger services using this corridor;
- Whilst Bucharest to Suceava via Ploiesti and Ploiesti to Brasov lines have CRR of about 0.4, there are numerous branch lines with a CRR less than 0.1. The majority of these lines are single track and not electrified. Although this contributes to lower maintenance requirements, the lack of passengers and freight trains is the main factor.

5.5.5 Large parts of the rail network in Romania generates relatively little revenue, either through fare-box income or freight track access costs, relative to their operating and maintenance costs. Different funding scenarios were examined to understand the trade-offs between the percentage of passenger and freight traffic that would be retained by the proposed networks and the funding implications. This assessment highlighted the retention of about 55% of the 18,973km network would enable about 99% of the traffic to continue. The estimated 18,973 main line track kilometres includes redundant station sidings and running lines, so the impact on the actual operational network would be smaller. Using unit rates per track kilometre for maintenance and renewals which are comparable to other parts of the EU, the budget required would equate to €287m and €245m for renewals per annum respectively, plus a further €518m each year for a 15 year period to address the backlog. The introduction of some commercial initiatives might boost revenues by a further €45m per annum. Figure 5.25 presents the coverage of the network that would be retained and includes a small number of links that would also be retained for strategic connectivity. These add-ons include sections near Timisoara and border crossing north of Suceava towards Ukraine. Some other links may have an importance in terms of carrying coal or oil to a power station or raw materials to a steelworks. It should be acknowledged that the use of average costs and revenues may bias the results against privately-operated lines, so it is recommended that some marginal links will need to be re-examined before decisions are finalised.

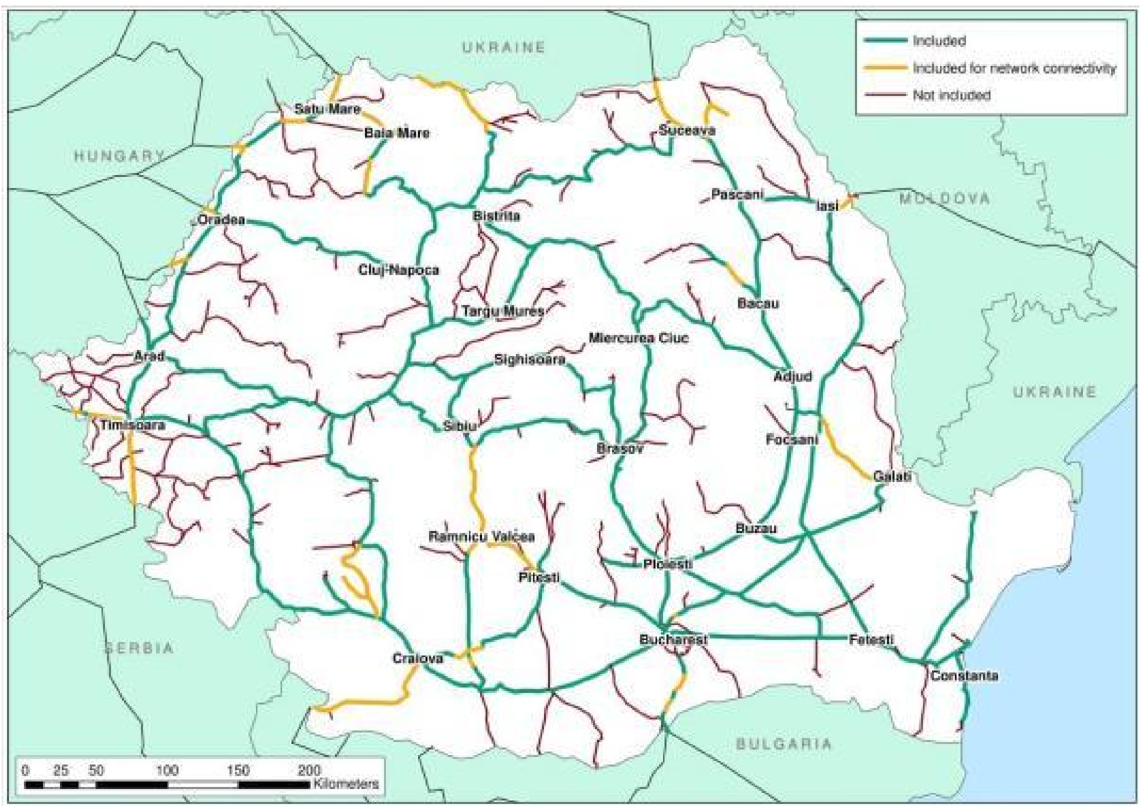


Figure 5.25 Definition of the Primary Network

Alternative Maintenance Regime

5.5.6 In addition to the funding available to maintain the network, the timing of these works also needs to be revised. The completion of works in the morning is inconvenient for passengers travelling at that time, since trains either do not operate, or are affected by slower journey times. Instead of completing maintenance works between 08.00 and 13.00 it is proposed these works are rescheduled to be completed overnight. Although this change could affect overnight freight services with necessary mitigation measures to be identified, it would facilitate the introduction of a more intensive passenger service in the morning by removing the lengthy timetable gaps which reduce the attractiveness of rail. Whilst this revised strategy would result in higher labour costs and a requirement for additional plant equipment to facilitate overnight works, CFR Infrastructure could recoup these costs from higher track access charges. The increased maintenance spend based on international. Furthermore, CFR Calatori would then be able to attract a higher number of passengers and the increased revenues would help to offset the increased costs.

5.5.7 Table 5.9 summarises the potential impacts if the maintenance backlog was removed. This can be measured in terms of the current average speed and the results if the design speed was increased. These results are presented for the main rail corridors. The average increase in speed between the current versus the potential scenario is about 33%, although the speeds between Arad and Timisoara would more than double.

Table 5.9: Summary of the current and average design speed for selected lines

Corridor(s)	Movement	Average Speed (km/h)	Average speed with design speed - fast service (km/h)[1]	% improvement
IV-S/900	Bucharest - Timisoara	61	70	15
IV-S/900	Bucharest - Craiova	69	80	16
IV-S	Craiova - Timisoara	55	65	18
IV-S	Timisoara - Arad	45[2]	92	104
IV-N	Bucharest - Constanta	77	113	47
IV-N	Bucharest - Brasov	60	87	45
IV-N	Bucharest - Arad	59	79	34
IV-N / 300	Bucharest – Cluj-Napoca	57	73	28
IV-N / 300	Bucharest - Oradea	56	69	23
IX	Bucharest - Bacau	63	83	32
IX	Bucharest - Iasi	59	82	39
IX / 700	Bucharest - Galati	55	79	44
IX	Bucharest - Ploiesti	77	98	27
Other TEN-T / IV-N	Cluj-Napoca - Timisoara	55	68	24
Other TEN-T / IX	Cluj-Napoca - Iasi	55	62	13
Other TEN-T	Cluj-Napoca - Oradea	49	56	14
Other TEN-T	Bucharest - Sibiu	54	72	33
[1] Interregio and Intercity services [2] Includes Regio Services				

5.5.8 In addition to the definition of a primary network, there are three further overarching themes which need to act in a complementary manner: competitive passenger services, performance accountability services and an efficiency improvement programme. Some of the topics to support these themes are summarised below.

Management and Operations

5.5.9 Addressing network inefficiencies is the second generic theme identified and has been sub-divided into several topics.

Track

5.5.10 **Problem**: Productivity is low compared to other European countries with Romanian railways only achieving 40% of the average;

5.5.11 **Proposed solution:** Introducing measures to improve this ratio must be a priority and would be tackled by introducing a more intensive timetable, as described in the timetable interventions below. This would help to attract a higher number of passengers to the rail network and is especially relevant for demand between Bucharest and cities located 2-3 hours travel time from the capital. In particular, there is significant scope to grow market share for rail journeys between Bucharest and Constanta, Craiova, Brasov, Ploiesti, and Buzau, primarly those corridors which are less well served by road;

Stations

5.5.12 **Problem:** Romania has about 1,100 passenger stations, although many of these are local halts which attract low passenger demand. The number of local services calling at them is also very limited with lengthy gaps between trains. Station usage statistics from 2011 indicate that over 65% of the stations are used by fewer than 100 passengers per day, with only 8% of stations used by at least 500 passengers per day;

5.5.13 **Proposed solution:** The scope to reduce the number of stations through a programme of closures therefore must be examined, particularly if the overall travel market using a branch line is small and therefore offers limited scope for growth. Reducing the number of stations could create opportunities to cut journey times between the larger stations. It would also reduce the costs associated with maintaining a large number of under-utilised stations;

Timetables

5.5.14 **Problem:** The timetables are constrained by a number of factors including slow travel speeds, the requirement to complete brake safety checks while units are in operation. The lengthy dwell times at stations account for up to 10% of total travel time on some services. Turnaround times at some terminus stations are also longer than necessary, with trains sitting for up to five hours resulting in numerous inefficiencies. Furthermore, the lack of a regular interval timetable with a consistent timing of departures and trains to the same destinations is confusing for passengers;

5.5.15 **Proposed Solution:** For the designated primary routes, timetable changes are proposed which feature higher frequencies on the busiest corridors with a simplified, regular pattern. Scheduling is also more efficient with shorter turnarounds at the terminus station. The proposals are discussed below for individual lines;

Rolling Stock Fleet

5.5.16 **Problem:** Only 65% of the current fleet are required to operate the timetable in Romania and this proportion is markedly low than other European countries (typically 85-90%). The high rolling stock age contributes to poor reliability and necessitates a larger allowance for spare units to cover breakdowns;

5.5.17 **Proposed solution:** A restructured, more intensive timetable that features modern units will offer a significantly improved service for passengers and will help to strengthen the case for other investment. During the lifetime of the Masterplan, all rolling stock will need to be replaced with the exception of the Desiro units. This provides an opportunity to replace some of the inefficient loco-hauled sets with electric or diesel multiple units. Instead of replacing loco-hauled trains on a like-for-like basis, the EMUs or DMUs have lower operating costs and would enable the capacities to be more closely aligned with forecast demand. A more detailed description of the rolling stock strategy is set out below.

5.5.18 There are numerous opportunities to boost the commercial performance of the railway. Some of these initiatives will need to be introduced incrementally, to maximise their impact once other improvements have been delivered. Some potential themes are set out below.

Yield Management

5.5.19 **Problem:** The existing fare structure for rail travel in Romania is relatively inflexible with limited financial incentives to encourage passengers to book in advance to secure cheaper tickets. Most fares are distance based, although some tickets can be purchased in advance using the CFR Calatori website. However, there is considerable scope for further improvements. With advance tickets in Romania between 75% and 100% more expensive than other European countries for similar distances and adjusted to take account of wage differences, this merits further review;

5.5.20 **Proposed solutions:** This could be addressed by the introduction of measures to maximise yields on the most popular trains. In parallel, greater discounts for passengers able to travel at less popular times could be introduced. Season tickets and discounts for frequent travellers could also be introduced and these measures would attract more passengers to rail. The timetable revisions described below further reinforces the importance of introducing more effective yield management. These timetable changes would deliver additional capacity on selected routes, particularly for journeys of 2-3 hours to / from Bucharest.

Fare Evasion

5.5.21 **Problem:** Discussions with CFR Calatori indicate that 25-30% of passengers are either travelling with the incorrect ticket or do not have a ticket at all. The estimated revenue loss is about €50m per annum. Lines operated by CFR Calatori generally have the highest levels of fare evasion which reflects the more comprehensive revenue protection measures which private operators have introduced;

5.5.22 **Proposed solutions:** To address the current levels of ticketless travel, measures which incentivise operators to collect a greater proportion of the total revenue are urgently required and should be linked to the Governance section described above. In addition, campaigns which highlight the social and financial implications of fare evasion are required, with more stringent fines for passengers found without a ticket, or the correct ticket for their journey. Many of the private operators introducing such measures have boosted revenue by 6-7 times compared with the CFR Calatori services. This indicates the initiatives to reduce fare evasion should be self-funding.

Availability of Redundant Land

5.5.23 **Problem:** The reduction in train services and other efficiency savings mean the requirement for land to stable trains and for maintenance have been significantly reduced. Consequently, there is considerable redundant land available in certain locations which could now be reused for other purposes. This includes redundant sidings, buildings at stations, or part of depots or marshalling yards;

5.5.24 **Proposed solutions:** Some of this land could be redeveloped for office development, retail or as an intermodal facility. These opportunities are particularly relevant in the larger population centres if the plots are adjacent to the city centre or the main road network. Bucuresti Triaj has been suggested as a possible scheme, although other sites in the capital should be identified and then prioritised given the potential for a stronger financial case versus other examples. Best practice from elsewhere including Krakow in Poland may also be informative to identify possible schemes.

Station facilities

5.5.25 **Problem:** The facilities available at most railway stations in Romania are relatively poor and do not encourage rail travel. For example, there are no stations monitored by CCTV, whilst adequate lighting, seating areas, toilets and covered waiting shelters are generally not available;

5.5.26 **Proposed Solutions:** Real time information and communication systems also help to generate higher passenger demand by reducing the uncertainty about potential delays. In addition to improving the facilities described above, better links with other transport modes and pedestrian networks are required. The opportunity to improve facilities within each station will be determined by the current and potential usage, as well as the likely construction costs. The potential principal stations on each corridor that could benefit from these improvements are described in Table 5.10.

5.5.27 In addition to the measures to improve the commercial focus and the efficiency of operations, a number of fundamental changes to the governance regime are also required, primarily to address the limitations of the current Public Service Contracts. The discussion below highlights the constraints, and recommends some revisions to address these limitations.

Limitations of the Existing Governance Approach

5.5.28 **Problem:** In addition to the commercial regimes identified above, fundamental revisions are also needed to the governance regime. Consequently, the payments to operators for the Public Service Contracts are mainly linked to the number of trains run, rather than the timing of these trains or the actual patronage attracted. The PSC mechanism to compensate train operators is fairly simplistic, with 80% of compensation paid to CFR Calatori depending on the number of train kilometres operated, with a further 20% based on passenger revenues. As a result, this mechanism introduces little or no financial incentive to maximise efficiency, reduce delays and improve performance;

5.5.29 **Proposed Solutions:** A fundamental revision to the PSC is therefore required and is dependent on the delivery of other interventions described above. This includes delivery of a more intensive operating timetable with 85-90% of units deployed rather than the current 65%. This will deliver substantial savings in rolling stock requirements for the current timetable and would affect the number of replacement units required. In addition to the rolling stock efficiencies, there is also scope to reduce staff costs by allocating train crew in a more efficient way. Other measures include alternative maintenance regime which enables services to operate throughout the morning, rather than the current gap of up to 7 hours will help to attract new passengers and boost revenues. Various commercial initiatives including more effective yield management, introduction of more competitive rail services plus strategies to target fare evasion and improve station facilities will help to boost revenue.

5.5.30 A revised position with the range of commercial and other initiatives have been delivered. The implementation of these measures will enable both costs and revenues to be boosted prior to changes affecting the current PSC. Revisions to the existing contract will then need to be examined and should include transferring a much greater commercial risk onto the operator. At present, the commercial risk being taken by the operator is relatively limited and this adversely affects their willingness or appetite to introduce alternative initiatives. A contractual model that takes account of the differences between the revenues and costs once the above initiatives have been implemented is recommended. Some of these improvements intended to deliver cost savings and patronage growth is required since it is recognised some improvements may need to be delivered incrementally over a longer time period. The structure of the financial support needs to be tailored to achieve these outcomes.

5.5.31 The introduction of a revenue share framework may also be advantageous to provide further incentives for the operator to achieve future growth. These changes will need to be introduced gradually to avoid the operator being affected by financial problems if the changes are not introduced quickly enough or alternatively make excessive profits if the changes to the commercial regime are too onerous or generous. Once the system has been introduced, useful background evidence will illustrate the scope for revenue growth and / or cost savings which will enable the future commercial targets to be tailored accordingly.

5.5.32 To ensure the transition between the current compensation regime and a future framework which includes a greater commercial focus is managed effectively, the feasibility of operating the passenger rail services as a concession rather than a franchise for an initial period must be examined. Instead of a new operator taking the revenue risk for services that will initially undergo substantial change, the feasibility of the Romanian Government taking revenue risk in the short term during the transitional period should be examined. This would enable the financial impacts of taking revenue risk during this period to be minimised. As part of the concession, the operator should still be incentivised to deliver wider changes and achieve revenue growth. Once the transitional period is completed, an alternative contractual regime could be introduced based on a franchise with the operator taking revenue risk.

5.5.33 The proposed Rail Reform Agency would be established to implement many of these changes described above. Its role would vary over time, with a remit to tackle specific tasks in a prioritised order to ensure the wider programme of works is completed in a timely manner. This would help to improve the overall financial position of the operator and the infrastructure provider.

5.5.34 The RRA would be responsible for recruiting staff and defining roles, managing the transition between the current system and the implementation of different initiatives, managing the process to identify the primary network and then implement the programme of network closures, defining the geographic areas for concessions initially and then the transition towards franchises in the longer term, helping CFR Infrastructure draw up a Plan according to EU 34/2012 and obtain agreement with the Ministry of Transport for finance and preparing market responsive contracts between the operator and infrastructure manager to ensure efficient services.

Safety and Regulation

Some possible solutions to improve signalling and address the current limitations is described below.

5.5.35 **Problems:** There are significant inefficiencies affecting CFR Calatori and CFR Infrastructure. Slow speeds and the current pattern of timetables means CFR Calatori requires 15-20% more drivers than necessary to operate services. Meanwhile, CFR SA still operates many signalling systems manually which means staff numbers are higher than the minimum;

5.5.36 **Proposed solutions:** For example, stations with electric signals require just one third of the total staff compared with manual controls. A progression towards greater automation would enable staff numbers to be reduced. For example, the introduction of ERTMS pilot would help to achieve these objectives, whilst the feasibility of better communications with centralised control would also contribute.

Infrastructure Deficit and Inadequate Services

5.5.37 The introduction of a revised maintenance strategy would enable trains to be scheduled throughout the morning to address the lengthy gaps which currently result on many routes. This would allow timetable gaps to be filled, and ensure trains operate at times passengers wish to travel rather than imposing a service-led timetable. Details of the service changes for individual corridors are set out below. These timetable revisions have been examined in ‘packages’ to maximise the benefits. For example, introducing new rolling stock will not achieve competitive speeds unless the rail network is upgraded and these units will not be efficiently deployed unless more intense timetables are operated.

5.5.38 The main objective of the proposed timetables is to provide a fast and frequent service between key stations on each corridor, maximising the rail market share with minimal incremental change in operating costs. Existing InterCity (IC) and InterRegio (IR) services on each corridor are replaced by a regular interval service pattern timetable.

5.5.39 Rail interchanges are enhanced to maximise rail connectivity, reduce delays and increase the opportunity to complete long / medium distance journeys. IR feeder services from major branch lines and other parts of the network will be connected to the network at interchange points along the corridor. IC trains are generally substituted by shorter and more frequent IR trains, with the exception of International services which are assumed to be unaffected. There would be a journey time saving for trains using a rehabilitated line. Figure 5.26 summarises the proposed timetable structure, with each Line representing a train every 2 hours. Bucharest Gara du Nord would become an even more important interchange for passengers making journeys beyond the capital. It is assumed the proposed trains would adopt a calling pattern that stops at a limited number of intermediate halts. The service groups comprise:

o **DS01 Bucharest to Arad and Cluj Napoca via Brasov:** 2tph between Bucharest and Brasov, with 0.5tph extended to both Arad and Cluj Napoca

o **DS02 Bucharest to Constanta:** 1tph between these stations;

o **DS03 Bucharest to Deva and Arad via Craiova:** 2tph between Bucharest and Craiova with 0.5tph extended to both Deva and Arad via Timisoara;

o DS04 Bucharest to Galati, Focsani, Iasi and Suceava: 0.5tph to each station;

o **DS05 Bucharest to Pitesti, Sibiu via a new link west of Ramnicu Valcea:** 1tph between Bucharest and Pitesti, with alternate trains extended to Sibiu, plus a 2 hourly service from Brasov to Deva;

o **DS06 Iasi to Cluj Napoca via Suceava and Dej:** 2 hourly service, plus rehabilitation of track to design speeds;

o **DS07 Cluj Napoca to Oradea:** 2 hourly service, plus rehabilitation of track to design speeds, line doubling and electrification;

o **DS08 Stamora Moravita to Oradea via Timisoara:** 2 hourly service, plus rehabilitation of track to design speeds and electrification;

- **DS09 Oradea to to Cluj Napoca via Satu Mare and Baia Mare:** 2 hourly service, plus rehabilitation of track to design speeds;
- **DS10 Bucharest to Giurgiu:** 2 hourly service, plus electrification;
- **DS11 Craiova to Calafat:** 2 hourly service, plus electrification.

5.5.40 In addition to the proposed service pattern above, there are a number of key interchanges including Cluj Napoca, Timisoara, Brasov and Oradea where several services converge, albeit with relatively low frequencies. The timing of these connecting trains needs to be carefully scheduled to maximise the opportunities for interchange between these limited stop services, the complementary Regio trains and wider bus network.

5.5.41 In addition to the proposed network which could be served by a regular interval timetable, several other corridors were identified for improvements. These corridors include Fetesti to Faurei which would support the development of the agricultural economy in the area, plus links to Moldova from Faurei via Tecuci, Barlad, Vaslui and Iasi. The freight market would be the main beneficiary of the proposed improvements. However, making the economic case for these proposals will be challenging, especially given the proposed improvements for passengers services to / from Iasi via Pascani.

5.5.42 Furthermore, stakeholders have identified a number of lines which could fulfil a tourism function, but do not feature on the proposed primary network. For example, Oraviţa-Anina, Caransebeş-Haţeg, Sibiu-Agnita, Turda-Abrud, Luduş-Magheruş and Tg. Mureş-Sovata Băi could be retained as secondary routes by the relevant local authorities, subject to more detailed assessments which take account of their tourism potential.

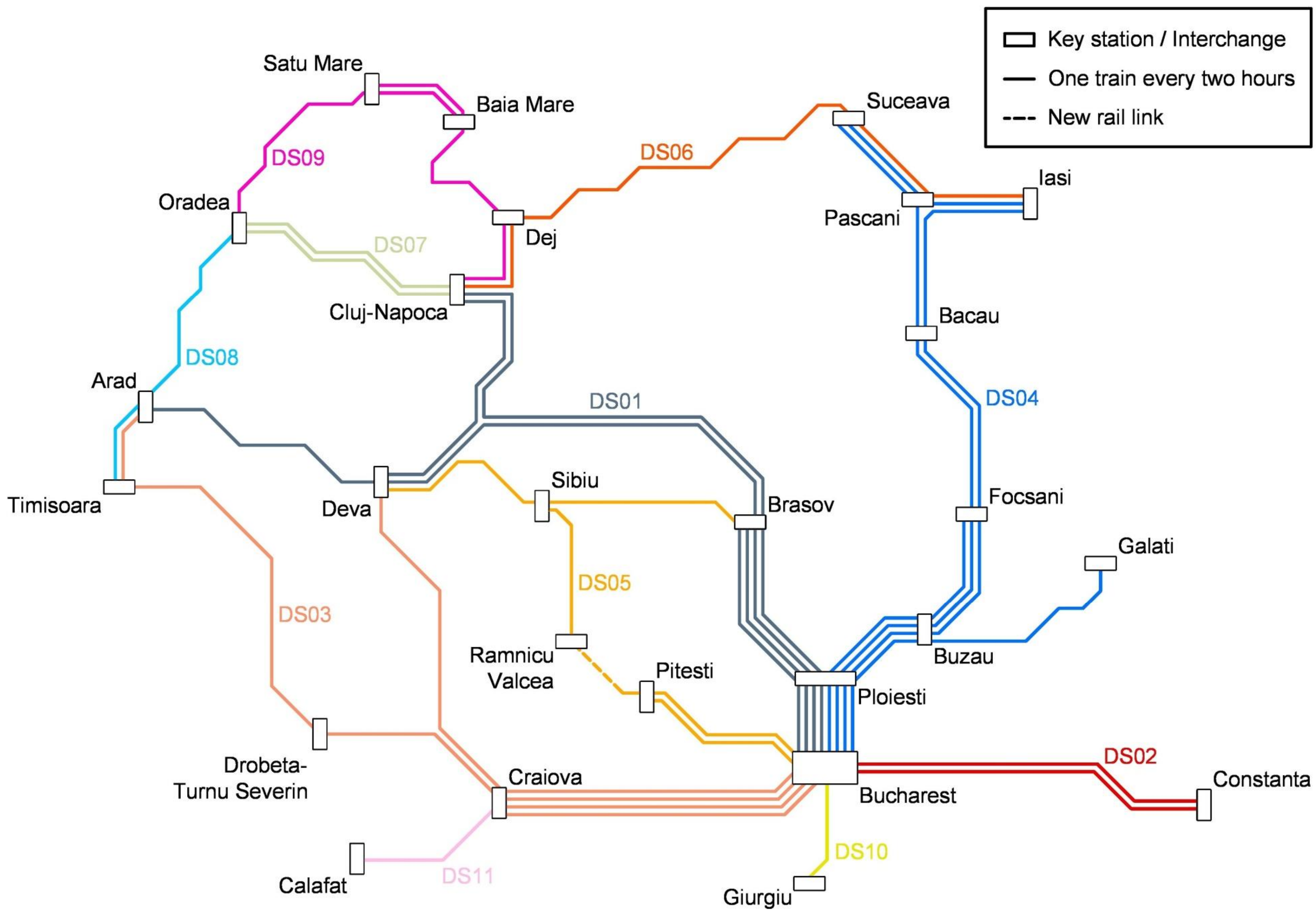


Figure 5.26: Proposed regular interval timetables

5.6 Testing Rail Service Options

5.6.1 It has been assumed that the base line for the rail service option assessment is steady state maintenance and repairs of the core network, 'as now' maintenance of the rest of the network and that the 2011 timetable will be operated in 2020, 2030 and 2040 (except for passenger services on line 902). Table 5.10 includes a brief description of the improvements modelled for each alternative.

Table 5.10: Key model run statistics.

Description	Test code	Test description
Bucharest to Arad / Cluj via Brasov	DS01A	Core TEN-T corridor IV-N and link to Cluj-Napoca to design speed. Package of measures includes track rehabilitation to design speed, improvements to the power supply and signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Bucharest Nord, Ploiesti, Brasov, Sighisoara, Medias, Blaj, Teius, Alba Iulia, Deva, Arad, Razboieni, Campia Turzil and Cluj Napoca). **Network to be rehabilitated:** 795km **Service frequency:** 2 tph to Brasov, then 0.5tph extended to Arad and 0.5tph to Cluj Napoca **Number of new units:** 22 EMUs **Further electrification:** No **Double tracking:** No
	DS01B	Core TEN-T corridor IV-N and link to Cluj-Napoca to enhanced speed. Other interventions as per the proposals above
Bucharest to Constanta	DS02A	Line Bucharest to Constanta comprises new rolling stock and improved station facilities at major nodes (Fundulea, Lehliu-Gara, Ciuinita, Fetesti, Cernavoda Pod, Medgidia, Constanta). Interventions will make better use of the previously rehabilitated network. There may be some scope for further improvements when bridges and stations which are currently being rehabilitated are completed **Network to be rehabilitated:** 0km (except bridges and stations) **Service frequency:** 1 tph to Constanta **Number of new units:** 4 EMUs **Further electrification:** No **Double tracking:** No
Bucharest to Arad via Craiova	DS03A	Bucharest to Arad via Craiova to design speed. Improve power supply and introduce regenerative braking, enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Bucharest Nord, Videle, Rosiori de Vede, Caracal, Craiova, Filiasi, Strehaia, Drobeta, Baile Herculane, Caransebes, Lugoj, Timisoara and Arad) **Network to be rehabilitated:** 875km **Service frequency:** 2 tph to Craiova, then 0.5tph extended to Arad via Timisoara and 0.5tph to Deva **Number of new units:** 19 EMUs **Further electrification:** No **Double tracking:** No
	DS03B	Bucharest to Arad via Craiova to enhanced speed. Other interventions as per the proposals above

Description	Test code	Test description
Bucharest to Galati / Iasi / Suceava	DS04A	Core TEN-T corridor IX and links Buzau to Galati and Pascani to Suceava to design speed. Improve power supply and introduce regenerative braking, enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Bucharest Nord, Ploiesti, Buzau, Ramnicu, Focsani, Marasesti, Adjud, Bucau, Roman, Pascani, Dollnasca, Veresti, Suceava, Faurei, Braila, Galati, Pascani, Tagu Frumos and Iasi). **Network to be rehabilitated:** 1,260km **Service frequency:** 0.5tph to Suceava, 0.5tph to Iasi, 0.5tph to Galati, 0.5tph to Focsani **Number of new units:** 25 EMUs **Further electrification:** No **Double tracking:** No
Bucharest to Sibiu via Ramnicu Valcea	DS05A	Line Bucharest to Pitesti to design speed and new link Videle - Ramnicu Valcea. Package of other improvements to include enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Bucharest Nord, Titu, Gaesti, Pitesti). **Network to be rehabilitated:** 320km **Service frequency:** 1tph to Pitesti, then 0.5tph extended to Craiova and 0.5tph to Sibiu **Number of new units:** 7 DMUs **Further electrification:** No **Double tracking:** No
	DS05B	Line Bucharest – Pitesti to design speed, new link Videle - Ramnicu Valcea and line electrification. Other interventions as per the proposals above, plus improved signalling and regenerative braking **Number of new units:** 7 EMUs **Further electrification:** Yes
Cluj Napoca to Iasi	DS06A	Line Cluj-Napoca to Iasi to design speed. Other interventions include improve power supply and introduce regenerative braking, enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Cluj Napoca, Gherla, Dej Calatori, Beclean pe Sommes, Salva, Ilva Mica, Vatra Dornei, Compulang Mold, Suceava, Veresti, Dollnasca, Pascani, Targu Frumos, Iasi) **Network to be rehabilitated:** 740km **Service frequency:** 0.5tph from Cluj Napoca to Iasi **Number of new units:** 7 EMUs **Further electrification:** No **Double tracking:** No
	DS06B	Line Cluj-Napoca to Iasi to enhanced speed. Other interventions as per the proposals above.

Description	Test code	Test description
Cluj to Oradea	DS07A	Line Cluj-Napoca to Oradea to design speed. Other interventions include improve power supply and introduce regenerative braking, enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Cluj Napoca, Huedin and Oradea). **Network to be rehabilitated:** 270km **Service frequency:** 1tph to Cluj Napoca to Oradea **Number of new units:** 4 DMUs **Further electrification:** No **Double tracking:** No
	DS07B	Line Cluj-Napoca to Oradea to design speed plus electrification and line doubling Other interventions as per the proposals above. **Number of new units:** 4 EMUs **Further electrification:** Yes **Double tracking:** Yes
	DS07C	Line Cluj-Napoca to Oradea electrification **Number of new units:** 4 EMUs **Further electrification:** Yes
Stamora Moravita to Oradea via Timisoara	DS08A	Line Timisoara – Oradea to design speed. Other interventions include improve power supply and introduce regenerative braking, enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Timisoara Nord, Arad and Oradea). **Network to be rehabilitated:** 200km **Service frequency:** 0.5tph to Stamora Moravita to Oradea via Timisoara **Number of new units:** 5 DMUs **Further electrification:** Partial **Double tracking:** No
Oradea to Cluj via Baia Mare and Satu Mare	DS09A	Line Oradea to Satu Mare and Satu Mare to Cluj-Napoca to design speed. Package of other improvements to include enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Oradea, Satu Mare, Baia Mare, Dej and Cluj Napoca) **Network to be rehabilitated:** 475km **Service frequency:** 0.5tph between Baia Mare and Oradea via Satu Mare, 0.5tph to Satu Mare via Cluj Napoca via Baia Mare **Number of new units:** 6 DMUs **Further electrification:** No **Double tracking:** No
Bucharest to Giurgiu	DS10A	Line Bucharest to Giurgiu via Gradistea to design speed. Package of other improvements to include enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Bucharest Nord, Videle and Giurgiu). **Network to be rehabilitated:** 95km **Service frequency:** 0.5tph to Giurgiu from Bucharest **Number of new units:** 2 DMUs **Further electrification:** No **Double tracking:** No

Description	Test code	Test description
	DS10B	Line Bucharest to Giurgiu via Gradistea to design speed plus line electrification. Package of other improvements to include enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Bucharest Nord, Videle and Giurgiu). **Number of new units:** 2 EMUs **Further electrification:** Yes
Craiova to Calafat	DS11A	Core TEN-T corridor IV-N section Craiova to Calafat to design speed. Package of other improvements to include enhanced signalling equipment, new rolling stock and improved station facilities at major nodes (for example, Craiova and Calafat). **Network to be rehabilitated:** 115km **Service frequency:** 0.5tph to Craivoa from Calafat **Number of new units:** 3 DMUs **Further electrification:** Yes **Double tracking:** No
Combined scenario	DS99A	Combined scenario with the upgrades considered for the best performing alternative for each corridor. Package of other improvements to include enhanced signalling equipment, new rolling stock and improved station facilities at major nodes

Source: AECOM

5.6.2 There are a limited number of further stations which benefit from station improvements but are not served by the proposed regular interval timetable, for example, Targoviste and Miercurea Ciuc. The case for improving these stations would need to be evaluated separately.

5.6.3 The above package of proposals has been compared against the Reference case assumption which is based on a similar level of service to the 2011 timetable to assess their impact. Whilst there may have been modest service improvements delivered since 2011, the package of measures described above will offer substantial improvements for those corridors which offer the strongest opportunities to increase the existing rail travel market.

High Level Results for the Service Options

5.6.4 Figure 5.27 summarises the overall benefit cost ratio for each test. Although the combined scenario produces a benefit cost ratio of 1.0, individual schemes that comprise service proposals radiating from Bucharest are expected to yield a good value for money (BCR over 1), whilst the results for routes linking other cities generally produce poor value for money (BCR under 1). Scenario DS10 is the best performing scheme with a BCR of about 4.2. This high figure is due to the characteristics of the corridor with no rail services operating in 2011 on line 902 from Giurgiu beyond Gradistea due to the collapse in 2005 of the Arges river bridge. Reconstructing this bridge, bringing speeds back to design parameters, and implementing a regular interval timetable on the line generates significant benefits at a modest cost.

5.6.5 Similarly, test DS02A could deliver substantial benefits from the deployment of a more intensive timetable operated by modern rolling stock on the Constanta line. Although this line has been rehabilitated in the last decade to a high standard with design speeds of up to 200 km/h, services have not achieved the anticipated travel times after rehabilitation. NTM model runs evidence that the potential rail market share on this section has not been fulfilled, with the upgraded infrastructure currently underutilised.

5.6.6 Scenarios involving rehabilitation of long corridors radiating from Bucharest such as DS01, DS03 and DS04, yield BCR's marginally above 1. Although this figure indicates that the rehabilitation programme is worthwhile, the forecast demand distribution shows how while rail traffic of sections closer to Bucharest soars, this figure decreases as the distance from the capital grows. For this reason, the paragraph below includes a section by section analysis, in which the results of these tests are split into shorter stretches.

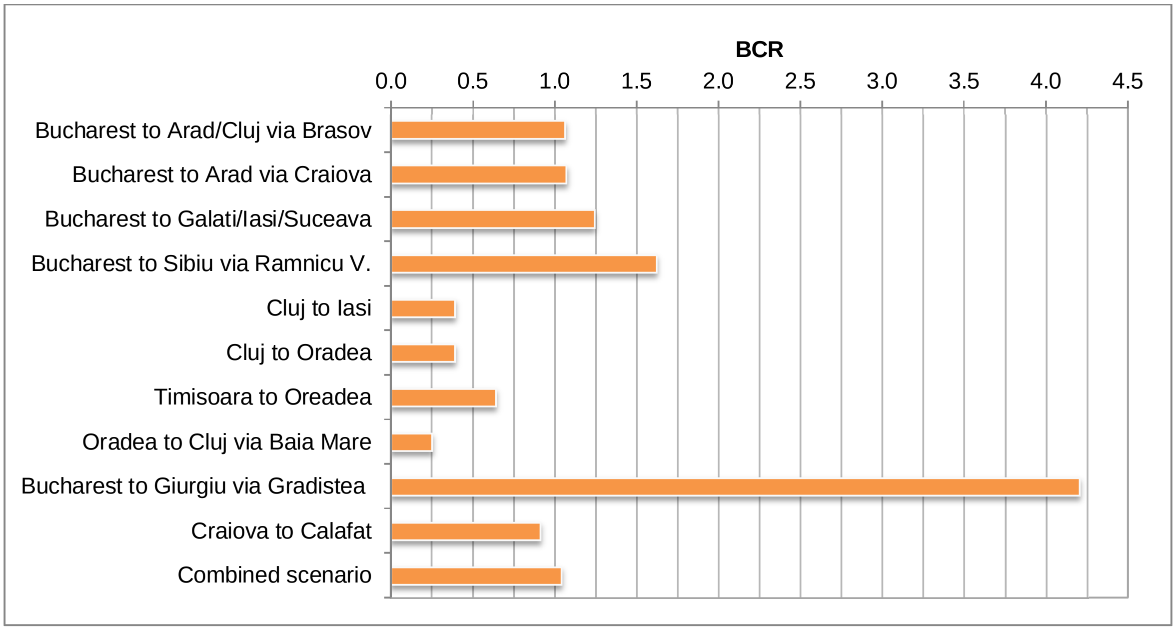


Figure 5.27: BCR of the best performing test for each scenario involving infrastructure upgrades

Results Analysis – Key Performance Indicators

5.6.7 Table 5.11 summarises key outputs for the rail model runs described above using the National Transport Model. The results illustrate the performance of each modelled test versus the Rail reference scenario which demonstrates the potential to achieve rail growth if an appropriate package of investment is delviered. It should be highlighted that steady state maintenance and repairs of the core network will translate into increased maintenance and renewals costs. The outputs include change in passenger kilometres, change in tonne kilometres, the Net Present Value of the scheme and the benefit cost ratio. Upgrading a corridor generates several impacts on rail demand:

- Overall increase in rail demand (generation of trips);
- Rerouting of traffic towards the upgraded line (abstraction from other corridors).

5.6.8 The main conclusion emerging is the variation in results, with the main lines to / from Bucharest attracting more demand and producing a higher benefit cost ratio compared with other corridors than remote corridors that only attract lower passenger numbers and / or freight traffic. This implies the main lines around Bucharest should be prioritised if limited funds for investment are available. In general terms, the forecasts demonstrate the impacts on the passenger sector are generally greater than the freight sector. This is partially due to the assumption that freight trains only receive a smaller time saving after corridor rehabilitation. This assumption can also be validated by observing freight travel times on the Constanta line before and after the line rehabilitation. The very low rail mode share and significant proportion of the population without a car available contribute to the relatively high increase in passenger demand.

5.6.9 Similarly, Table 5.11 highlights that scenario “A” variants tend to perform better than the alternative scenario “B”, particularly if the only differences are the assumed maximum design speed. This implies that the extra benefits generated from the higher maximum speeds does not justify the additional costs. Whilst there are sections where upgrades beyond the current design speed would help to smooth speed profiles, these proposals should be examined in more detail. For example, Test DS05B comprises the electrification of the line between Bucharest and Sibiu via Pitesti and Ramnicu Valcea (Corridor 200) removes air pollution dis-benefits that would occur in DS05A from the diesel freight trains. The only enhancement in test DS05B versus DS05A is electrification, whilst DS07B includes line doubling and electrification.

5.6.10 The results for scenario DS07 suggest that either variant ‘A’ or ‘B’ could be included in the combined scenario alternative (DS99A). However, DS07A has been selected since it generates the highest NPV. Test DS02A results in a minor reduction in freight traffic following the removal of speed restrictions between Bucharest and Constanta. This corridor did not achieve a reduction in freight journey time savings in the early 2000s suggesting that the current condition of the line does not constrain travel times. In this context, the passenger trips transferring from road to rail slightly improves the traffic flow using the parallel motorway which in turn improves the attractiveness of road freight.

Table 5.11: Headline Results from Selected Model Runs

Model run	Increment in Pass-km (000's 2030)	Increment in Pass-km share (2030)	Increment in Tonne-km (000's 2030)	Increment in Tonne-km share (2030)	NPV € Mill (2014 Prices)	BCR
DS01A	+5,814 (+27%)	+1.7%	+4,175 (+9%)	+1.2%	129	1.06
DS01B	+6,374 (+30%)	+1.9%	+4,189 (+9%)	+1.2%	-90	0.96
DS02A	+1,422 (+7%)	+0.4%	-14 (+0%)	0%	261	19.62
DS03A	+4,946 (+23%)	+1.5%	+4,101 (+9%)	+1.2%	116	1.07
DS03B	+5,721 (+27%)	+1.7%	+4,083 (+9%)	+1.2%	16	1.01
DS04A	+6,783 (+32%)	+2.0%	+2,159 (+5%)	+0.6%	548	1.24
DS05A	+1,253 (+6%)	+0.4%	+1,435 (+3%)	+0.5%	0.01	-595
DS05B	+1,238 (+6%)	+0.4%	+1,358 (+2%)	+0.4%	670	1.62
DS06A	+1,390 (+7%)	+0.4%	+1,220 (+3%)	+0.3%	-1,173	0.39
DS06B	+2,156 (+10%)	+0.6%	+1,221 (+3%)	+0.3%	-1,724	0.35
DS07A	+180 (+1%)	+0.1%	+456 (+1%)	+0.1%	-313	0.3
DS07B	+389 (+2%)	+0.1%	+456 (+1%)	+0.1%	-736	0.39
DS07C	+58 (0%)	+0%	-19 (0%)	0%	-5	0.98
DS08A	+1,212 (+6%)	+0,4%	+281 (+1%)	+0.1%	-90	0.64
DS09A	+1,085 (+5%)	+0.3%	+414 (+1%)	+0.1%	-626	0.25
DS10A	+545 (+3%)	+0.16%	+123 (+0%)	0%	335	4.2
DS10B	+545 (+3%)	+0.16%	+123 (+0%)	0%	347	2.68
DS11A	+363 (+2%)	+0.1%	+92 (+0%)	0%	-12	0.91
DS99A	+24,289 (+115%)	+7.1%	+8,525 (+19%)	+2.5%	337	1.04

[1] All figures are versus Rail reference scenario: steady state maintenance of the core network and 2011 passenger timetables.
Source: AECOM

Detailed Results Analysis

5.6.11 An approximate BCR has been calculated by route section by sub-dividing the costs and benefits, as shown in Table 5.12. Although this exercise produces aggregated results, it does provide a helpful indicator to rank projects and help inform the selection of priorities. A more detailed description of the test results is included in Appendix C. Table 5.12 demonstrate how sections of track closer to Bucharest tend to generate a better value for money. The two exceptions include Timisoara to Arad and Baia Mare to Satu Mare which link medium to large size cities with a poor rail service at present. Higher frequency regular interval timetables have been proposed between these cities which are expected to attract significant patronage given the competition with local bus services. The Reference Case also assumes some sections of corridor Core Ten-T IV-N will be rehabilitated by 2020. In accordance with the model outputs, the network changes governance and service improvements have the potential to reverse the trend of falling passenger and freight demand and deteriorating network conditions. There is significant scope to increase passenger and freight traffic on core routes which would improve the rail network and provide better services at lower cost.

Table 5.12: Detailed Results for selected tests, 2014 prices

Test	Section	From	To	PVC (Mill €)	PVB (Mill €)	NPV (Mill €)	BCR
DS01A	All	Bucharest	Arad / Cluj	2,102	2,232	129	1.06
	1	Bucharest	Campina	63	371	307	5.87
	2	Campina	Brasov	139	312	174	2.25
	3	Brasov	Sighisoara	656	723	67	1.10
	4	Sighisoara	Teius	0	74	74	-
	5	Teius	Arad	706	603	-104	0.85
	6	Teius	Cluj	538	149	-389	0.28
DS01B	All	Bucharest	Arad / Cluj	2,500	2,411	-89.59	0.96
	1	Bucharest	Campina	60	400	340	6.63
	2	Campina	Brasov	314	341	27	1.09
	3	Brasov	Sighisoara	634	785	152	1.24
	4	Sighisoara	Teius	0	83	83	-
	5	Teius	Arad	683	641	-41	0.94
	6	Teius	Cluj	810	160	-650	0.20
DS03A	All	Bucharest	Arad	1,623	1739	116	1.07
	1	Bucharest	Craiova	560	703	142	1.25
	2	Craiova	Caransebes	785	689	-96	0.88
	3	Caransebes	Timisoara Nord	186	201	15	1.08
	4	Timisoara Nord	Arad	91	146	55	1.60
DS03B	All	Bucharest	Arad	1,979	1,996	16	1.01
	1	Bucharest	Craiova	565	729	163	1.29
	2	Craiova	Caransebes	1131	916	-215	0.81
	3	Caransebes	Timisoara Nord	192	212	20	1.11
	4	Timisoara Nord	Arad	91	139	48	1.53
DS04A	All	Bucharest	Galati / Iasi / Suceava	2,213	2761	548	1.25
	1	Bucharest	Buzau	231	891	660	3.85
	2	Buzau	Pascani	784	1259	476	1.61
	3	Pascani	Iasi	428	124	-304	0.29
	4	Pascani	Suceava	410	56	-354	0.14
	5	Buzau	Galati	359	430	71	1.20
DS06A	All	Cluj Napoca	Iasi	1,910	737	-1,173	0.39
	1	Cluj Napoca	Beclean pe Somes	420	239	-181	0.57
	2	Beclean pe Somes	Suceava	817	348	-469	0.43
	3	Suceava	Pascani	299	52	-246	0.17
	4	Pascani	Iasi	375	98	-277	0.26
DS06B	All	Cluj Napoca	Iasi	2,634	910	-1,724	0.35
	1	Cluj Napoca	Beclean pe Somes	420	195	-225	0.46
	2	Beclean pe Somes	Suceava	1,541	601	-940	0.39
	3	Suceava	Pascani	299	45	-253	0.15
	4	Pascani	Iasi	375	68	-306	0.18
DS09A	All	Cluj	Oradea	822	196	-626	0.24
	1	Cluj	Baia Mare	610	71	-539	0.12
	2	Baia Mare	Satu Mare	65	112	48	1.74
	3	Satu Mare	Oradea	147	13	-135	0.09

Source: AECOM forecasting model

5.6.12 The example presented in Figure 5.28 illustrates the forecast traffic changes for the combined scenario, which comprises the impact of including all the best performing options for each corridor. Passenger traffic is forecast to increase across the majority of the network, with the estimated rail patronage more than doubling compared with the reference scenario. The number of daily passengers between Bucharest and Ploiesti increases of least 25,000 in both directions, whilst there are increases of at least 10,000 between Timisoara and Arad, Bacau and Ploiesti, Brasov and Ploiesti and Craiova to Bucharest. The only parts of the network affected by a reduction in passengers include Iasi to Tecuci and Bistrita to Miercurea Ciuc, although these changes are caused by service improvements on parallel corridors.

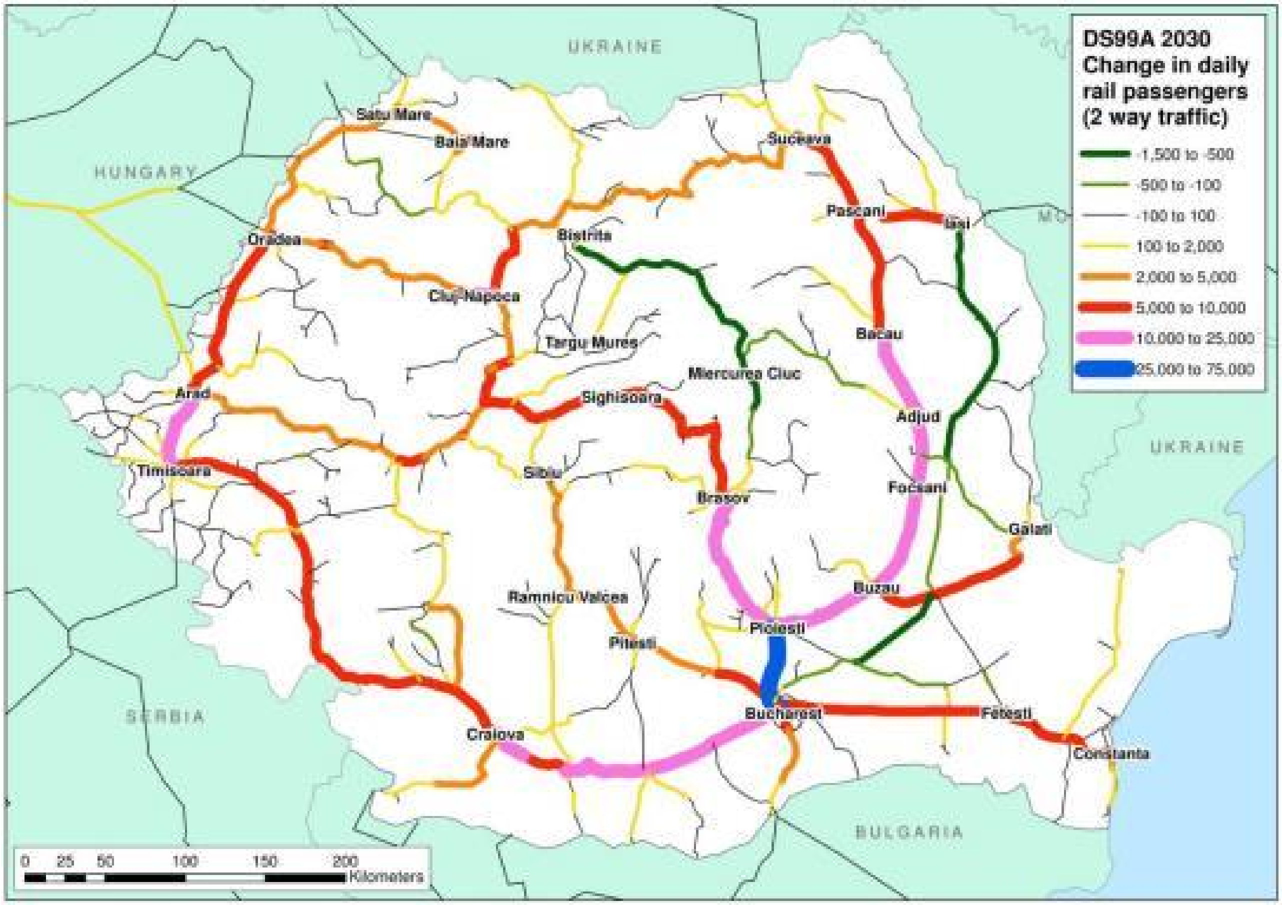


Figure 5.28: Change in Passenger Demand versus the Reference Case- 2030 Combined Scenario

Source: AECOM forecasting model

5.6.13 The increase in passenger traffic is even more evident when the foreasted flow for the 2030 combined scenario is compared against the observed 2011 flows, as Figure 5.29 demonstrates. Core corridors experience a substantial passenger traffic increase, with flows to and from Bucharest facing the largest increases in absolute terms.

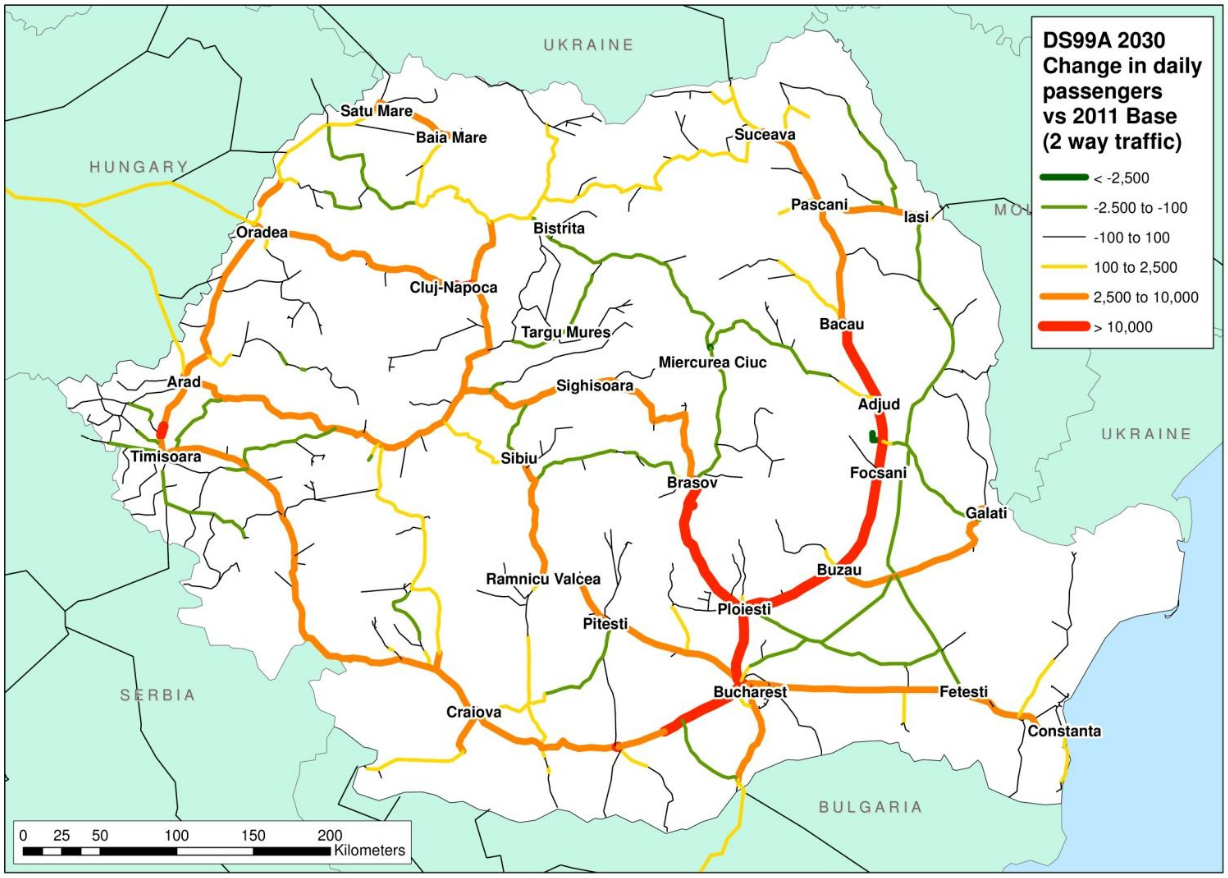


Figure 5.29: Change in Passenger Demand versus the base 2011 Case- 2030 Combined Scenario

Source: AECOM forecasting model

5.6.14 Freight traffic has been also forecast to rise about 20% in relative terms as shown in Figure 5.30.This increase would be achieved by restoring the rail network to design conditions, improving freight travel times considerably. Further demand growth could be delivered if new intermodal terminals were constructed and this is examined in Chapter 10. The corridors attracting most of the additional traffic are the lines from Bucharest to Arad via Craiova, Core Corridor Ten-T IX and the line Bucharest to Sibiu via the proposed new link between Valcele and Ramnicu Valcea.

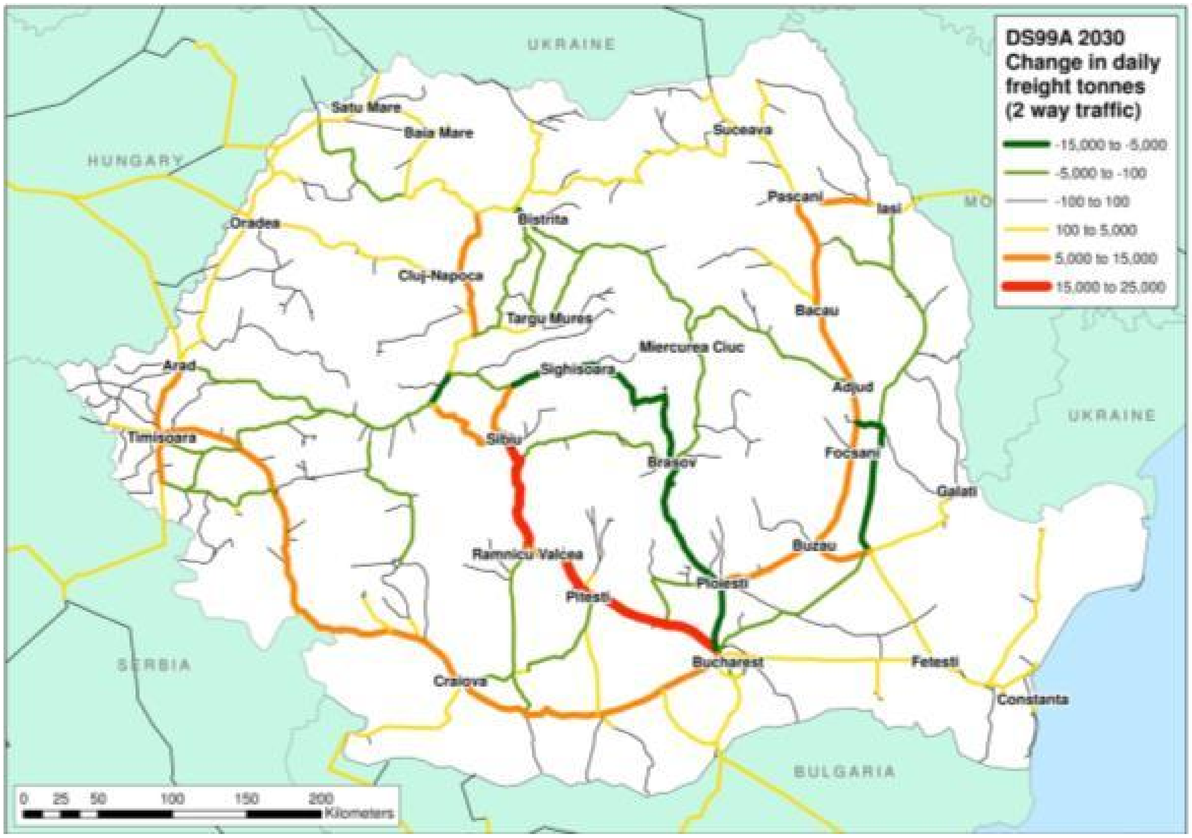


Figure 5.30: Change in Freight Demand - Combined Scenario

Source: AECOM forecasting model

Electrification Strategy

5.6.15 The potential impact of electrification schemes has been evaluated. Data presented in a World Bank report indicated about 6,000km of the current network has not been electrified, so the business case for investment must be calculated. The business case for electrification is usually determined by the potential reduction in operating costs that could be realised, although these efficiencies can be supplemented by the quantifying the economic value of reducing emissions if electric trains are introduced to replace diesel examples. The following assumptions have been applied to calculate the benefits and costs associated with electrification:

- o DMU cost for Inter-Regio trains: 52.6 lei / train kilometre;
- o EMU cost for Inter-Regio trains: 39.5 lei / train kilometre;

o Value of air pollution – diesel train kilometre: 0.6239 EUR (costs were converted to lei to provide consistency with other inputs);

o Value of air pollution – electric train kilometre: 0 EUR (costs were converted to lei to provide consistency with other inputs);

o Value of greenhouse gas – diesel train kilometre: 0.1792 EUR (costs were converted to lei to provide consistency with other inputs);

o Value of greenhouse gas – electric train kilometre: 0.1557 EUR (costs were converted to lei to provide consistency with other inputs);

o Capital costs per kilometre are estimated as 3.09m lei per single track kilometre. This estimate reflects the typical electrification costs per track kilometre for other European schemes, adjusted to reflect the lower wage rates in Romania;

o Other inputs include specifying the minimum number of train kilometres per day and hence the annual total, plus the load factor, required to demonstrate the scheme offers a robust economic case (for example, the benefit cost ratio exceeds 1.0).

o The values for the environmental parameters are based on the 'rural' rather than the 'metropolitan' area. The percentage of the railway that operates in the latter area is relatively small, so it is assumed that 100% of the route is located within a former area.

5.6.16 For a notional 100km electrification scheme, the high level results indicate an average of 1 train per hour in each direction for a 17 hour period would need to operate using electric traction to produce a positive business case (benefits exceed costs). All trains operating on this 100km section are assumed to be converted from diesel to electric traction to generate the necessary benefits. A conversion factor of 350 has been assumed to convert the daily totals to annuals. This minimum frequency threshold to make a positive business would need to be increased if there are sections of double track on the individual route sections, for example, Cluj Napoca to Oradea. Capital costs would be higher if a double track section of the network was electrified rather than a single track section would require a higher service frequency to produce a robust economic case. Assuming about 50% of the proposed route is double, the minimum frequency would need to increase by a similar proportion to generate sufficient benefits.

5.6.17 The business case for electrifying individual route sections has been examined to determine whether minimum frequencies are reached. This assessment has been conducted based on the current timetable, as well as the future service pattern assuming a regular interval pattern was introduced. This analysis indicated the section between Oradea and Cluj Napoca should be electrified regardless of the potential future timetable changes. There may be a case for electrifying the line from Galati / Tecuci to Barlad and Iasi, although parts of this line do not have sufficient trains to make an economic case.

5.6.18 There are a small number of other schemes that may generate a positive case for electrification assuming an improved timetable is introduced. This includes Bucharest to Pitesti and Brasov to Alba Iulia via Sibiu. In addition, there may be a case for electrifying between Santana to Oradea and Baia Mare to Dej, although this depends on the likely changes to the Regio services once an improved InterRegio timetable is introduced. The current train frequencies operating on non-electrified lines are included in Table 5.13.

Table 5.13 Summary of Current and Proposed Daily Frequencies (one-way)

Route Section	Current	Future	Route Section	Current	Future
Galati – Barlad – Crasna – Iasi – Husi	10	10	Brasov – Sibiu – Alba Iulia	14	17
Veresti – Botosani – Dangeni – Iasi – Cristesti Jijia	4-9	4-9	Blaj – Tarnaveni	11	11
Darmanesti – Dornesti	10	10	Tarnaveni – Praid	4	4
Dornesti – Nisipitu	4	4	Razboleni – Targu Mares – Deda	13	13
Bicaz – Bacau	9	9	Razboleni – Sarmasu – Sieu Magherus	7	7
Roman – Buhaiesti	6	6	Deva – Arad via Santana	6	6
Ploiesti – Urziceni – Giurgeni	5	5	Santana – Oradea	12	19
Bucharest – Urziceni – Faurei	10	10	Oradea – Cluj Napoca	23	27
Faurei – Tecuci	2	2	Oradea – Satu Mare	10	10
Ploiesti – Slanic	3	3	Satu Mare – Baia Mare	9	14
Ploiesti – Maneciu	2	2	Baia Mare – Dej	11	19
Bucharest – Pitesti	16	22	Jibou – Saculeni	6	6
Pitesti – Curtea de Arges	4	4	Satu Mare – Bixad	6	6
Pitesti – Argesel	5	5	Jibou – Carei	5	5
Pitesti – Rosiori de Vede	10	10	Timisoara – Resita	11	11
Pitesti – Craiova	10	10	Timsisoara – Jimbola	3	3
Rosiori de Vede – Zimnices	9	9	Timisoara – Sannicolau Mare	5	5
Rosiori de Vede – Turnu Magurele	4	4	Salva – Valea Viseului	6	6
Corabia – Caracal	6	6	Medgidic – Tulcea	4	4
Caracal – Sibiu	10	13	Medgidic – Negru Voda	2	2
Craiova – Calafat	4	4	Eforie – Mangalia	7	7
Bucharest – Oltenita	2	2	Videle – Giurgiu	7	7
Buzau – Neholasu	9	9	Caransebes – Subcetate	5	5
Sibiu – Copsa Mica	13	13	Lugoj – Illa	9	9
Tecuci - Barlad	15	15	Bucharest – Giurgiu via Baneasa	2	2
Timisoara – Stamora Moravita	10	10			

Rolling Stock Strategy

5.6.19 The relative inefficiency of the current rolling stock deployment was highlighted in the review of current problems. Just 65% of the fleet is required to operate the existing service, yet the timetables used in many Western European countries assume 85% of units are deployed. A combination of inefficient rolling stock scheduling and a higher allowance to reflect the relatively poor reliability of old units have contributed to this outcome. Using the ratio of train kilometres per day, the average speed of trains and the actual number of units deployed by Northern Rail in the UK, the revised number of trains required to operate the current timetable in Romania has been calculated. Even if an allowance is included to reflect less efficient diagramming of services compared with Northern Rail, an estimated 680 units would be required to operate the current service, with about 580 in daily service.

5.6.20 In addition, the number of additional units to operate the regular interval timetable has been calculated. Table 5.14 summarises the fleet requirements by service proposal, and indicates the type of rolling stock that could be introduced to best meet the journey patterns of passengers. A total of 104 units (or nearly 550 carriages) would be required to operate this timetable.

5.6.21 The initial forecasting outputs and the proposed service patterns described above were used to inform the selection of rolling stock, in terms of the the mixture of long or medium distance electric or diesel multiple units. Loco hauled sets could have a role to play assuming there is sufficient demand for the longer distance services, since this type ofoperation hauling less than 6 coaches is inefficient. Furthermore, there may be potential to introduce rolling stock with capability to tilt. This type of rolling stock may enable some journey time savings to be achieved, albeit with a higher capital costs. A separate feasibility study is needed to determine whether there is a business case for higher specification rolling stock once the possible line speed improvements have been evaluated. A generic cost per coach for new rolling stock has been used in the scheme appraisal. References to ‘electric’ or ‘diesel’ in Table 5.14 reflect the potential opportunities to introduce alternative traction, depending on the outcome of the cost-benefit analysis for electrification.

Table 5.14: Additional Rolling Stock Requirement

Scheme	Scheme	Rolling stock	Traction	No. of carriages
Bucharest to Arad / Cluj via Brasov	DS01	22	Electric	5
Bucharest to Constanta	DS02	4	Electric	4
Bucharest to Arad via Craiova	DS03	19	Electric	9
Bucharest to Galati / Iasi / Suceava	DS04	25	Electric	5
Bucharest to Sibiu via Ramnicu Valcea	DS05	7	Electric or diesel	4
Cluj Napoca to Iasi	DS06	7	Electric	4
Cluj to Oradea	DS07	4	Electric or diesel	2-3
Timisoara to Oradea	DS08	5	Electric or diesel	4
Oradea to Cluj via Baia Mare	DS09	6	Diesel	3
Bucharest to Giurgiu	DS10	2	Electric or diesel	5
Craiova to Calafat	DS11	3	Electric of diesel	3
Combined scenario	DS99	104		

5.7 MCA Analysis

5.7.1 As noted in Chapter 2.8, project prioritisation forms a critical step in producing the Master Plan, since the programme of investment identified are far greater than the available financial allocations. This implies the necessity of ranking projects considering a set of predefined evaluation criteria, which will assure a fair and neutral project prioritisation. Adding the funding restrictions to the list of ranked projects leads to obtaining of the implementation calendar. The following schemes have been prioritised using the multi-criteria assessment, as shown in Table 5.14.

5.7.2 The overall approach to project selection and the way in which projects are combined to form the final scenarios was set out in Section 2.6.

5.7.3 The funding allocations are discussed fully in Section 11.3 but are summarised here for the road network in Table

Table 5.14 Funding Allocation for Rail Investments (€M)

2014-2020	2021-2030	2014-2030
4,316	11,077	15,393

5.7.4 Whilst the final grouping of schemes is informed by the model and financial analysis, it is not a purely mechanistic process. At each stage, the masterplan team undertook reality and sense checks to ensure the process did not result in a poorly connected network or one that brought schemes forward for implementation in an illogical manner.

5.7.5 Also, additional criteria for prioritisation were the project readiness/maturity, which implies promoting as priority interventions being in a more advanced stage of project preparation and also the availability of remaining budgets in 2020 or 2030.

5.7.6 In this respect, the following changes were done to the prioritisation:

o DS01A Bucharest to Hungary via Brasov + Teius to Cluj. Rehabilitation to design speed was promoted as a priority in year 2020. This implies, in fact, the completion of Corridor IV North rehabilitation, which states as a high priority for Romania, at the present time, and it also serves the EC objectives.

o There are available approximatively 2.4 bn EUR in 2020, for which Phase 1 of DN04A Bucharest to Iasi via Bacau + Buzau to Galati + Pascani to Ukraine. Rehabilitation to design speed is recommended. This implies the rehabilitation to design speed of section Bucharest-Sabaoani.

5.8 Summary of Interventions

Table 5.14: Results of the Multi-Criteria Analysis – Rail Schemes

		Code	Project Description	TEN-T	Score	Length	EIRR	Cost € Million (2014 prices)	Cumulated Cost € Million (2014 prices)	Implementation period
1	Rail	DS10A	Bucharest to Giurgiu via Gradistea. Rehabilitation to design speed. Revised timetable, signalling and station refurbishments.	Core TEN-T link	80.0	0.0	**14.7%**	145	145	2014-2020
2		DS02A	Bucharest to Constanta. Rehabilitation to design speed. Revised timetable, signalling and station refurbishments.	Core TEN-T link	41.1	0.0	**68.3%**	20	165	2014-2020
3		DS01A	Bucharest to Hungary via Brasov + Teius to Cluj. Rehabilitation to design speed. Revised timetable, signalling and station refurbishments.	Core TEN-T link	26.9	795.0	**5.3%**	3,035	3,200	2014-2020
4		DS04A	Bucharest to Iasi via Bacau + Buzau to Galati + Pascani to Ukraine. Rehabilitation to design speed. Revised timetable, signalling and station refurbishments.	Core TEN-T link	30.8	1260.0	**6.2%**	3,291	6,492	2014-2030
5		DS11A	Craiova to Calafat. Rehabilitation to design Revised timetable, signalling and station refurbishments. speed.	Core TEN-T link	30.0	0.0	4.5%	171	6,663	2021-2030
6		DS05B	Bucharest to Sibiu via Pitesti and Ramnicu Valcea. New link, rehabilitation to design speed and electrification. Revised timetable, signalling and station refurbishments.	Comprehensive TEN-T link	27.4	0.0	**8.2%**	1,241	7,904	2021-2030
7		DS03A	Bucharest to Arad via Craiova and Timisoara. Rehabilitation to design speed. Revised timetable, signalling and station refurbishments.	Core TEN-T link	26.3	875.0	**5.4%**	2,439	10,3434	2021-2030
8		DS07B	Cluj-Napoca to Oradea. Electrification and existing timetable. Revised timetable, signalling and station refurbishments.	Comprehensive TEN-T link	15.0	0.0	4.8%	399	10,742	2021-2030
9		DS08A	Oradea to Timisoara. Rehabilitation to design speed. Revised timetable, signalling and station refurbishments.	Comprehensive TEN-T link	14.0	0.0	3.3%	243	10,985	2021-2030

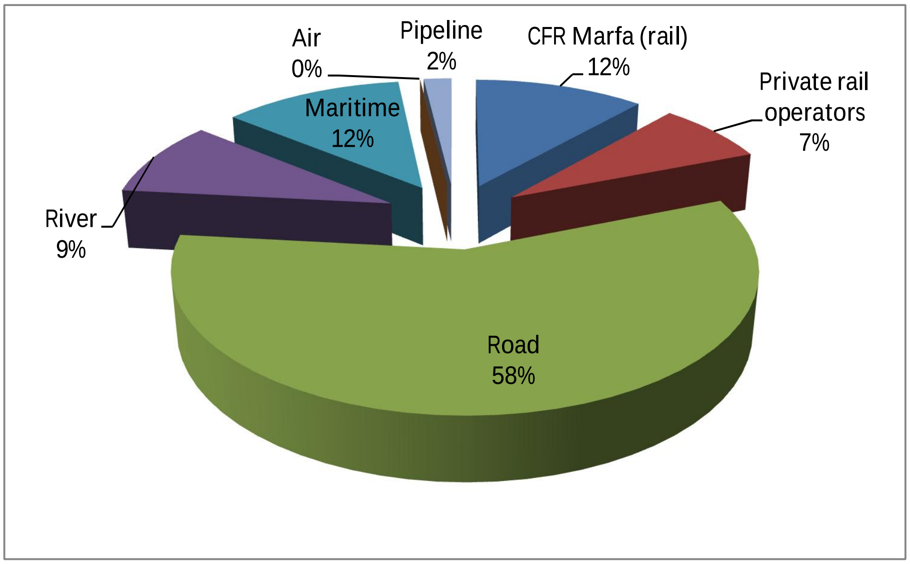
10		DS06A		Comprehensive TEN-T			0.3%			
11		DS09A		Comprehensive TEN-T			-1.3%			
12		DSF04	Timisoara to Stamora Morvita	Core TEN-T			-12.5%			

Ports and Waterways

6 Ports and Waterways

6.1 Existing Conditions

6.1.1 Over 318 million tonnes of freight was lifted in 2011. Figure 6.1 shows that there is also a large amount of water based freight both maritime and on the River Danube and canal systems.



Source: INSE and Consultants Estimate

Figure 6.1 – Modal Market Share of Freight Movements in Romania 2011

Ports

Constanta

6.1.2 As Romania's major seaport Constanta is the most developed and offers the widest range of facilities. The port handled 55million tonnes in 2013 and had 14,066 vessel movements of which 34% were maritime-related and 66% on to the river network (9,233). 64% of the port volume consists of dry bulk and cereals have recently been the most significant individual commodity at the port. Constanta also handles around 10million tonnes of liquid bulk and around 4 million tonnes of general cargo. In addition, it is a major regional container port, but it is not one the top 20 container ports (by volume) in Europe. It handled 661,000 TEU (Twenty foot equivalent units) in 2013, although the peak year for containers was 2007 when the port handled 1.41 million TEU. The ongoing economic conditions, particularly the low rates being paid for container movements, have affected shipping lines to the extent that fewer shipping lines serve the port and shared services arrive with containers for several shipping lines.

6.1.3 Constanta has a large hinterland and acts as a transhipment point for many goods. Several other European ports already provide good links to Central Europe but there is scope for Constanta to increase its throughput provided that road, rail and water links are improved. Being further east and geographically closer to China by several days sailing time than northern European ports means Constanta could attract market share from other ports if the economies of scale and shipping rates are attractive.

6.1.4 The port has completed several infrastructure projects in recent years such as Rehabilitation of the Breakwaters of Constanta's Port (€70 million); New Container Terminal on Pier II S South Constanta Port ($90 million); Barge Terminal (€24 million), Constanta Port Environment and

Infrastructure Project (€22 million); these were financed mainly by IFIs (EIB, Phare Programme, JBIC, EBRD) and co-financed by the state budget and the company's own resources.

6.1.5 Ongoing developments include four main projects financed by the Structural Funds of European Union and co-financed by the State Budget through the Sectoral Operational Programme in Transports 2007- 2013. These are the extension of the North Breakwater by 1050 m, (€136 million); the road bridge over the Black Sea Danube Canal and related road access infrastructure (€30 million); the development of the railway capacity in the river-maritime sector (€17 million) and the Southward Extension of the Lighter Berth in the Port (€5million).

6.1.6 The port commissioned its own Masterplan in 2013 aimed at identifying major investment plans, for example a €300m development at the south side, a plan for the development of a LPG/oil terminal (depending on private investor input) and other developments such as an ongoing dredging programme, and highway improvements including widening the main internal roads from two to four lanes.

Sulina

6.1.7 Sulina is a comprehensive TEN-T port as it serves an essential service to the residents for both passenger and freight services in the Danube delta region. Sulina port has a quay length of 5,940m and has four berths. However, it is mostly focused on the movement of passengers, handling very little cargo traffic.

Tulcea

6.1.8 This is a major port with 41 berths and is designated as a comprehensive TEN-T port. It has eight gantry cranes (max 16t) and a total area 82,762m2 (open storage of 70,000m2). The port serves as a gateway to the Danube delta region and has passenger vessels and also serves the local industry. The port is dominated by the handling of raw mineral products (quarrying and gravel, gypsum, slag, salt) and is mainly involved in supplying the construction sector. As such the facilities it requires are based around quarry extraction and loading. Slightly further along the river is the Industrial Port of Tulcea. It was built in 1974 in order to provide raw materials for factories processing metal in Tulcea. The main activities are loading and unloading of various raw materials such as manganese, bauxite, iron ore, limestone, ferroalloys from maritime and river vessels.

Galati

6.1.9 Galati is the second largest port in Romania handling over 5 million tonnes in 2011, and is designated a core TEN-T port. The region also produces a lot of material which is suitable for transit[28]. Galati port is:

- The biggest river-maritime harbour in Romania
- A useful link from landlocked countries to Black Sea ports
- Home to a number of Value Added Logistics services.
- Linked directly with the Ukraine and Moldova (less than 7km by road).
- A rail connected port[29] uniquely with both European and Russian gauge, linking (respectively) to the European Union and former Soviet Republics.

[28] Meeting 4
[29] MT

o Home to 56 berths, 31 gantry cranes (max 32t), ten mobile cranes (max 63t) and nine floating cranes (max 32t). It has one reach stacker and conveyor belts for bulk handling of coal and iron ore.

o 864,131m^2 in size (open storage of 538,320m^2 and covered storage of 7,200m^2). In addition there is a free port zone area of 73,967m^2

6.1.10 As well as handling imports and exports Galati acts as a transhipment port from barge to coastal ship for onward delivery to Black Sea ports serving Ukraine, Russia and Turkey. Galati also conducts significant international trade with Austria, Serbia etc. on the Danube. Galati imports significant amounts of iron ore for the adjacent steelworks. There is an established significant domestic iron ore flow by barge from south west Romania to Galati which is a distance of 800km. Transit traffic forms the largest portion of traffic at Galati. Galati mainly handles grain, aggregate and scrap iron. Other commodities and routes at Galati include30: aggregate, cereals, coal, a developing container operation, scrap, chemicals, LPG Gas fuel and cement.

6.1.11 The current lack of facilities operating in intermodal system represents a major obstacle in the integration of port logistics in international flows, port infrastructure and railway marshalling yard are old and inadequate. The connections to the national road and rail transport networks are slow and ineffective.

Braila

6.1.12 This is a major port and designated as a comprehensive TEN-T port. It has twelve gantry cranes (max 16t), eight mobile cranes (max 25t), two floating cranes (max 30t), five reach stackers and conveyor belts and pneumatic equipment suitable for grain handling. The total port area is 398,630m^2 (open storage of 250,350m^2 and covered storage of 10,804m^2) of which 22,750m^3 is of grain and 6,000m^3 animal fodder silos. The port is rail connected but this infrastructure is old and the roads leading to the port, particularly from its northern entrance are not ideal with poor signage and security. Braila handles raw mineral products, grain, wood products and fertiliser.

Cernavoda

6.1.13 This designated core port has three gantry cranes (max 16t) and an open storage area of 20,000m^2 and 2,000m^2 of covered storage. APDF purchased a ship which is based at the port for €11m to handle ship waste, facilitate treatment and store water.

6.1.14 Cernavoda handles the unloading of raw minerals and wood (unloading 101,065 tonnes of the former and 24,396 tonnes of the latter in 2011, as opposed to loading 5,322 and 1,050 tons respectively) and as such does not require heavy investment in other commodity types, although the port should aim to be flexible in the range of commodities it handles.

Medgidia

6.1.15 Medgidia Port offers both industrial (17) and commercial (5) berths in addition to its passenger services. It also has 3 gantry cranes and 2 floating cranes and its main industries are agricultural operations and cement handling. However, there is room for improvement to the area for ships waiting for access, where the concrete has become damaged.

[30] Meeting 4

Port of Basarabi/Murfatlar

6.1.16 Basarabi/Murfatlar port is located on the Danube-Black Sea Canal, and offers 11 berths within its basin for industrial use, along with its single passenger berth. It also has a couple of gantry cranes and 3 mobile cranes for cargo handling.

Port of Calarasi

6.1.17 Calarasi port is accessed by a short navigation channel and is designated as a comprehensive TEN-T port. The operating area is split between 81,505m2 for Calarasi Commercial, 62,500m2 for Calarasi industrial and 5,091m2 for Calarasi Chiciu. The commercial port (on the Danube) handles mostly agricultural goods currently, whilst the industrial port (on the navigation channel) was designed to be a key shipment point for steel from the vast Combinatul Siderurgic Călărași – Siderca steel works. Now mostly abandoned, apart from a limited production area, this has not provided the tonnage for which the port was developed (although it has an estimated capacity of 470,000 tonnes per year), and extensive looting has resulted in significant damage to links with the under-utilised steel mill.

Port of Oltenita

6.1.18 This port is designated as a comprehensive TEN-T port and has three quay cranes and can accommodate barges of up to 2,000t and handles around 520,000t per year. Oltenita is currently undergoing quay works to build 200m of stepped frontage and has invested €25m for processing passengers and bulk goods[31]. Despite its close location to Bucharest, unlike Giurgiu it handles little to no container traffic, instead mostly handling raw mineral products and grain.

Port of Giurgiu

6.1.19 Giurgiu is designated as a core TEN-T port. It is located on the intersection between the River Danube and Corridor IX, which is the north-south route between the Baltics and Bulgaria, Greece and Turkey. The bridge between Giurgiu and Ruse in Bulgaria has been a key link for rail and road services over the years. The border crossing has seen significant volumes of goods traffic often foreign lorries and the route is in the top four Romanian rail freight border crossings. Giurgiu is also one of the closest Danube ports to Bucharest which makes it geographically important. The port has eight berths, two gantry cranes (max 16t), one mobile crane (max 50t), and one reach stacker. The port has a 17,000m^2 freeport zone with a customs bonded warehouse and 7,200m^2 of covered storage. It also has 10,000m^2 container storage yard with container stuffing and stripping. APDF recently purchased a ship which is based at the port for €11m to handle ship waste, facilitate treatment and store water.

6.1.20 Giurgiu Port operates from 4 locations which offer dedicated port facilities:

- Commercial Port "Ramadan": passenger harbour, plus berths handling agricultural products from vertical grain elevators, ballast (gravel) products, coal, general cargo.
- "Canalul Plantelor / Sf. Gheorghe" Port: grain elevator of 10.000 tons, also handles aggregate and general cargo.
- Cioroiu Port: oil terminal.
- Giurgiu Free Zone Port: operating general goods and containers.

6.1.21 Given its location near the land-based border crossing, and its location near Bucharest (along with its size) this port is an important node for future freight flows on the Danube. Giurgiu has had mixed fortune since 2008. This is likely to be due to the economic crisis. The tonnes handled

[31] APDF, AECOM meeting 10

in 2011 are 45% of tonnes handled in 2007. Containers have a growing role at the port and grain and cereal products are key commodities too.

Port of Corabia

6.1.22 Corabia currently handles little freight traffic and is in a relatively severe state of dilapidation, with the exception of some grain and cereal traffic and storage facilities. However, it is well located, as it is the only port of considerable size between Giurgiu and Calafat, and has therefore a large hinterland which could be accessed from the port. It is also over 227,000m^2 offering plenty of space for further development and expansion. As such the scheme explored the potential for improving the quality of the berthing facilities at the port:

Port of Bechet

6.1.23 The port of Bechet currently has little regular freight traffic, although floating cranes are available if notified in advance for the loading/unloading of freight. The main user of Bechet is the RO-RO ferry across the Danube to Bulgaria. However, the port is located near to the industrial hub of Craiova, and as such may be a potentially useful terminal for the handling of abnormal loads.

Port of Calafat

6.1.24 Calafat is designated a core TEN-T port which has three berths, two land-based cranes, assorted floating cranes and can accommodate barges of up to 2,000t and handles 139,000t in 2011. It has 11,000m^2 of storage and RO-RO facilities. APDF purchased a ship for €11m that is based at the port to handle ship waste, facilitate treatment and store water. Calafat is on the recently designated TEN-T Corridor IV South which makes use of the newly opened road and rail bridge linking Vidin in Bulgaria to Romania. This corridor has a significant potential as it could become a core route for freight flows from Germany and Central Europe to Turkey and could offer a real alternative to existing routes through Serbia, and indeed has seen significant recent growth in tonnage handled.

6.1.25 Due to existing current flow growth, along with potential new flows and the new border crossing it is important to improve links with the port by other modes so that full realisation of these benefits can be achieved.

Port of Drobeta Turnu Severin

6.1.26 Drobeta is designated a core TEN-T port and is the first port classified by AECOM as being of national importance when approaching Romania from Central Europe and is located on the TEN-T Corridor South. The port has seven berths, three gantry cranes (max 16t), one luffing-slewing crane (max 60t) and 13,725m^2 of open storage. APDF purchased a ship which is based at the port for €11m to handle ship waste, facilitate waste treatment and store water.

6.1.27 Drobeta Turnu Severin is strategically located to act as a transhipment point on the Danube for traffic headed to northwest Romania and to cities such as Craiova. Furthermore, tonnage has proven resilient at the port despite the economic downturn and is now growing strongly once more.

Port of Orsova

6.1.28 This port has four gantry cranes (max 16t), 16,000m2 of open storage and 6,650m3 of grain silos. However the infrastructure is aged and in need of some modernisation and this is therefore considered under the following scheme. Building materials and mineral products are an important component of freight trade at Orsova however no one industry is dominant nor is tonnage particularly consistent.

Port of Moldova Veche

6.1.29 This port has been included for consideration with a possible improvement scheme as it is the first port reached in Romania when travelling downstream. It has 3 berths, luffing-slewing cranes (max 36t) and 30,000m^2 of open storage and 2,000m^2 of covered storage. The port can provide container maintenance and repair, storage and container stuffing and stripping.

Local Ports

Port of Drencova

6.1.30 The port of Drencova is a small port, handling fewer than five vessels a year at its single berth. As such it is not seen as currently requiring further development or study for the masterplan.

Port of Gruia

6.1.31 Gruia mostly handles bulk ballast and gravel and is a small port (1,000m^2) which does not require further assessment at this time due to its limited infrastructure and future development potential for alternative uses.

Port of Cetate

6.1.32 Similarly, Cetate is a port of limited current size (1,000m^2) which handles bulk ballast and gravel from the dredging of the Danube and is currently not seen to require further development at this time.

Port of Turnu Magurele

6.1.33 Turnu Magurele is associated mostly with the chemical/fertiliser plant which is located adjacent to the port, handling both the chemical inputs and the fertiliser output of the port. Its specialisation towards this industry and limited use for other purposes would suggest that further development should be pursued in collaboration with the fertiliser plant rather than solely through public funds.

Port of Zimnicea

6.1.34 The steel sector is one of the ports key users, along with some ballast shipment. Due to its close working relationship with the steel industry, it is recommended that any further development should be pursued in collaboration with this sector rather than solely through public funds as its alternative uses are currently limited.

Port of Harsova

6.1.35 The port of Harsova has a single basin with 500m of sloped quay; which aside from passenger services is currently only used for shipment of sand extracted from the river bed. It is not felt that further development of this port is needed at the current time.

Port of Turcoaia

6.1.36 The port of Turcoaia is focused on the processing of construction stone from the Dantana Lui Manole quarry. As such, there is currently little scope for alternative development and so it is not considered further within the masterplan.

Port of Macin

6.1.37 Macin handles stone for the domestic construction industry and is focused entirely on the shipment of this; as such it requires no further consideration at the current time as it is not necessary for more general use.

Port of Gura Arman

6.1.38 Gura Arman is focused on handling stone from the Iacob-Deal quarry. As such, there is currently little scope for alternative development and so it is not considered further within the masterplan.

Port of Isaccea

6.1.39 Isaccea operated exclusively with the construction industry in terms of transporting and handling wood, stone and sand; whilst important within this sector it is not currently foreseen that it will need development for more general goods traffic and further assessment was therefore not undertaken.

Port of Mahmudia

6.1.40 Mahmudia is also focused on the domestic shipment of stone for the construction industry; with no need for alternative use and so its development is therefore not considered further.

Port of Ovidiu

6.1.41 Ovidiu is a port located on the Poarta Alba-Midia Branch of the Danube-Black Sea Canal. The port has two berths and handled 529,000 tonnes in 2011. No problems have been found at Ovidiu.

Port of Chilia Veche

6.1.42 Chilia Veche currently handles little or no commercial freight traffic, and as such is not considered further in this masterplan.

Port of Fetesti

6.1.43 Fetesti port is on the *Bratul Borcea* part of the River Danube. The port is not a significant freight operation. No problems have been identified at Fetesti.

Port of Tisovita

6.1.44 Tisovita port is not a significant freight operation and did not handle any freight in 2010 and 2011. No problems have been identified at Tisovita.

Port of Rast

6.1.45 Rast port is on the River Danube in the shared Romanian-Bulgarian section. The port is a very small operation.

Port of Bazias

6.1.46 Bazias port is on the River Danube close to the border with Serbia. The port is a very small operation.

Port of Luminita

6.1.47 Luminita port is part of the Danube-Black Sea Canal authority's (ACN) network of ports. It is close to Midia port (Constanta's satellite port). Whilst Luminita handles some freight, this is mainly mineral products. Luminita's proximity to Midia and Constanta means most freight generated in the area would be handled at these ports.

Waterways

River Danube

6.1.48 The Danube is a Class VII river under UN categorisation. It flows for approximately 1,075km within Romania and hence is a significant natural transport corridor forming much of Romania's southern border with Bulgaria. The Danube-Black Sea Canal directly links Romania's major seaport Constanta to the Danube. The Danube carries 9% of all freight in Romania (source: INSSE, year 2011), in terms of tonnes of transported commodities. There are some major settlements and industries located along the Danube corridor but many major settlements are not located on the waterway network (including Bucharest) and much of the country is poorly connected to the river.

Danube – Black Sea Canal

6.1.49 The Danube-Black Sea Canal was created to provide a shorter link to the Black Sea from the Danube, thereby avoiding having to navigate the difficult Danube delta. The canal bifurcates with the main canal going south towards the port of Constanta at Agigea. The north canal reaches the Black Sea at Midia port.

6.1.50 The Danube-Black Sea Canal was designed to facilitate the transit of convoys comprising as much as 6 towed barges, up to 3,000 tonnes each (therefore up to 18,000 tonnes per convoy). Ships of up to 5,000 tonnes (as well as respecting the maximum dimensions) can pass through the canal.

Future Trends in Water Freight Transport

Constanta

6.1.51 Figure 6.2 shows the future trends for Constanta port.

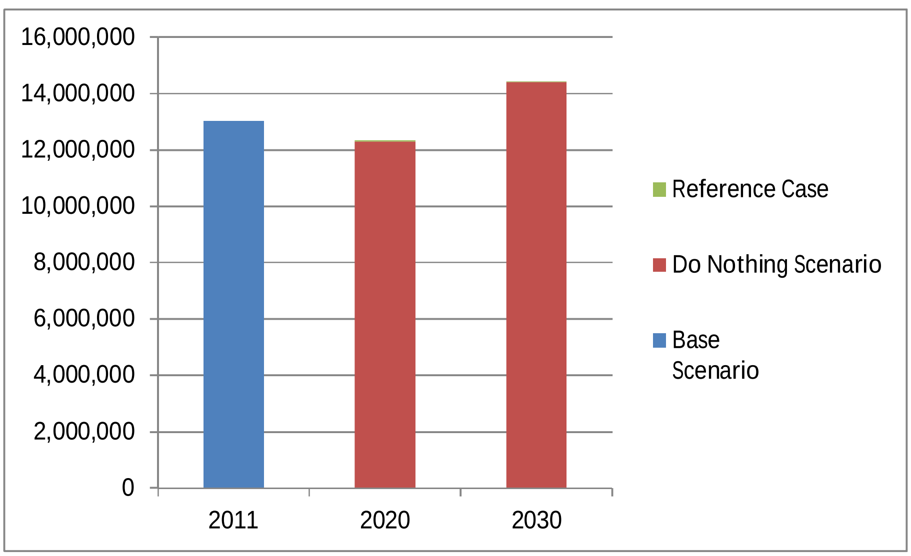


Figure 6.2 – Annual Water Frieght Tonnes Handled by Constanta

6.1.52 Figure 6.2 shows that despite a slight drop in the number of tonnes handled by Constanta between 2011 and 2020, between 2020 and 2030 the number of water freight tonnes handled by the port increases.

<u>Danube Ports</u>

6.1.53 Figure 6.3 shows that the future trends for the Danube ports that are part of the Primary Economic Network (see section 8.1.2 for further information on the Primary Economic Network).

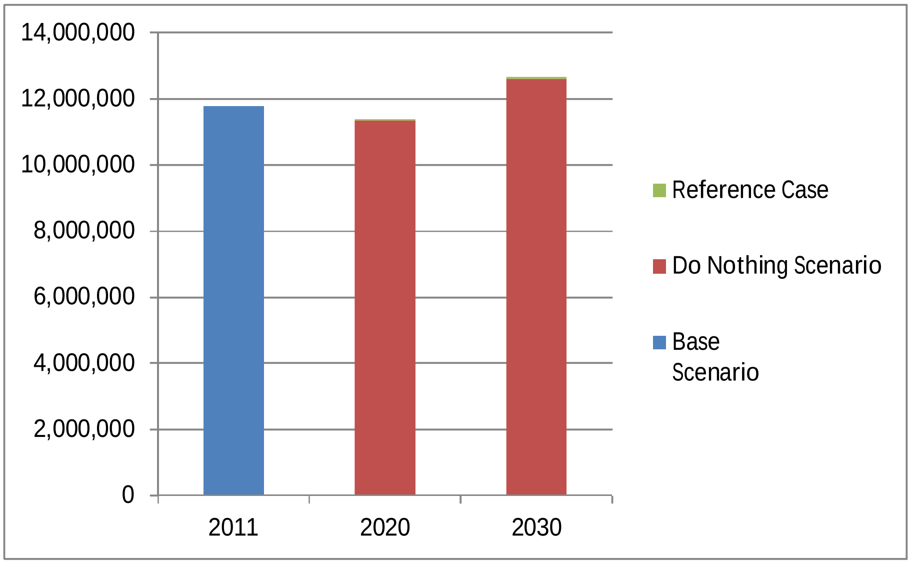


Figure 6.3 – Annual Water Freight Tonnes Handled by Danube Ports that are part of the Primary Economic Network

6.1.54 Figure 6.3 shows that despite a slight drop in the number of tonnes handled by the Danube Ports between 2011 and 2020, between 2020 and 2030 the number of water freight tonnes handled by the ports increases.

Existing Conditions of the Selected Ports and Waterways

6.1.55 The selected ports come from AECOM's Primary Economic Network. AECOM defined the Primary Economic Network as a mechanism for where we believe investment should be focused. This network was devised using a number of criteria:

- The existing designated TEN-T Ports
- Existing and predicted future volume of tonnage
- Connectivity with the rest of Romania
- Connectivity with key border crossing points (for other modes)
- Economically significant corridors, defined as those which carry high volumes of goods traffic

6.1.56 The selected Ports form a coherent network that provides convenient mooring and servicing facilities for river traffic. The ports are shown on Figure 6.4:

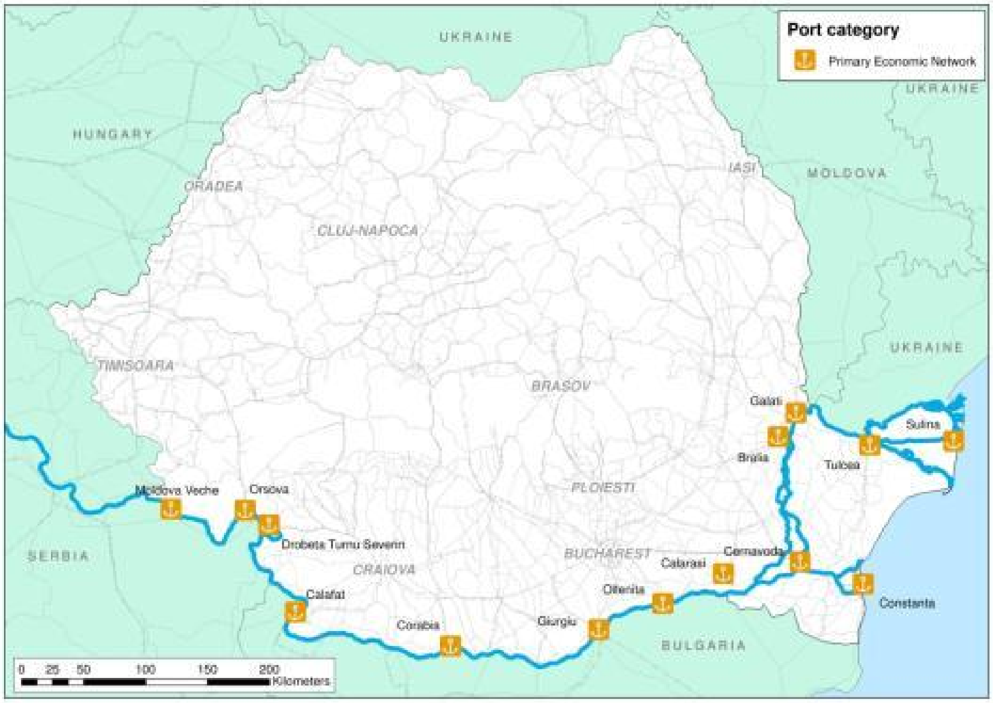


Figure 6.4: Romanian Water Freight Primary Economic Network

6.1.57 Note that the choice of Primary Economic Network ports does not mean that the remaining ports should be neglected. Many are tactical for one or two commodities and even those that that see little freight should be safeguarded for the future.

Constanta

6.1.58 Constanta is Romania's major seaport and offers the widest range of facilities. The port handled 55 million tonnes in 2013. It handles around 10 million tonnes of liquid bulk and around 4 million tonnes of general cargo and is a major regional container port. However Constanta is not in the list of top 20 European containers ports and has lost market share in recent years. In 2011 the port was estimated as being 46% utilised. Regaining market share and thereby container volumes by reassigning port facilities to container movements and regenerating older infrastructure should be considered a priority for the port. The port has commissioned its own Masterplan which will address the problems of Port Infrastructure and services in greater detail.

o **Problem:** Constanta has some old infrastructure that is unsuitable for handling new flows, including with containers. It also could improve its connectivity.

o Proposed Solution: Build a new container terminal at Constanta (III & IVS)

o The south of Constanta Port offers development potential for a container terminal, with the main advantage conferred by large depths for berths. A range of full and empty container handling should be developed in accordance with traffic projections to ensure Constanta competes with other major container ports. Whilst current capacity at Constanta is sufficient it is considered inadequate to accommodate growth in the longer term. Any such solution should be phased according to market conditions.

Sulina

6.1.59 Sulina port is designated a TEN-T port and is located on the mouth of the Sulina Channel at the Black Sea. The port serves town of Sulina and does not handle much freight. Sulina town can only be accessed by the port so the port handles a number of passenger ferry services.

- No problems have been identified at the port

Tulcea

6.1.60 Tulcea is a major port with 41 berths and designated as a comprehensive TEN-T port. It has eight gantry cranes and a total area of 82,762m^2. The port serves as a gateway to the Danube delta region and hence has passenger vessels and also serves the local industry. The port handles mineral products and raw materials. The port also has a significant shipbuilding industry. The land surrounding the port is arable farmland and much of the grain is currently transported by road to Constanta as the port has no facilities to handle grain. The port has been approaching capacity in terms of tonnes handled and will need to create additional facilities in order to handle grain.

- Tulcea is situated in the Danube Delta and there are some communities located between it and Sulina.
- **Problem:** People living in Sulina itself are not well connected to the national transport network due to Sulina's geography.
- Proposed Solution: Improve the existing passenger ferry service running from Tulcea to Sulina

6.1.61 There may be scope for an additional passenger ferry service to improve connectivity at Tulcea. The effect of this would be to reduce living costs for those people in the Danube Delta and increase the usage of Tulcea port. The connection with Braila and Galati will satisfy the Regional Development objective and offer some agglomeration benefits to Tulcea and Sulina. Additionally, the Danube Delta is a tourist attraction thanks to its unique biodiversity, and the ferry will be an environmentally-friendly way of transporting the increasing numbers of tourists to the area.

6.1.62 Tulcea is surrounded by arable farmland producing grain

- **Problem:** The grain is currently transported by road as the port is not set up to handle grain. Tonnes handled by Tulcea has grown since 2007 and in 2011 the port was almost at capacity.
- Proposed Solution: Development of a grain terminal

6.1.63 This would see the construction of 3 berths for the direct loading of ships with grain. This would also require the construction of suitable operating/loading facilities and some dredging to provide adequate depth. Connections to and from the port will also need to be upgraded.

Galati

6.1.64 Galati is the second largest port in Romania handling over 5 million tonnes in 2011. Transit traffic forms the largest portion of traffic at Galati. Galati handles grain, aggregate, steel, iron ore, coal and scrap iron. However, the current lack of intermodal facilities represents a major obstacle in the integration of port logistics in international flows. Additionally the port's infrastructure and railway marshalling yard are old and inadequate for modern logistics needs and the connections to the national road and rail transport networks are slow and ineffective. These factors limit the tonnage handled by Galati, leading to the port's current under-utilisation.

6.1.65 Galati is potentially well located to handle increased flows and serve north east Romania and Moldova but has old infrastructure and poor connectivity which are hindering its development.

The ageing infrastructure was designed around the needs of the local steel industry which has declined over the last decade. With lower volumes of coal and iron ore the port needs and wants to diversify to meet the needs of modern industry.

- **Problem:** Galati lacks intermodal facilities which is limiting the tonnage handled by the port
- Proposed Solution: Build a new trimodal terminal

6.1.66 A new trimodal terminal will facilitate direct transhipment of containers between vessels, trains and trucks. The terminal will also be equipped with RO-RO and facilities for trucks and offer some logistics services. The project will link with the port's Free Trade Zone and take advantage of Galati's proximity with Moldova and Ukraine.

- **Problem:** Galati's infrastructure is old, set up to handle flows that witnessed significant decline from what was intended. The port also sufferes from poor connectivity. All of this is hindering the port's development.
- Proposed Solution: Modernisation of existing bulk terminals

6.1.67 Modernising the existing bulk terminals so that a new terminal for palletised goods can be created will allow the port to improve its capacity to handle modern freight flows.

Braila

6.1.68 Braila is a major port and is designated as a comprehensive TEN-T port. It has significant dedicated infrastructure including reach stackers for containers and equipment suitable for grain handling. The total area is 398,630m^2 of which 22,750m^3 is of grain and 6,000m^3 animal fodder silos. In 2011, grain, wood products and raw mineral products were mainly handled by Braila. Braila has some berths that need upgrading and the road and rail network inside the port experiences congestion. The access road to the north of the port is of particularly poor quality with a lack of signage and good security. Upgrading the berths and port infrastructure will help to improve the port's capacity and which in turn will help to relieve its current high utilisation. Braila's berths are ageing and the port suffers from poor connectivity. The port has been highly utilised between 2007-2011.

- **Problem:** Braila's berths are ageing and the port suffers from poor connectivity
- **Problem:** The port is running out of capacity
- **Proposed Solution:** Both of these problems can be resolved by increasing capacity through berth improvement schemes. Existing, aged berths can be renovated and this will improve efficiency by allowing the berths to handle the goods that need to be handled. Note that the port is already undertaking schemes to address these issues.

Cernavoda

6.1.69 Cernavoda is a designated TEN-T core port with three gantry cranes and storage area of 22,000m^2. Cernavoda currently handles the unloading of raw minerals and wood. The port is poorly equipped to handle other commodity types, which restricts its flexibility and ability to adapt to changes in circumstances. This is reflected in freight volumes: the port handled over 130,000t in 2011, but the berths were only 5% utilised.

- **Problem:** Cernavoda is not able to handle further volumes of bulk freight
- Solution: Develop the infrastructure

6.1.70 Infrastructure improvements to Cernavoda would consist of dredging across the mouth of the basin as well as modernisation and refurbishment of cargo berths within the basin, including the provision of utility networks.

Calarasi

6.1.71 Calarasi port is a designated comprehensive TEN-T port. The port is split between Calarasi Commercial, Calarasi industrial and Calarasi Chiciu. The commercial port handles mostly agricultural goods, whilst the industrial port was designed to be a key shipment point for steel from the Combinatul Siderurgic Calarasi-Siderca steel works. The steel works has reduced much of its production and reduced in size. The effect has been to reduce the freight volumes passing through the port. As such the port is not achieving volumes for which the port was developed (an estimated capacity of 470,000 tonnes per year), and criminal activity has resulted in significant damage to the facilities. This prevents the port's full use for freight.

- **Problem:** The infrastructure at Calarasi is ageing and does not offer much in the way of added value services. Furthermore, much of the infrastructure was set up to handle steel from the nearby steel works. That steel works has now reduced much of its production and reduced its size. This means Calarasi is providing the wrong type of capacity, capacity which is no longer required.
- **Proposed Solution:** Modernise and rehabilitate the infrastructure at the port

6.1.72 Modernising and rehabilitating the infrastructure at the port would mean that the port could handle more freight that is actually being moved as opposed to the defunct flows.

Oltenita

6.1.73 Oltenita is a designated TEN-T core port. Oltenita is currently undergoing quay works to build 200m of stepped frontage and has invested €25m for processing passengers and bulk goods.

6.1.74 Despite its close location to Bucharest, unlike Giurgiu it handles little to no container traffic, instead mostly handling raw mineral products and grain. The port has also been highly utilised for the period 2007-2011.

- **Problem:** Oltenita is highly utilised and could run out of available capacity
- Proposed Solution: Develop the bulk handling infrastructure

6.1.75 Oltenita needs additional handling infrastructure in order to handle additional freight. The berths need to be improved at Oltenita which will make them suitable to handle mixed traffic.

Giurgiu

6.1.76 Giurgiu is a designated core TEN-T port. The bridge between Giurgiu and Ruse in Bulgaria has been a key link for rail and road services over the years. The border crossing has seen significant volumes of goods traffic, often moved by foreign lorries moving on a north-south axis and the route is in the top four Romanian rail freight border crossings. Giurgiu is also one of the closest Danube ports to Bucharest which makes it geographically important. The port is very dependent on the wider economy and was hard hit by the economic downturn. The port is handling an increasing number of containers and needs to be configured to handle the increased volumes. It also handles large volumes of grains and cereals.

- **Problem:** The bulk handling facilities at Giurgiu are approaching capacity, despite the port being less than 7% utilised in 2011. As such there is underdeveloped bulk handling infrastructure at Giurgiu.
- Potential Solution: Infrastructure and modernisation works
- Infrastructure and modernisation works at the port can see the port rearrange its infrastructure to accommodate modern logistics practices.
- Proposed Solution: Build a new tri-modal terminal

A new trimodal terminal at Giurgiu will increase the port's ability to handle intermodal containers. This development will include railway sidings of sufficient capacity, good road connections and secure access to the port itself.

Corabia

6.1.77 Corabia is well located, as it is the only port of considerable size between Giurgiu and Calafat, and has therefore a large hinterland which could be accessed from the port. It is also over 227,000m^2. Despite this, Corabia currently handles little to no freight traffic and is in a state of dilapidation, with the exception of some of its grain and cereal traffic and storage facilities. This is reflected in the low volume of freight that the port handled in 2011, which is down almost 50% since 2007.

- **Problem:** Corabia has antiquated infrastructure that is preventing effective and efficient flows of freight.
- Proposed Solution: Modernisation and rehabilitation of infrastructure
- The scheme would involve works to improve the berths which are currently in poor condition. Some of the higher piers require some remedial structural work to ensure their continued use.

Calafat

6.1.78 Calafat is a designated core TEN-T port which has three berths, two land-based cranes, assorted floating cranes and can accommodate barges of up to 2,000t. The port handled 139,000t in 2011 which is up 228% from 2007. Calafat is on TEN-T Corridor IV South alongside the newly opened road and rail bridge linking Vidin in Bulgaria to Romania. This corridor has significant potential as it could become a core route for freight flows from Germany and Central Europe to Turkey and is likely to see significant growth in tonnage moved. Due to potential new flows it is important to improve links between Calafat port and other modes of transport otherwise the potential of the Port will not be realised.

- **Problem:** Calafat has underdeveloped infrastructure
- Proposed Solution: Develop bulk handling infrastructure

6.1.79 Improve and modernise the handling infrastructure in order to be able to handle increasing freight volumes now that the port has new opportunities with the opening of the new bridge.

Drobeta

6.1.80 Drobeta is the first Core TEN-T port within Romania from the West. Drobeta is also located on the TEN-T Corridor South. Drobeta is strategically located to act as a transhipment point on the Danube for freight heading into northwest Romania and has handled a resilient volume of freight during the economic downturn which is now growing strongly once more. Drobeta needs to be able to handle this increase in freight tonnes by developing its infrastructure otherwise it will not be able to take competitive advantage. Whilst the port is only estimated to be 40% utilised in 2011, it has witnessed large growth in petroleum products and iron ore and needs to be able to handle these increased commodity volumes.

- **Problem:** Drobeta port does not have a dedicated container handling infrastructure which is causing inefficiency when handling containers.
- Potential Solution: Build a new trimodal terminal

6.1.81 This would see the existing intermodal facilities developed to take advantage of its position in Romania and the increasing flows of intermodal containers o **Problem:** Drobeta has old warehousing and storage facilities which are not suited to modern logistics practices.

o Potential Solution: Develop the infrastructure

o This scheme sees the improvement of facilities available at berths including handling equipment and provision of services. Improvement works would allow for the easier handling of freight.

Orsova

6.1.82 Orsova port has four gantry cranes (max 16t), open storage and grain silos. The port handles building materials and mineral products but no one industry is dominant nor is tonnage handled consistent from one year to the next. The infrastructure at Orsova is old and in need of some modernisation.

o **Problem:** Orsova's antiquated infrastructure is preventing effective and efficient flows of freight.

o Potential Solution: Modernisation of the port

6.1.83 This scheme would see the modernisation of the infrastructure through repairs and introduction of new facilities.

Moldova Veche

6.1.84 Moldova Veche is the first Romanian port reached when travelling downstream on the Danube. The port handles a variety of freight, the type and volume of which can vary considerably. The port offers added value services such as maintenance and repair, storage and container stuffing and stripping. However the port's infrastructure, in particular the berths and water depth is not adequate for efficient and effective freight operations. This is reflective in the number of tonnes that the port has been handling and its low utilisation. Moldova Veche is a small port that handles a mix of freight that varies in volume from year to year.

o **Problem:** The infrastructure at Moldova Veche is inadequate and inefficient. This is reflected by the low volumes handled

o Potential Solution: Development of the infrastructure

6.1.85 This scheme would see the development of the infrastructure at Moldova Veche so that the port would be able to handle a wider variety of freight which will reduce the port's reliability on volatile flow volumes.

River Danube

6.1.86 River Danube has few standard physical pinchpoints such as locks. The only lock on the Romanian section of the Danube is near the Iron Gates and is located 1,890km from the mouth of the river. Between the Iron Gates to Braila the Danube is more than 2km wide with numerous islands. The navigation channel moves several times per year due to the currents and remediation work is often needed to maintain the minimum 2.5m depth. There can also be problems with the width of the navigation channel which sometimes necessitates a single flow operation (as opposed to two way flow).

6.1.87 The Danube is not always navigable 365 days a year. Weather related factors such as drought or flood or ice do affect the river's navigation and the amount of traffic it can process. Ice is a problem during the winter months and in 2012 three months were lost as the Danube froze over which prohibited navigation. There is no dedicated ice breaker on the Danube. Water level is also an issue with the depth varying throughout the year. One operator estimated that full and efficient operation is only possible on about 250 days a year which means for the remaining 100 days operators need to make contingencies to get their loads delivered, either through sub-optimally loaded barges or in worst case scenarios having to use other modes of transport to deliver the goods.

6.1.88 The UN defines the Danube as an international waterway and the draught required for such status is 2.5m, although 2.8m is preferable. Seven sections of the Danube regularly fall below 2.5m draught and navigation was impossible on the lower river for more than 38 days in September and October 2011 because of insufficient water levels. A barge requires a draught of 0.5m when empty and up to 3m when fully laden. This variance allows an operator to vary how much load their barge can carry depending on the water levels. The only constant is the pushers that require between 1.8-2m of water. Shallow waters can make it impossible to push 2 or 3 barge-width convoys so some operators will split the convoy into two and double back. When this happens in the Zimnicea sector, the 150km stretch that should normally be traversed in 6 hours can take between 1 and 2 days. There is also the issue of barges having enough navigable ‘fairway’ in order to be able to pass each other.

6.1.89 Operators want a guarantee of water depth of 2.5 meters because otherwise they are not able to operate. Work is being done to try and obtain this by 2013 through intensive dredging (section Călărași-Brăila) and then this will be maintained which will cost less on an annual basis. Romania is currently spending €4m annually on dredging the fairway whereas Bulgaria only spends €100,000.

6.1.90 Some sections of the Danube are particularly vulnerable to shifting sands, especially in the Zimnicea sector. Annual maintenance through dredging does help but this is very expensive and cannot always maintain the desired 2.5m depth. More effective management of water on the secondary arms is thought to be needed to effectively combat this.

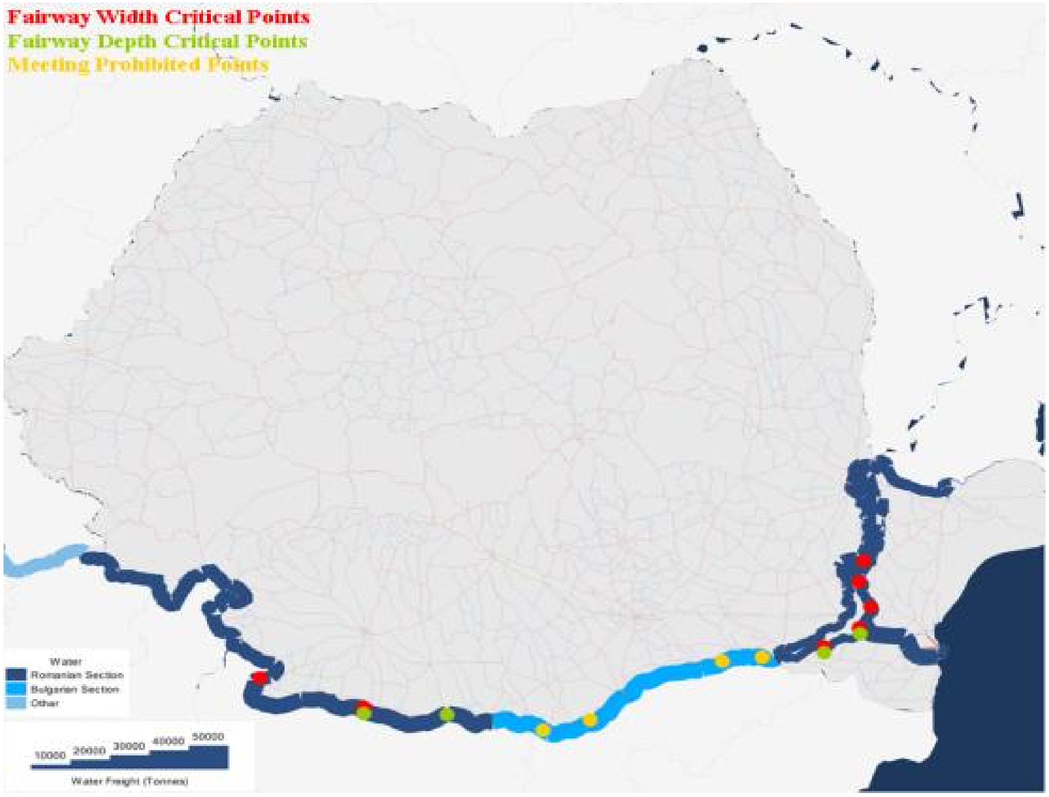


Figure 6.5 – Critical Navigation Points on the River Danube

6.1.91 The Danube has pinchpoints along its length where the fairway depth or width is reduced to below optimal standards (Figure 6.5 shows a snapshot of these). Low temperatures can cause the Danube to freeze and there is no dedicated ice breaking vessel for the Romanian section.

6.1.92 The maintenance budget Romania provides for the Danube is low compared to other countries which may be a contributory issue to the navigation problems on the Romania section. It is understood that there is an even smaller budget in Romania

6.1.93 As a consequence of the reduced navigability, vessels have had to make unscheduled stops and loads have been pilfered from them.

Danube – Black Sea Canal

6.1.94 The Danube – Black Sea Canal runs between Cernavoda on the River Danube to Constant on the Black Sea. The Danube-Black Sea Canal was created to provide a shorter link to the Black Sea from the Danube, thereby avoiding having to navigate the difficult Danube delta. The canal bifurcates with the main canal going south towards the port of Constanta at Agigea. The north canal reaches the Black Sea at Midia port.

6.1.95 The Danube-Black Sea Canal was designed to facilitate the transit of convoys comprising as much as 6 towed barges, up to 3,000 tonnes each (therefore up to 18,000 tonnes per convoy). Ships of up to 5,000 tonnes (as well as respecting the maximum dimensions) can pass through the canal.

6.1.96 There are locks on the Canal at Cernavoda, Agigea, Navodari and Ovidiu. The Canal's administrator ACN charges for transit of the Canal

6.2 Strategic Objectives

Strategic Vision

6.2.1 The strategic vision for Romania for water freight can be defined between the ports and its waterways. The strategic vision will satisfy the following strategic objectives:

- o Economic Development
- o Economic Efficiency
- o Safety
- o Sustainability
- o Environmental Impact

6.2.2 For Romania's ports the strategic vision is a core network of ports (called the Primary Economic Network – Figure 6.6) that strategically serves Romania with modern and efficient equipment and logistics practices. These ports have been chosen for based on specified criteria such as their status as TEN-T ports, scale, current and potential for freight operations and location.

Figure 6.6 – the Primary Economic Network

6.2.3 For Romania's port the strategic objectives that will be satisfied are:

- o Economic Development
- o Economic Efficiency
- o Sustainability
- o Environmental Impact

6.2.4 For Romania's waterways the strategic vision is a network that provides 24/7 access to all waterways users. This will ensure a common service level that is of a high standard that gives operators and passengers and freight confidence to use the waterways. This will be achieved by improving and maintaining the fairway to the 2.5m depth required as well as investing in features that will reduce or eliminate any impact of avoidable instances of reduced navigation such as dedicated ice breaking vessels.

6.2.5 For Romania's port the strategic objectives that will be satisfied are:

- Economic Development
- Economic Efficiency
- Sustainability
- Environmental Impact.

6.3 Operational Objectives

6.3.1 The water based operational objectives are:

- OW1 – Improve availability of the Danube
- OW2 – Improve Danube connectivity to reduce cost and time
- OW3 – Unblock barriers to operational efficiency
- OW4 – Reduce costs through operational efficiency
- OW5 – Improve coordination between levels of government and enable investment
- OW6 – Review existing assets to focus intervention to increase capacity
- OW7 – Reduce procedural delays to water freight
- OW8 – Reduce number and cost of accidents on Danube
- OW9 – Reduce emissions of CO2 and Sulphur Dioxide
- OW10 – Increase the amount of freight moved by sustainable modes
- OW11 – Make efficient use of port land and facilities
- OW12 – Increase use of intermodal transport

6.3.2 Each intervention has been rated against the operational objectives to determine validity.

6.4 Testing Interventions

6.4.1 This section considers the results from the National Transport Model on the interventions. Note that interventions from Section 8.3.4 have not been tested by the model.

Constanta:
Build a new container terminal at Constanta (III & IVS)

Proposal Description:

6.4.2 The south of Constanta Port offers development potential for a container terminal, with the main advantage conferred by large depths for berths. A range of full and empty container handling should be developed in accordance with traffic projections to ensure Constanta competes with other major container ports. Whilst current capacity at Constanta is sufficient it is considered inadequate for long term future growth. Any such solution should be phased according to market conditions. Specifically the project will incorporate:

- Safe handling and storage facilities

o Mobile or STS cranes for vessel loading and unloading

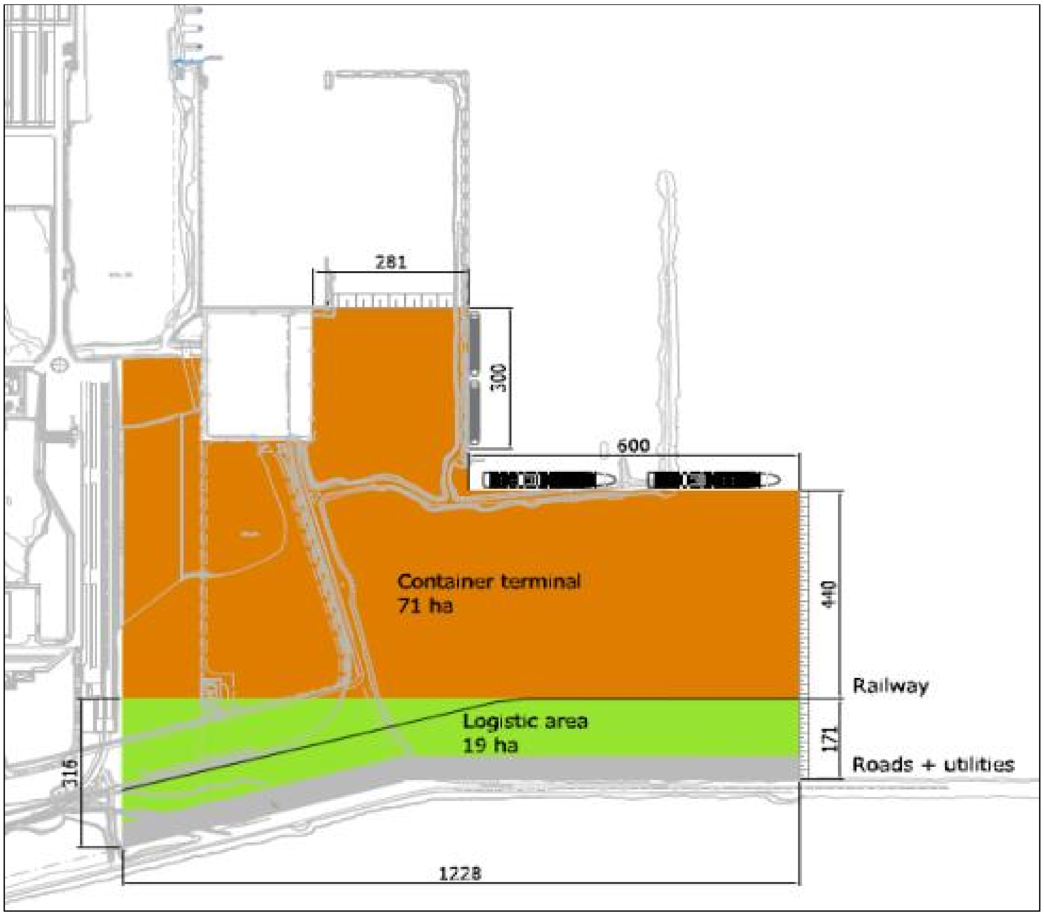


Figure 6.7 – Plans for a New Container Terminal at Constanta

Problems Addressed:

6.4.3 This intervention addresses the following issues at Constanta:

o A lack of modern infrastructure at the port

o A forecast lack of future capacity at Constanta

o The increasing competition from other ports by ensuring Constanta remains an attractive choice to international freight movers

Potential Market

6.4.4 This proposal would be for Constanta's large container operations.

Undiscounted Costs:

6.4.5 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**224.15**	**New container terminal** **Handling and storage area** **Mobile or STS cranes**
OPEX	**0**	
Total	**224.15**	**CAPEX + OPEX**

Outcomes:

6.4.6 The intervention gives a good return with a benefit-cost ratio (BCR) of 2.02. The terminal is anticipated to generate just short of a further 600,000 tonnes of containerised freight through Constanta in 2020. Based on these favourable results this project is recommended for inclusion in the Masterplan.

Test code	P-CO-S (W25)
Annual Water Tonnes Change (2020)	599,554
NPV € Mill (2014 Prices)	228
BCR	2.02
EIRR	8.9%
Masterplan Recommendation	✓

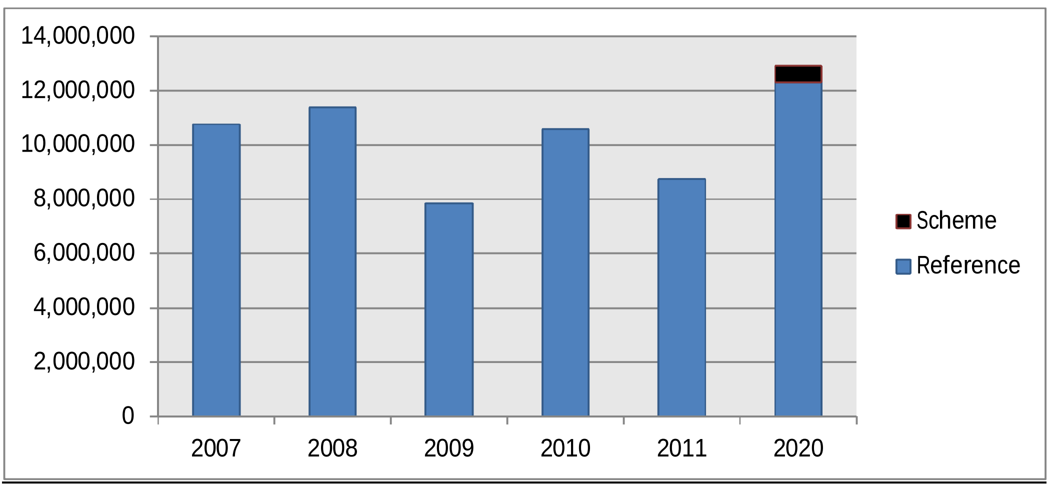


Figure 6.8 – Water Freight Tonnes Handled at Constanta 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.7 This scheme would be implemented by Constanta Port Authority in conjunction with private terminal operators.

Implementation years: 2021-2030

6.4.8 The port is still below its peak handling figure for containers (which was in 2008), however it is forecast that the port will exceed 2008's peak by the end of the decade. The consequences of this would mean that Constanta would exceed its current available capacity to handle containers. Therefore Constanta should begin to build this terminal by the end of the decade. The implementation schedule should be subject to market conditions at the port and adjusted accordingly.

Tulcea:
Development of a grain terminal

Proposal Description:

6.4.9 This would see the construction of a new grain terminal for which the port does not currently have. Specifically the project will incorporate:

- 3 berths for the direct loading of ships with grain.
- Construction of suitable operating/loading facilities
- Dredging to provide adequate depth to the berths
- pgrade of the connections to and from the port

Problems Addressed:

6.4.10 Currently the grain is transported by road where ultimately much of it ends up at Constanta to be exported around the world. This intervention would address the following issues:

- A lack of grain handling infrastructure at the port
- Reduction in road freight miles
- Maintain Tulcea's viability and competitiveness as a port

Potential Market

6.4.11 This proposal would be for grain operations.

Undiscounted Costs:
It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	10.15	New grain terminal Handling and storage area Mobile or STS cranes
OPEX	0	
Total	10.15	CAPEX + OPEX

Outcomes:

6.4.12 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.59. The terminal is anticipated to generate over 328,000 tonnes of additional freight in 2020. As the EIRR is less than 3% this project is not recommended for inclusion in the Masterplan.

Test code	P-TL-S (W41)
Annual Water Tonnes Change (2020)	328,527
NPV € Mill (2014 Prices)	-4
BCR	0.59
EIRR	-1.1%
Masterplan Recommendation	✗

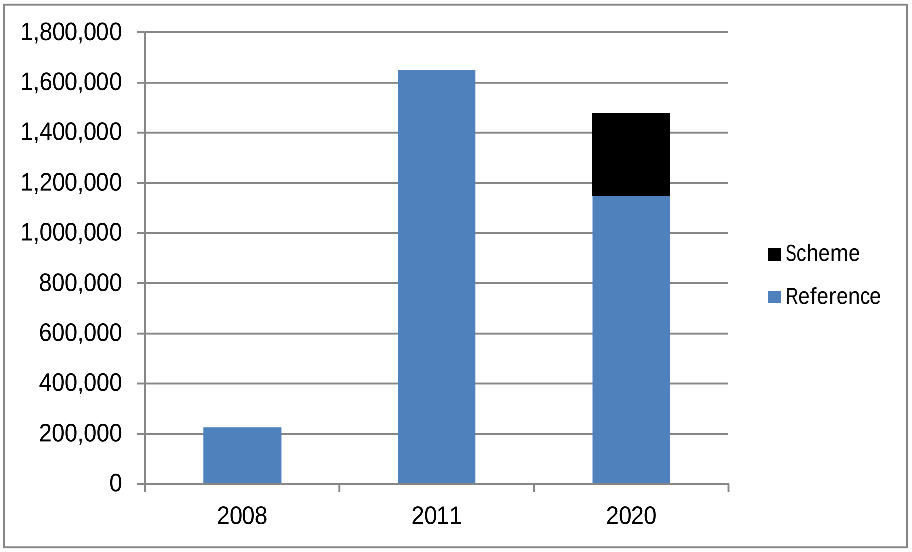


Figure 6.9 –Tonnes Handled at Tulcea in 2008 and 2011 and Forecast in 2020

Improve the existing passenger ferry service running from Tulcea to Sulina

Proposal Description:

6.4.13 This proposal involves an improved passenger ferry service running between Tulcea and Sulina and intermediate communities. Specifically the project will incorporate:

- The purchase of three new ferries
- The upgrade of 15 terminals

Problems Addressed:

6.4.14 For several communities in the Danube Delta the most suitable method of transport is on water. This intervention would address the following issues:

- Poor and dilapidated state of some of the terminals
- Improved connectivity for those who rely on the Danube Delta as either their home or business
- Improved potential for tourism

Potential Market

6.4.15 This proposal would be for passenger operations and possibly some light freight (such as mail).

Undiscounted Costs:

6.4.16 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	19.2	15 upgraded passenger terminals 3 new ferries
OPEX	0	
Total	19.2	CAPEX + OPEX

Outcomes:

6.4.17 The intervention gives a good return with a benefit-cost ratio (BCR) of 1.47. The terminal is anticipated to generate over 176,000 passengers in 2020. This project is recommended for inclusion in the Masterplan due to its green credentials and the increased connectivity it would have to the region.

Test code	W101
Number of Passengers per annum (2020)	176,713
NPV € Mill (2014 Prices)	9
BCR	1.47
EIRR	4.4%
Masterplan Recommendation	✓

Implementing organisation:

6.4.18 This scheme would be implemented by APDM Galati, possibly in conjunction with a private terminal operator.

Implementation years: 2014-2020

6.4.19 The implementation could happen as soon as project sign off is completed. It is not dependent on any other conditions.

Galati:
Build a new trimodal terminal

Proposal Description:

6.4.20 As part of a strategic network of intermodal terminals throughout Romania, Galati has been identified as a key location. The proposal is to build a new trimodal terminal at the port so that intermodal containers can take advantage of Galati's road, rail and water connections. Specifically the proposal will incorporate:

- A new intermodal terminal 7 hectares in size, including handling equipment
- Links to both European and Russian gauge railway lines
- RoRo facilities for trucks
- Logistics facilities
- Connectivity to the port's Free Trade Zone

Problems Addressed:

6.4.21 The port does not currently have a dedicated intermodal terminal which is limiting its potential. This intervention would address the following issues:

- Lack of a dedicated intermodal terminal
- Lack of an intermodal terminal network in Romania

Potential Market

6.4.22 This proposal would be for container operations.

Undiscounted Costs:

6.4.23 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**14.4**	**Trimodal terminal including handling equipment** **Links to European and Russian gauge railways** **Logistics facilities**
OPEX	**0**	
Total	**14.4**	**CAPEX + OPEX**

Outcomes:

6.4.24 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.94. The terminal is anticipated to generate over 186,000 of containerised freight in 2020. Whilst the modelled outputs are not entirely favourable this project is recommended for inclusion in the Masterplan as it is considered an important node in Romania's intermodal network and a port of Galati's size should be able to handle containers using modern methods.

Test code	I-GL-S (W18)
Annual Water Tonnes Change (2020)	186,743
NPV € Mill (2014 Prices)	-1
BCR	0.94
EIRR	4.7%
Masterplan Recommendation	✓[32]

Implementing organisation:

6.4.25 This scheme would be implemented by APDM Galati, possibly in conjunction with a private terminal operator.

Implementation years: 2021-2030

6.4.26 The implementation could happen as soon as project sign off is completed however it is recommended that development of the intermodal terminal is phased to suit prevailing market conditions.

Modernisation of existing bulk terminals

Proposal Description:

6.4.27 There are bulk terminal facilities at Galati that are old and inefficient. This inefficiency is leading to an underutilisation of the port. Modernising these facilities will improve options at the port. Specifically the project will include:

- A new terminal for palletised goods
- Dredging and realigning the basin for modern vessels
- Reinforcement of the structures

Problems Addressed:

6.4.28 Current facilities are old and not suitable for modern logistics practices. Whilst the port has spare capacity on paper, this is not realised in reality due to the condition of some of the facilities. This proposal would address the following problems:

[32] To be a phased development in line with demand and considered with adjacent scheme at Galati

- o Give a new lease of life for old infrastructure and terminals by making it suitable for modern logistics requirements
- o Turn over underutilised capacity to industries and commodities that need additional capacity
- o Realign the basin to allow modern vessels to easily use the port
- o Prevent further decay of the port and secure the port's long term future and viability

Potential Market

6.4.29 This proposal would be for Galati's bulk operations such as grain, aggregate and steel.

Undiscounted Costs:

6.4.30 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**10.93**	**Modernised bulk terminal** **Dredging and basin realignment** **Reinforced structures**
OPEX	**0**	
Total	**10.93**	**CAPEX + OPEX**

Outcomes:

6.4.31 The intervention gives a good return with a benefit-cost ratio (BCR) of 32.89. The terminal is anticipated to generate over 618,000 of freight in 2020. This project is recommended for inclusion in the Masterplan.

Test code	P-GL-S (W34)
Annual Water Tonnes Change (2020)	618,501
NPV € Mill (2014 Prices)	348
BCR	32.89
EIRR	39.9%
Masterplan Recommendation	✓

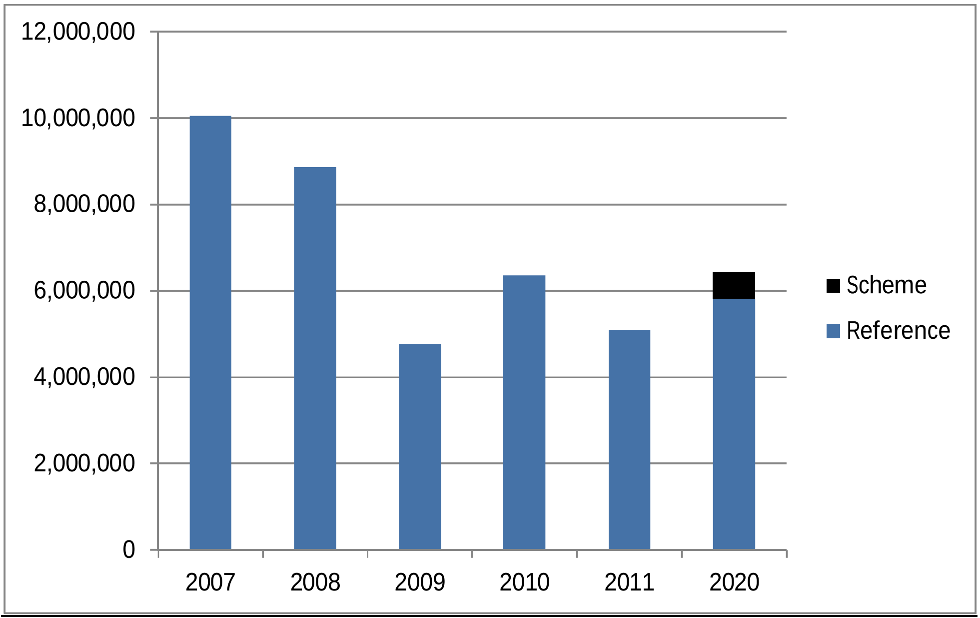


Figure 6.10 –Tonnes Handled at Galati 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.32 This scheme would be implemented by APDM Galati, possibly in conjunction with a private terminal operator.

Implementation years: *2014-2020*

6.4.33 The implementation could happen as soon as project sign off is completed however it is recommended that any terminal upgrades are phased to suit prevailing market conditions.

Cernavoda:
Develop the infrastructure

Proposal Description:

6.4.34 Cernavoda could do with its infrastructure being developed. This proposal will include:

- Modernisation and refurbishment of the berths so that it can handle multiple commodities
- Dredging of its basin
- Improved navigation signals

Figure 6.11 – Plans for infrastructure development at Cernavoda

Problems Addressed:

6.4.35 Undertaking this proposal would address the following problem:

- A reliability on a small range of commodity types which has lead to high volatility in freight volumes handled in the past

Potential Market

6.4.36 This proposal would be for Cernavoda's raw minerals as well as potential new commodities like aggregates. New markets would be determined by a future feasibility study.

Undiscounted Costs:

- o It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**4.36**	**Modernised and refurbished berths** **Basin dredging** **Navigation signals**
OPEX	**0**	
Total	**4.36**	**CAPEX + OPEX**

Outcomes:

6.4.37 The intervention gives a good return with a benefit-cost ratio (BCR) of 6.98. The terminal is anticipated to generate over 365,000 of freight in 2020. This project is recommended for inclusion in the Masterplan.

Test code	P-CV-S (W28)
Annual Water Tonnes Change (2020)	365,350
NPV € Mill (2014 Prices)	26
BCR	6.98
EIRR	22.4%
Masterplan Recommendation	✓

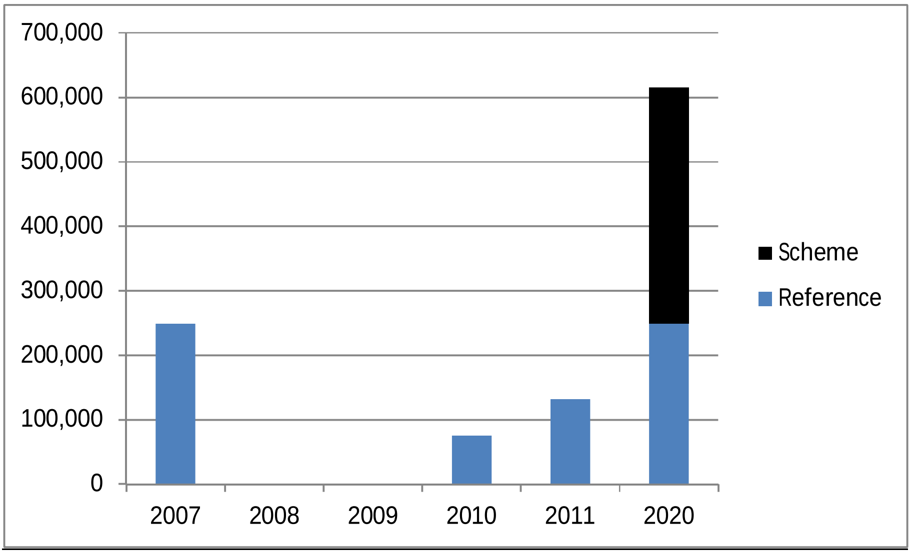


Figure 6.12 –Tonnes Handled at Cernavoda 2007-2011 and Forecast in 2020

Implementing organisation:

- This scheme would be implemented by APDM Galati, possibly in conjunction with a private terminal operator.

Implementation years: 2014-2020

- The implementation could happen as soon as project sign off is completed.

Basarabi:

Modernise the infrastructure

Proposal Description:

6.4.38 This scheme would see the some of the port infrastructure being modernised. Specifically the proposal includes:

- Modernisation of some port infrastructure
- Rehabilitation of 1,000m of road to improve connectivity to the port
- Improved security and provision of port services

Problems Addressed:

6.4.39 Basarabi has recently handled large volumes of freight related to local road building. Now that this is complete the volumes to be handled by the port are forecast to drop. Undertaking this proposal will address the following problems:

- A limitation in the current port infrastructure to handle modern freight
- Poor connectivity to the road network

- o Forecast low volumes for the future

Potential Market

6.4.40 This proposal would be for the port's existing operations.

Undiscounted Costs:

6.4.41 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**3.51**	**Modernise some of the port infrastructure** **Rehabilitate main connecting road** **Improve security and port services**
OPEX	**0**	
Total	**3.51**	**CAPEX + OPEX**

Outcomes:

6.4.42 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.46. The terminal is anticipated to generate just over 5,000 tonnes of freight in 2020. Because of the poor modelled results this project is not recommended for inclusion in the Masterplan.

Test code	P-BS-S (W26)
Annual Water Tonnes Change (2020)	5,145
NPV € Mill (2014 Prices)	-2
BCR	0.46
EIRR	1.2%
Masterplan Recommendation	✘

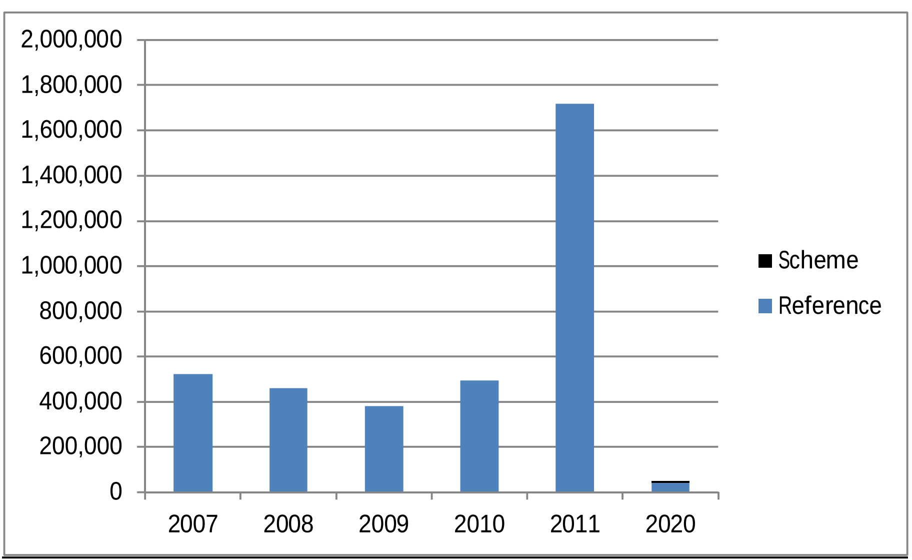


Figure 6.13 –Tonnes Handled at Basarabi 2007-2011 and Forecast in 2020

Oltenita:

Develop the bulk handling infrastructure

Proposal Description:

Oltenita is close to Giurgiu. As Oltenita does not handle any containerised freight AECOM has designated Oltenita as the port to handle the region's bulk freight, particularly that heading towards Bucharest. Oltenita can achieve this by developing its bulk handling infrastructure. Specifically the proposal consists of:

- Improvements to six berths which would allow them to handle mixed freight
- Dredging of the port basin
- Improved port services

Problems Addressed:

Designating Oltenita as the regional bulk handling port means that it does not inadvertently compete with Giurgiu. Undertaking this proposal will address the following problems:

- Ensure that both Oltenita and Giurgiu have a role to play in Romania's economy
- Gives Oltenita a clear purpose
- Enables the port to handle modern freight in an efficient manner

Potential Market

This proposal would be for Oltenita's bulk handling operations.

Undiscounted Costs:

It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	3.51	Modernise some of the port infrastructure Rehabilitate main connecting road Improve security and port services
OPEX	0	
Total	3.51	CAPEX + OPEX

Outcomes:

The intervention gives a good return with a benefit-cost ratio (BCR) of 29.35. The terminal is anticipated to generate over 35,000 tonnes of freight in 2020. This project is recommended for inclusion in the Masterplan.

Test code	P-BS-S (W26)
Annual Water Tonnes Change (2020)	35,908
NPV € Mill (2014 Prices)	99
BCR	29.35
EIRR	30.1%
Masterplan Recommendation	✓

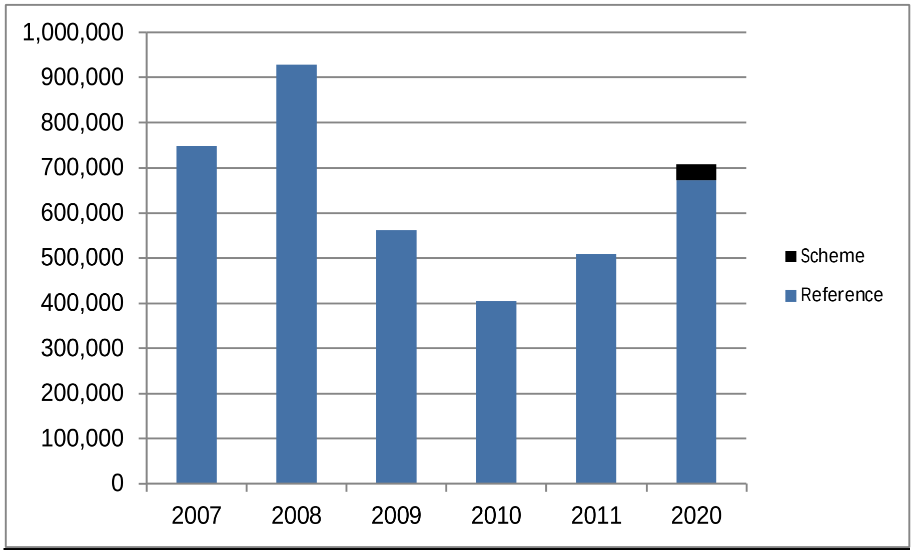


Figure 6.14 –Tonnes Handled at Oltenita 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.43 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years: 2014-2020

6.4.44 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later).

Giurgiu:
Build a new tri-modal terminal

Proposal Description:

6.4.45 As part of a strategic network of intermodal terminals throughout Romania, Giurgiu has been identified as a key location. The proposal is to build a new trimodal terminal at the port so that intermodal containers can take advantage of Giurgiu's road, rail and water connections. By specialising Giurgiu to handle containers this ensures that the port does not inadvertently compete with the geographically close by port of Oltenita. Giurgiu's proximity to Bucharest makes it a ideal choice for inclusion on Romania's intermodal network. Specifically the proposal will incorporate:

- A new intermodal terminal 6-8 hectares in size, including handling equipment
- Logistics facilities
- Connectivity to the port's Free Trade Zone

Problems Addressed:

6.4.46 The port currently has the ability to handle containers but would benefit from a modern and dedicated intermodal terminal operation to achieve its potential. This intervention would address the following issues:

- Lack of a large and modern dedicated intermodal terminal

- Lack of an intermodal terminal network in Romania

Potential Market

6.4.47 This proposal would be for container operations.

Undiscounted Costs:

6.4.48 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**6.8**	**New intermodal terminal 6-8 hectares in size** **Logistics facilities** **Improved connectivity**
OPEX	**0**	
Total	**6.8**	**CAPEX + OPEX**

Outcomes:

6.4.49 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.56. The terminal is anticipated to generate over 69,000 tonnes of intermodal freight in 2020. Even though the modelled outputs suggest a limited return, this project is of strategic importance for Romani and so is recommended for inclusion in the Masterplan.

Test code	I-GR-S (W20)
Annual Water Tonnes Change (2020)	69,803
NPV € Mill (2014 Prices)	-5
BCR	0.56
EIRR	1.4%
Masterplan Recommendation	✓

Implementing organisation:

6.4.50 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years:

6.4.51 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later). Given that the port currently handles containers, the project should be phased in scale to suit prevailing market conditions.

Infrastructure and modernisation works

Proposal Description:

6.4.52 Giurgiu is a large and strategically important port that counts Bucharest as part of its hinterland. Some of its infrastructure is no longer suitable to accommodate modern logistics requirements. This proposal will incorporate:

- Improvements to the berths

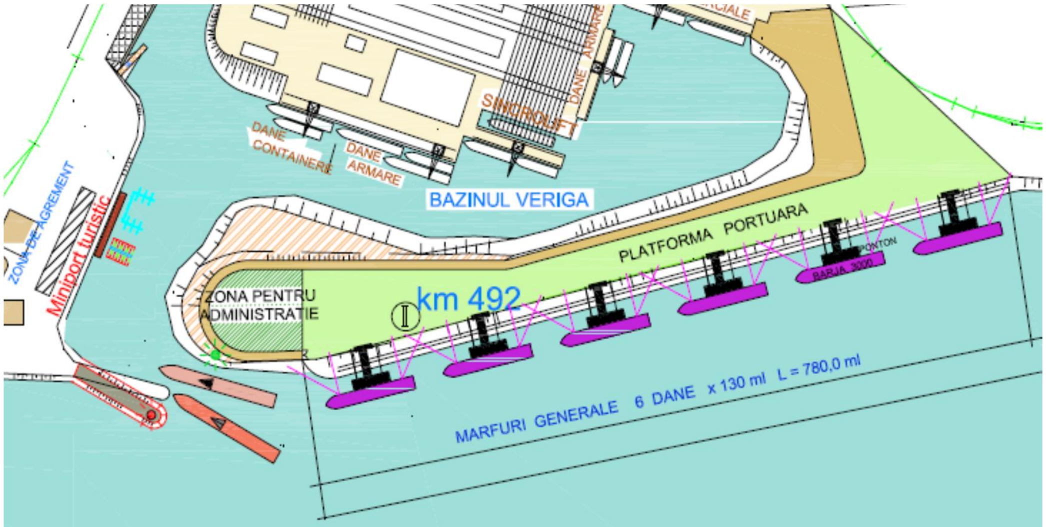


Figure 6.15 – Infrastructure and Modernisation Plans at Giurgiu

Problems Addressed:

6.4.53 The port intends to increase its ability to handle containers but must ensure that its infrastructure can cope. This intervention would address the following issues:

- Old infrastructure that is ill equipped for modern logistics needs

Potential Market

- This proposal would be for all operations at Giurgiu including grains and cereals.

Undiscounted Costs:

6.4.54 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**2.76**	**Rehabilitated berths**
OPEX	**0**	
Total	**2.76**	**CAPEX + OPEX**

Outcomes:

6.4.55 The intervention gives a good return with a benefit-cost ratio (BCR) of 17.53. The proposal is anticipated to generate over 54,000 tonnes of freight in 2020. This project is recommended for inclusion in the Masterplan.

Test code	P-GR-S (W37)
Annual Water Tonnes Change (2020)	54,372
NPV € Mill (2014 Prices)	46
BCR	17.53
EIRR	24.3%
Masterplan Recommendation	✓

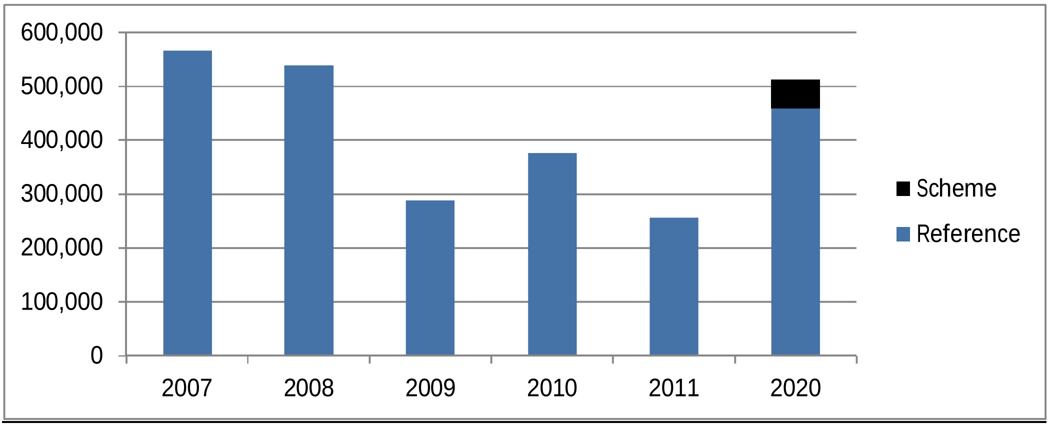


Figure 6.16 –Tonnes Handled at Giurgiu 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.56 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years: 2014-2020

6.4.57 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later).

Corabia:
Modernisation and rehabilitation of infrastructure

Proposal Description:

6.4.58 Corabia is well located but currently handles little freight traffic and is in a relatively severe state of dilapidation, with the exception of some grain and cereal traffic and storage facilities. This proposal will see the rehabilitation of its dilapidated infrastructure and modernised to suit current logistics practices. Specifically the proposal incorporates:

- Rehabilitation of the berths
- Remediation work to some of the infrastructure
- Modernisation to accommodate modern logistics requirements

Problems Addressed:

6.4.59 The problems addressed by this proposal are:

- Modernisation will attract other freight flows increasing the tonnage handled by the port

Potential Market

6.4.60 This proposal would benefit Corabia's current operations in cereals and grain but also any other potential commodities identified in a feasibility study.

Undiscounted Costs:

6.4.61 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**2.84**	**Rehabilitated berths** **Remediated and modernised infrastructure**
OPEX	**0**	
Total	**2.84**	**CAPEX + OPEX**

Outcomes:

6.4.62 The intervention gives a good return with a benefit-cost ratio (BCR) of 11.04. The proposal is anticipated to generate over 73,000 tonnes of freight in 2020. This project is recommended for inclusion in the Masterplan.

Test code	P-CB-S (W32)
Annual Water Tonnes Change (2020)	73,848
NPV € Mill (2014 Prices)	29
BCR	11.04
EIRR	25.1%
Masterplan Recommendation	✓

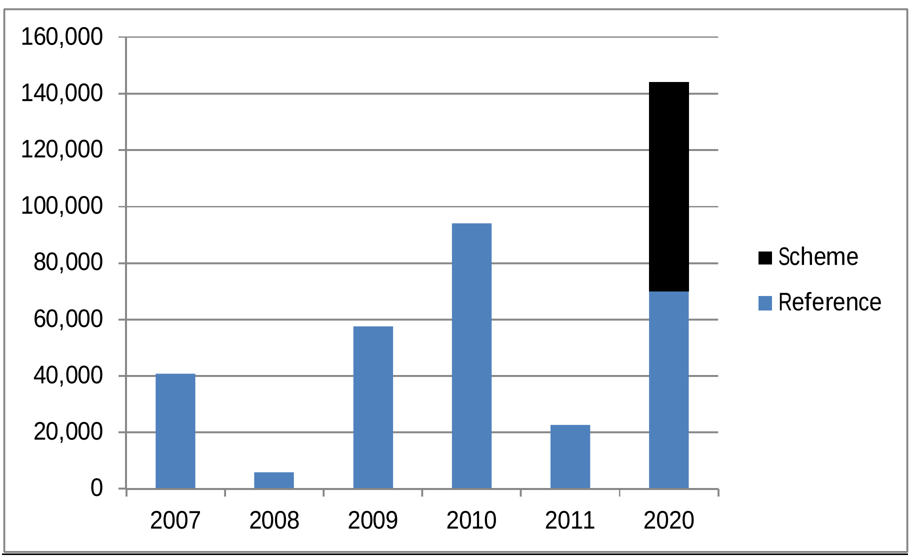


Figure 6.17 –Tonnes Handled at Corabia 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.63 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years: 2014-2020

6.4.64 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later).

Calafat:
Develop bulk handling infrastructure

Proposal Description:

6.4.65 Corabia is linked to Vidin, Bulgaria and the port is located near to the newly opened bridge. To maximise the benefit of this new link the port needs to develop its bulk handling infrastructure. The proposal would incorporate:

- o Restoration and extension of the berths
- o New berths to accommodate new freight

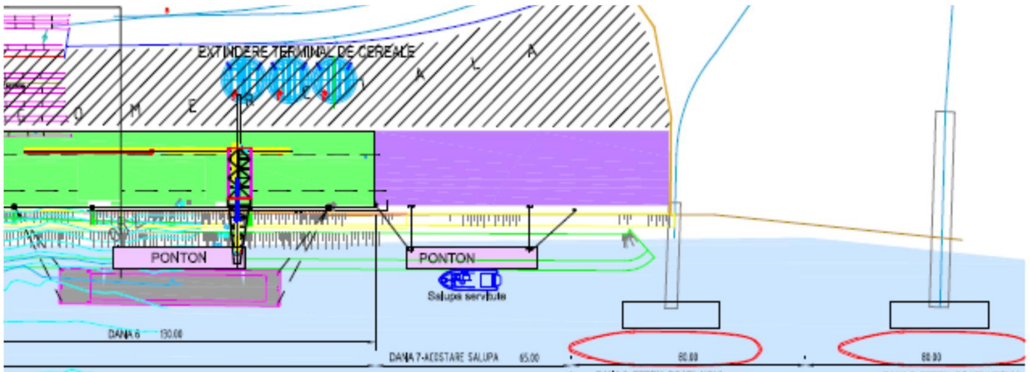


Figure 6.18 – Plans to Develop Bulk Handling Infrastructure at Calafat

Problems Addressed:

6.4.66 The problems addressed by this proposal are:

- o Current growth trends suggest that the port will run out of capacity
- o Some of the berths are not set up for modern logistics needs

Potential Market

6.4.67 This proposal would be for Calafat's current operations as well as new flows that will arrive due to the construction of the bridge.

Undiscounted Costs:

6.4.68 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**12.44**	**Rehabilitated berths** **New berths**
OPEX	**0**	
Total	**12.44**	**CAPEX + OPEX**

Outcomes:

6.4.69 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.6. The proposal is anticipated to generate over 11,000 tonnes of freight in 2020. Since the EIRR is less than 3% this project is not recommended for inclusion in the Masterplan.

Test code	P-CF-S (W27)
Annual Water Tonnes Change (2020)	11,871
NPV € Mill (2014 Prices)	-5
BCR	0.60
EIRR	2.4%
Masterplan Recommendation	×

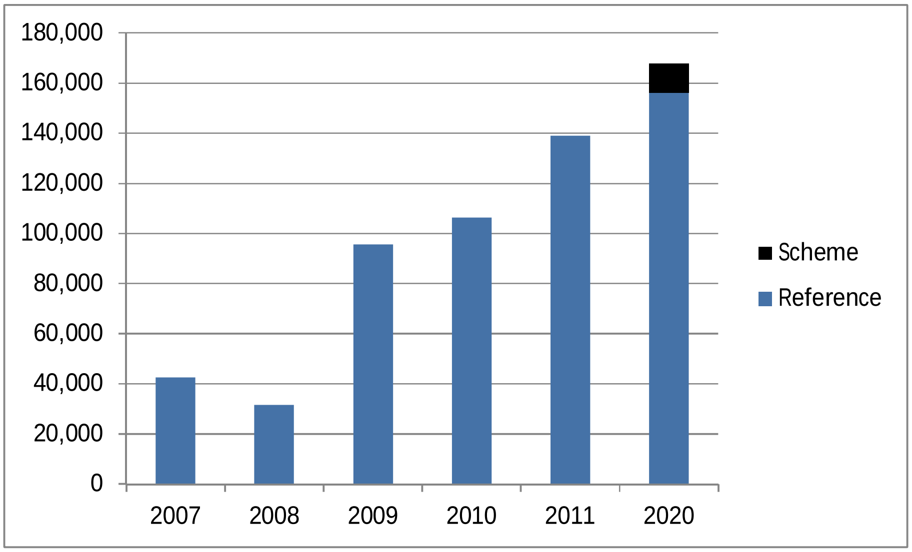


Figure 6.19 –Tonnes Handled at Calafat 2007-2011 and Forecast in 2020

Drobeta:
Build a new trimodal terminal

Proposal Description:

6.4.70 Drobeta is strategically place to benefit from a trimodal intermodal terminal as part of Romania's intermodal network. Developing intermodal facilities will boost the port and provide its hinterland a useful asset. Specifically the proposal will incorporate:

- An intermodal 6-8 hectares in size with accompanying handling equipment
- 2 gauge cleared rail lines of 750m in length
- Improved road connections

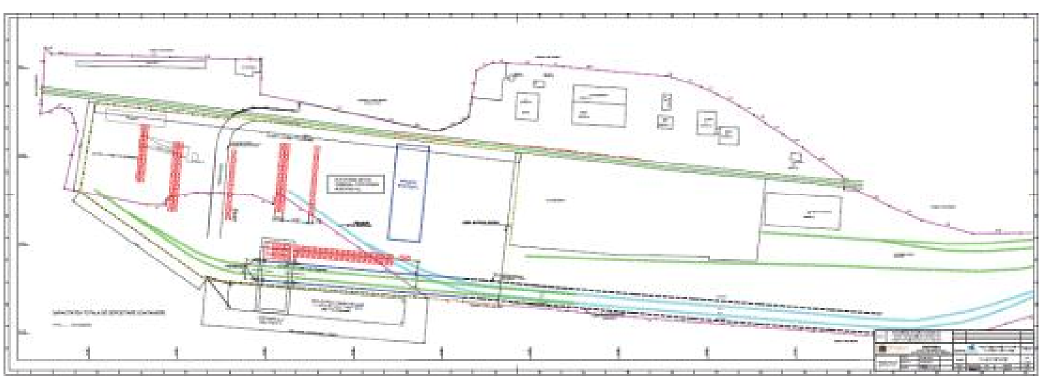


Figure 6.20 – Trimodal Terminal Plans at Drobeta

Problems Addressed:

6.4.71 Drobeta port is not currently well set up to handle containers. The problems addressed by this proposal are:

- o A modern container terminal that can handle containers efficiently and effectively
- o Establish Drobeta as the regional container port

Potential Market

6.4.72 This proposal would be for container operations.

Undiscounted Costs:

6.4.73 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	5.2	Intermodal terminal 6-8 hectares Handling equipment 2 gauge cleared railway lines Improved road connections
OPEX	0	
Total	5.2	CAPEX + OPEX

Outcomes:

6.4.74 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.6. The proposal is anticipated to generate over 11,000 tonnes of freight in 2020. Although the model outputs are limited this his project is recommended for inclusion in the Masterplan.

Test code	I-DB-S (W19)
Annual Water Tonnes Change (2020)	100,5149
NPV € Mill (2014 Prices)	1
BCR	1.11
EIRR	5.6%
Masterplan Recommendation	✓

Implementing organisation:

6.4.75 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years: 2021-2030

6.4.76 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later).

Develop the infrastructure

Proposal Description:

6.4.77 Drobeta's port infrastructure needs improving to be able to handle freight. Improved freight handling will increase the port's handling capacity. This proposal will incorporate:

- o Improvements to existing handling equipment and facilities
- o New berths
- o Additional freight handling areas through rearrangement of port facilities

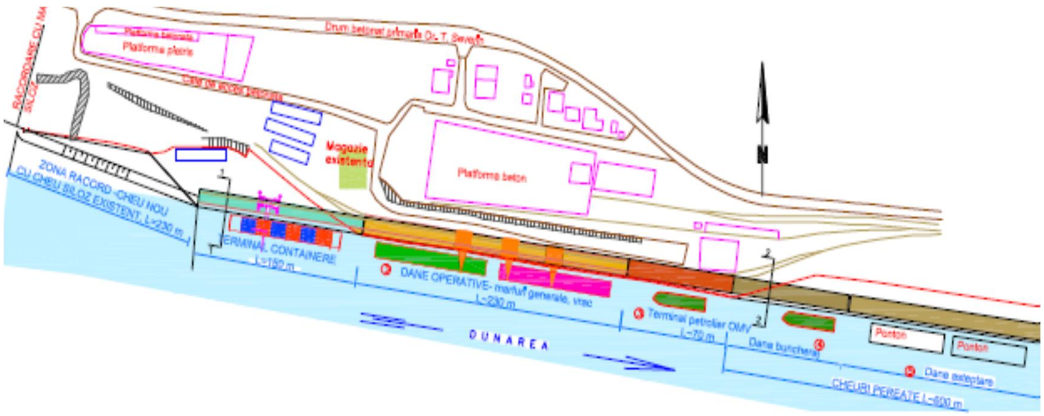


Figure 6.21 – Infrastructure Development Plans at Drobeta

Problems Addressed:

6.4.78 The problems addressed by this proposal are:

- o The current port layout is not maximising efficient use of port facilities and land
- o Current handling equipment is not suitable for modern freight requirements

Potential Market

6.4.79 This proposal would be for all of Drobeta's operations including its petroleum and iron ore trade.

Undiscounted Costs:

6.4.80 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**10.92**	**Improvement to handling equipment and facilities** **New berths** **Rearranged port layout**
OPEX	**0**	
Total	**10.92**	**CAPEX + OPEX**

Outcomes:

6.4.81 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.6. The proposal is anticipated to generate over 11,000 tonnes of freight in 2020. Although the model outputs are limited this project is recommended for inclusion in the Masterplan.

Test code	P-DB-S (W23)
Annual Water Tonnes Change (2020)	108,401
NPV € Mill (2014 Prices)	117
BCR	11.68

EIRR	22.8%
Masterplan Recommendation	✓

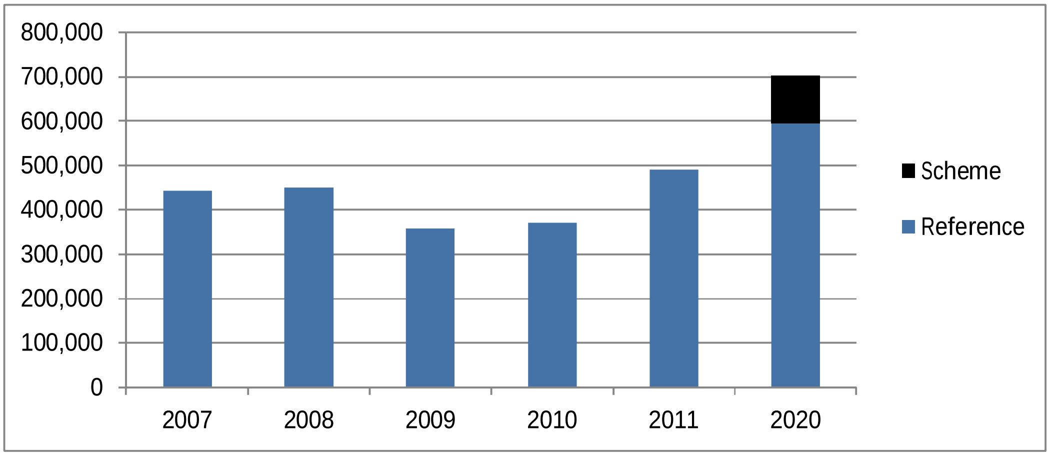


Figure 6.22 –Tonnes Handled at Drobeta 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.82 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years: *2014-2020*

6.4.83 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later).

Orsova:
Modernisation of the port

Proposal Description:

The infrastructure at Orsova is old and needs modernising. Specifically this proposal incorporates:

- Improvements to the berth area
- Improvements to signalling
- Creation of new berths to handle modern freight

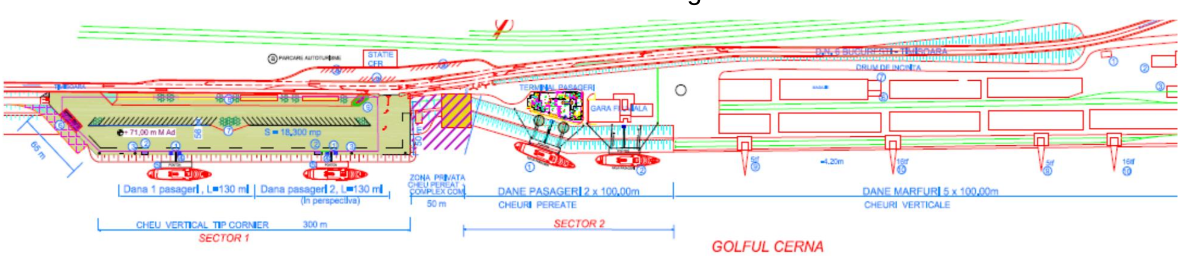


Figure 6.23 – Modernisation Plans at Orsova

Problems Addressed:

6.4.84 The problems addressed by this proposal are:

- o Tonnes handled from one year to next varies and so a general modernisation programme at the port will provide stability
- o Old infrastructure is not suitable to modern freight requirements

Potential Market

6.4.85 This proposal would benefit all operations at the port such as building materials and raw minerals and may attract new flows.

Undiscounted Costs:

6.4.86 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**4.92**	**Improvement to berth area** **New berths** **Improved signalling**
OPEX	**0**	
Total	**4.92**	**CAPEX + OPEX**

Outcomes:

6.4.87 The intervention gives a good return with a benefit-cost ratio (BCR) of 12.7. The proposal is anticipated to generate over 66,000 tonnes of freight in 2020. This project is recommended for inclusion in the Masterplan.

est code	P-OV-S (W23)
Annual Water Tonnes Change (2020)	66,045
NPV € Mill (2014 Prices)	58
BCR	12.70
EIRR	24.8%
Masterplan Recommendation	✓

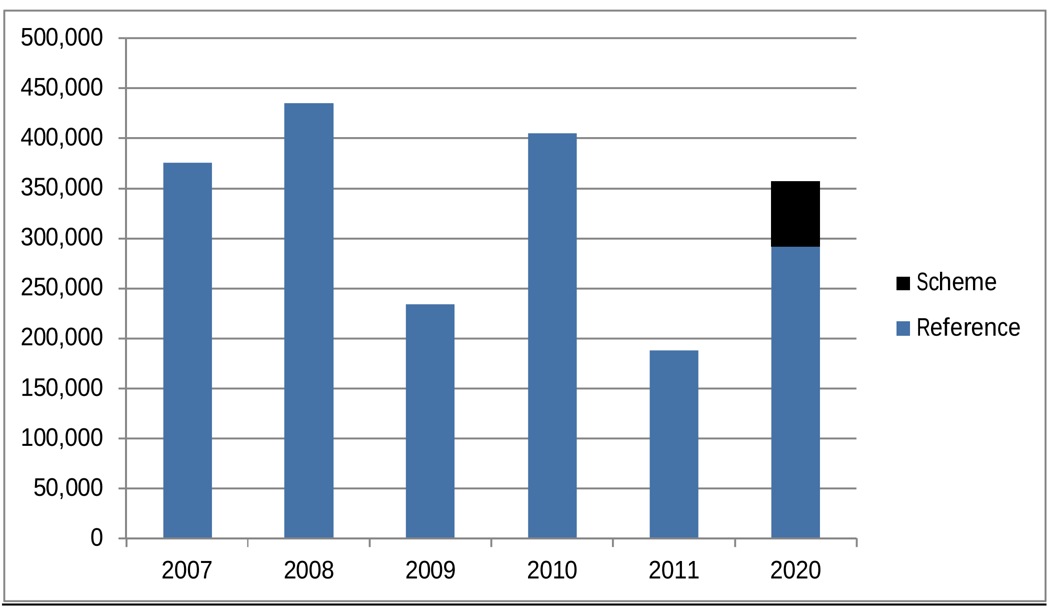


Figure 6.24 –Tonnes Handled at Orsova 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.88 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years: 2014-2020

6.4.89 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later).

Moldova Veche:
Development of the infrastructure

Proposal Description:

6.4.90 The volume of freight that passes through Moldova Veche varies considerably and so the development of the infrastructure at the port is intended to give greater stability in flow volumes. Specifically the proposal incorporates:

- Improving 2 existing berths
- 3 new berths
- Dredging of port basin
- Improved port services

Problems Addressed:

6.4.91 The problems addressed by this proposal are:

- Tonnes handled from one year to next varies and so a general development programme at the port will provide stability
- Old infrastructure is not suitable to modern freight requirements

Potential Market

6.4.92 This proposal would be to attract new flows to the port which would be identified in a detailed feasibility study.

Undiscounted Costs:

6.4.93 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	2.31	Improvement to berth area New berths Dredging of port basin Improved port services
OPEX	0	
Total	2.31	CAPEX + OPEX

Outcomes:

6.4.94 The intervention gives a good return with a benefit-cost ratio (BCR) of 1.51. For this reason the project is recommended for inclusion in the Masterplan.

Test code	P-MV-S (W29)
Annual Water Tonnes Change (2020)	2,961
NPV € Mill (2014 Prices)	1
BCR	1.51
EIRR	7.2%
Masterplan Recommendation	✓

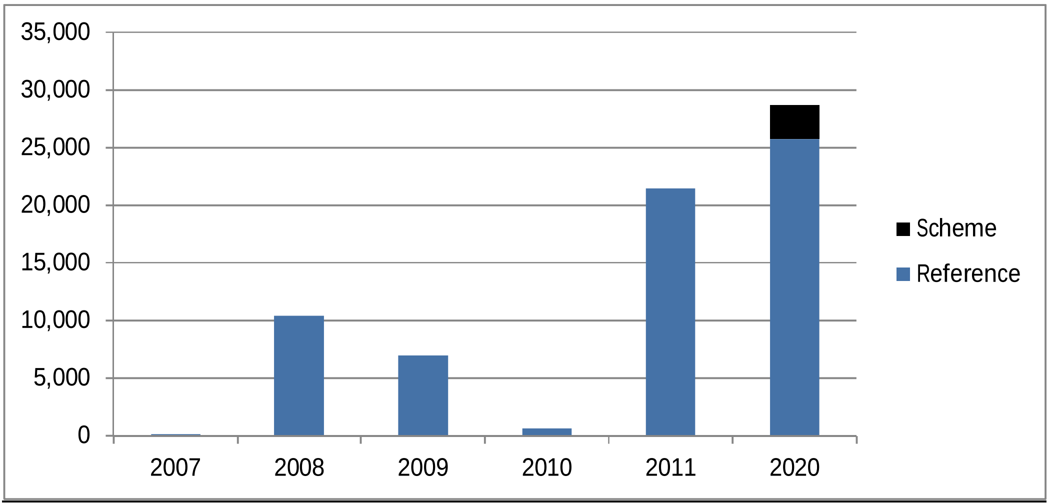


Figure 6.25 –Tonnes Handled at Orsova 2007-2011 and Forecast in 2020

Implementing organisation:

6.4.95 This scheme would be implemented by APDF Giurgiu, possibly in conjunction with a private terminal operator.

Implementation years: *2021-2030*

6.4.96 The implementation could happen as soon as project sign off is completed, however to achieve the maximum potential benefits it is recommended that project completion is scheduled after the completion of proposed navigation improvements to the River Danube (see later).

Waterways:

Improvements to the Navigation of the Danube

Proposal Description:

6.4.97 The Danube can suffer from poor navigability which can be caused by a number factors such as silting, low or high volumes of water or freezing. This proposal would incorporate:

- o Dredging of the fluvial Danube to maintain an adequate fairway
- o Purchase of a dedicated ice breaker
- o Provide an adequate maintenance budget

Problems Addressed:

6.4.98 The problems addressed by this proposal are:

- o Silting of the Danube will be addressed by one off significant dredging and planned maintenance dredging
- o Ice will be broken by a dedicated ice breaker

Potential Market

6.4.99 This proposal would benefit all operations on the Danube.

Undiscounted Costs:

6.4.100 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	**136**	**Dredging Danube fairway**
OPEX	**54**	**Continued planned dredging**
Total	**190**	**CAPEX + OPEX**

Outcomes:

6.4.101 The intervention gives a good return with a benefit-cost ratio (BCR) of 4.70. The proposal is anticipated to generate over 307,000 tonnes of freight in 2020 this project is being recommended for inclusion in the Masterplan.

Test code	W1
Annual Water Tonnes Change (2020)	307,672[33]
NPV € Mill (2014 Prices)	612
BCR	4.70
EIRR	19.6%
Masterplan Recommendation	✓

Implementing organisation:

6.4.102 This scheme would be implemented by AFDJ Galati.

Implementation years: *2014-2020*

6.4.103 This scheme should be implemented as soon as possible as it will affect all of the ports in this Masterplan.

Bucharest-Danube Channel

Proposal Description:

6.4.104 This would involve the creation of a direct link between Bucharest and the River Danube. A link was started in the 1980s but never completed. Specifically the proposal incorporates:

- o Creation of 104km waterway including making the Arges river navigable
- o Creation of a water freight terminal at Bucharest

[33] Tonnes change displayed here is for Romanian ports. Ports from other countries will benefit from a River Danube that has greater navigability however these ports are outside the scope of this study.

Problems Addressed:

6.4.105 Constanta has no direct link to the Danube and so freight and passengers must tranship, usually at Giurgiu

Potential Market

6.4.106 This proposal would benefit all operations in particular building materials and solid mineral fuels.

Undiscounted Costs:

6.4.107 It has been estimated that the project will incur the following costs:

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	939	Completion of Bucharest-Danube Channel Creation of water freight terminal at Bucharest
OPEX	0	
Total	939	CAPEX + OPEX

Outcomes:

6.4.108 The intervention gives a limited return with a benefit-cost ratio (BCR) of 0.95. The proposal is anticipated to generate over 2.7m tonnes of freight in 2020. This project is being recommended for inclusion in the Masterplan although it should be revisited closer to 2030 by a detailed feasibility study.

Test code	W36
Annual Water Tonnes Change (2020)	2,760,878
NPV € Mill (2014 Prices)	-48
BCR	0.95
EIRR	4.7%
Masterplan Recommendation	✓

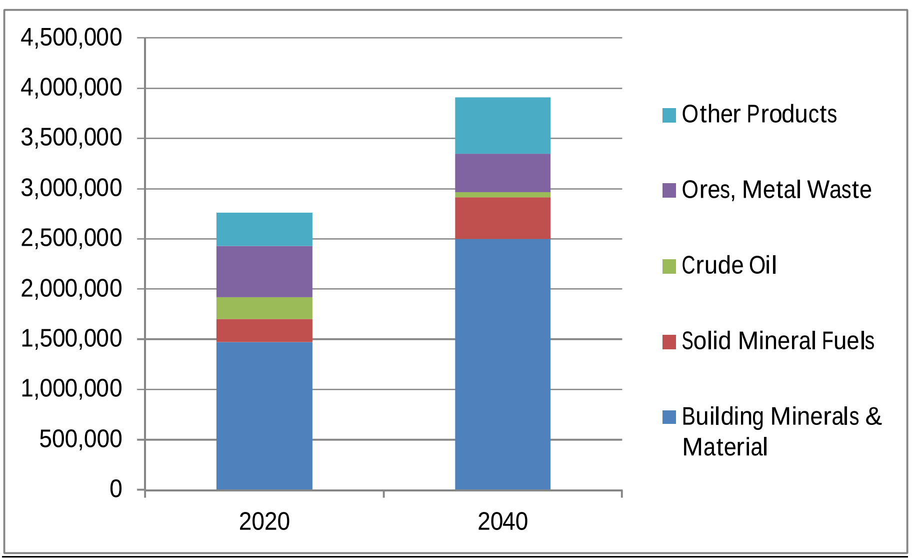


Figure 6.26 - Water Freight Tonnes on the Bucharest – Danube Channel (per annum)

Implementing organisation:

6.4.109 A new channel will need a new authority in order to manage and maintain the channel, similar to how ACN manages the Danube-Black Sea Canal. In the interim it is suggested that the MT are the owner organisation.

Implementation years: After 2030

6.4.110 This is a long term project and not recognised as a priority for the Masterplan and so the timeline for implementation is suggested as being post 2030

6.5 River Danube Maintenance

Proposal Description:

6.5.1 The Danube maintenance can broadly be split into three: routine maintenance, non-routine and emergency maintenance. By maintenance AECOM means maintaining the viability of the Danube's navigation.

6.5.2 Routine maintenance:

6.5.3 This is maintenance that was planned and is regularly required on the Danube. This will typically include scheduled routine maintenance to the Danube's fairway and river banks. This is essentially day to day maintenance of the Danube. Planned preventative maintenance is included within routine maintenance. By spending money on maintaining the Danube and keeping it in a good working condition, the Danube is less likely to require more expensive emergency maintenance in the future as prevention is almost always cheaper than the cure.

6.5.4 Non-routine maintenance:

6.5.5 This is maintenance that can be foreseen however it occurs on an unscheduled basis. This can include ice breaking during winter months when it is possible to break the ice to allow safe and complete navigation.

6.5.6 Emergency maintenance:

6.5.7 This type of maintenance arises from situations that cannot be regularly anticipated such as a critical failure of the Danube's infrastructure such as through flooding or drought. Any repairs as a result of emergency maintenance should take place as soon as possible to minimise the disruption experienced by the Danube's users.

Problems Addressed:

6.5.8 Once the one-off dredging of the Danube has been completed it will be necessary to ensure the situation does not go back to how it currently is by undertaking regular and planned maintenance. The maintenance budget Romania provides for the Danube is currently low compared to other countries which may be a contributory issue to the current navigation problems experienced on the Romania section. It is understood that there is an even smaller budget in Bulgaria.

Implementing organisation:

6.5.9 AFDJ is responsible for the administration of the whole of the Romanian section of the Danube. AFDJ Galati's main objective is to facilitate transport on the Danube with the aim of maintaining a minimum depth of 2.5m on the "fluvial" section and 8.5m on the "maritime" section. Other key responsibilities include monitoring depths, dredging, maintenance of navigation aids and information provision.

Implementation years:

6.5.10 Once the one-off dredging described in the previous section has been completed

6.6 Institutional Reform

6.6.1 The following are institutional reforms recommended by AECOM that, when enacted, should more water a more attractive mode of transport:

Management and Operations:
Advise Authorities to be Flexible in Opening Times

Proposal Description:

Advise port authorities to be flexible in opening times/days so that facilities such as customs, booking offices and terminals are available if demand exists.

Adopt a Commercial Attitude

Proposal Description

Adopt a commercial attitude and review port charges to operators to ensure water freight is competitive
Problems Addressed:
Outdated charging methods make water freight less competitive against other modes. Adopting a commercial attitude will address this problem.
Implementing organisation:
All ports and waterways authorities
Implementation years:
Immediate

International Cooperation

Proposal Description:

Romania needs to work with other Danube countries to agree operational plans that will help to address the identified issues.
Problems Addressed:
The problems identified are:

- Differing maintenance budgets
- Differing rules on environmental standards
- Different systems are being used on the Danube

Implementing organisation:
The Danube countries, in particular their respective Transport Ministries.
Implementation years:
Immediate

Training

Proposal Description:

Establish suitable training for the needs of the naval sector.
Problems Addressed:
There are currently between 50 and 100 accidents each year on the Romanian section of the Danube involving personal injury. The cost of these accidents in 2011 has been estimated to be €2.8m. Proper training will help to reduce the frequency of these accidents.

Implementing organisation:
ANR, the Romanian Naval Authority, is responsible for the safety of civil navigation and should be responsible for this, along with certified training providers.
Implementation years:
Immediate; although consideration should be given to the quality of the current training provided, along with its content, to assess its suitability.

Use Modern Systems

Proposal Description:

Encourage the industry to use modern and integrated systems for customs, navigation, regulation and administration. For example the DoRIS river information system is now available by APP for mobiles in Austria.
Problems Addressed:
Different countries are using different systems and devices. Romania should follow the consensus to avoid issues further down the line.
Implementing organisation:
The MT in its capacity as the overarching body for other organisation such as AFDJ.
Implementation years:
Consultation and cooperation with other Danube countries should begin immediately with a decision made on the systems to adopt made within five years.

Security on the Danube

Proposal Description:

Enhance security to reduce thefts from vessels and port facilities.
Problems Addressed:
Theft costs all parties involved time and money and seriously affects the reputation of water freight as a mode of transport. Enhancing security to prevent further losses will address this.
Implementing organisation:
Port authorities and water freight operators should all take responsibility to enhance security.
Implementation years:
Action should be taken immediately.

Safety and Regulation:
Review port and customs administration procedures

Proposal Description:

Review port and customs administration procedures and rationalise and improve communication.
Problems Addressed:
Bureaucracy is limiting the efficiency of water freight when compared against other modes. Reducing bureaucracy will address the negative impacts.
Implementing organisation:
All port and customs authorities.
Implementation years:
Action to address this should be taken immediately.

Safety Training

Proposal Description:

Develop a safety plan including training to reduce accidents.
Problems Addressed:
Improved safety training will address the number of accidents that occur on the Danube.
Implementing organisation:
ANR, the Romanian Naval Authority, is responsible for the safety of civil navigation and should be responsible for this, along with certified training providers.
Implementation years:

> *Immediate; although consideration should be given to the quality of the current training provided, along with its content, to assess its suitability.*

6.7 Summary of Interventions

6.7.1 This section summarises the interventions that were tested using the National Transport Model.

Intervention	Location	Scheme Value (CAPEX)	Benefits	Benefit to Cost Ratio	Economic Internal Rate of Return	Masterplan Recommendation
Build a new container terminal at Constanta (III & IVS)	Constanta	€224.15m	€452m	2.02	8.9%	✓
Development of a grain terminal at the port	Tulcea	€10.15m	€6m	0.59	-1.1%	✓[34]
Improve the existing passenger ferry service running from Tulcea to Sulina	Tulcea	€19.2m	€28.2m	1.47	4.4%	✓
Build a new trimodal terminal	Galati	€14.4m	€17m	0.94	4.7%	✓[35]
Modernisation of existing bulk terminals	Galati	€10.93m	€359m	32.89	39.9%	✓
Develop infrastructure	Cernavoda	€4.36m	€30m	6.98	22.4%	✓
Modernise the infrastructure	Basarabi	€3.51m	€1.63m	0.46	1.2%	✗
Develop bulk handling infrastructure	Oltenita	€3.51m	€103m	29.35	30.1%	✓
Build a new tri-modal terminal	Giurgiu	€6.8m	€5.8m	0.56	1.4%	✓
Infrastructure and modernisation works	Giurgiu	€2.76m	€48m	17.53	24.3%	✓
Modernisation and rehabilitation of	Corabia	€2.84m	€31m	11.04	25.1%	✓

[34] Considered to be of importance
[35] To be a phased development in line with demand and considered with adjacent scheme at Galati

Intervention	Location	Scheme Value (CAPEX)	Benefits	Benefit to Cost Ratio	Economic Internal Rate of Return	Masterplan Recommendation
infrastructure						
Develop bulk handling infrastructure	Calafat	€12.44m	€7m	0.60	2.4%	✓
Build a new trimodal terminal	Drobeta	€5.2m	€9.7m	1.11	5.6%	✓
Develop infrastructure	Drobeta	€10.92m	€128m	11.68	22.8%	✓
Modernisation of the port	Orsova	€4.92m	€63m	12.70	24.8%	✓
Development of Infrastructure	Moldova Veche	€2.31m	€3m	1.51	7.2%	✗
Improvements to the navigation of the Danube	Danube	€136m	€777.7m	4.70	19.6%	✓
Create Bucharest - Danube Canal Connection	Danube-Bucharest	€939m	€891.1m	0.95	4.7%	✗

6.7.2 This section summarises additional interventions, which by their nature cannot be modelled using the national Transport Model, but which AECOM is recommending be included as part of the Masterplan.

Reference	Intervention	Location
W3	Invest in ice breaking facilities including replacing Perseus	Danube
W4	Increase maintenance budgets to match consistently across borders	Danube
W5	Advise authorities to be flexible in opening times/days so that facilities such as customs, booking offices and terminals are available if demand exists.	All ports
W6	Adopt a commercial attitude and review port charges to operators to ensure water freight is competitive	All infrastructure
W7	Romania to work with Danube countries to agree operational plans	NA
W8	Review port and customs administration procedures and rationalise and improve communication	All ports
W9	Establish suitable training for the needs of the naval sector	NA
W10	Encourage the industry to use modern and integrated systems for customs, navigation, regulation and administration	NA
W11	Develop a safety plan including training to reduce accidents	NA
W12	Enhance security to reduce thefts from vessels and port facilities at Ports on the Primary Economic Network	All infrastructure and vessels
W13	Reduce emissions from naval activity by adopting best practice: enforce EU regulations regarding emissions by non-EU vessels	NA
W14	Safeguard land and facilities at minor and underutilised ports	All ports
W15	Improve immediate local and internal road/rail connections	Galati, Calafat, Giurgiu, Drobeta, Braila

Aviation

7 Aviation

7.1 Existing Conditions

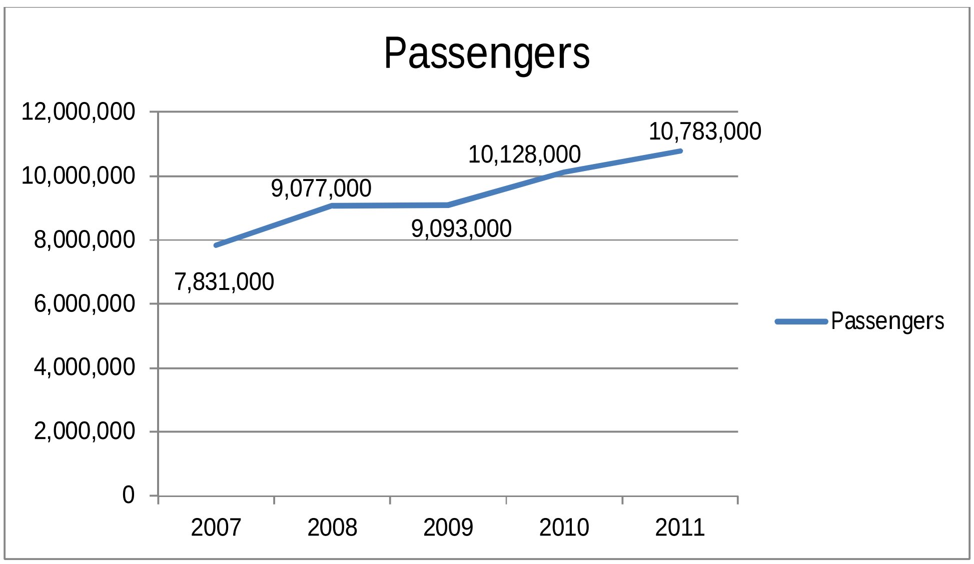
7.1.1 Romania's air transport infrastructure aims to provide regional centres with a means of fast transport to Bucharest, the capital, along with other regional centres. Air transport is also relied upon to provide international connectivity. As the country's highway network remains in development, and even the fastest section of the rail network (currently between Bucharest and Constanta) are subject to speed restrictions, air travel is a preferred choice for longer distance domestic transport where fast journey times, rather than financial cost, are a critical factor.

7.1.2 A total of 21 airfields are listed in Romania's Aeronautical Information Publication (AIP). Fifteen of these airports currently have scheduled flight operations. In some cases these scheduled services may not be year-round but seasonal. Three of these airports are operated by the Romanian government (Henri Coanda – the main airport for Bucharest, Timisoara and Constanta), with all the other airports being operated by the local counties.

Air Traffic Trends

7.1.3 Passenger numbers have grown from 7.8 mppa in 2007 to 10.8 mppa in 2011.

Figure 7.1: Historic Air Traffic Trends



7.1.4 Table 7.1 sets out the 2011 domestic and international air passenger numbers.

Table 7.1: 2011 Domestic and International Passenger Figures for Romanian Airports

Airport	Domestic	International	TOTAL
Bucharest Henri Coanda	649,682	6,670,884	7,320,566
Timisoara	336,152	1,019,867	1,356,019
Cluj-Napoca	189,139	815,682	1,004,821
Bacau	21,106	306,308	327,414
Targu Mures	10,477	216,361	226,838
Iasi	139,185	45,298	184,483
Sibiu	26,482	150,424	176,906
Constanta	11,647	64,817	76,464
Oradea	58,887	1,659	60,546
Craiova	19,397	11,872	31,269
Suceava	26,224	984	27,208
Satu Mare	19,534	3,207	22,741
Baia Mare	18,017	551	18,568
Arad	0	0	0
Brasov	0	0	0
Tulcea	0	0	0
TOTAL	**1,525,929**	**9,307,914**	**10,833,843**

Source: Actual flight departures by airport that were provided by the airport authority and used as baseline figures for the Air Forecasting Model

7.1.5 In 2011, a total of 10.8 million passengers travelled through all Romanian airports. Of this total, over 50% of passengers travelled through Bucharest's Henri Coanda International Airport – showing the strong capital-centric nature of the country's air transport system.

Role and Classification of Airports

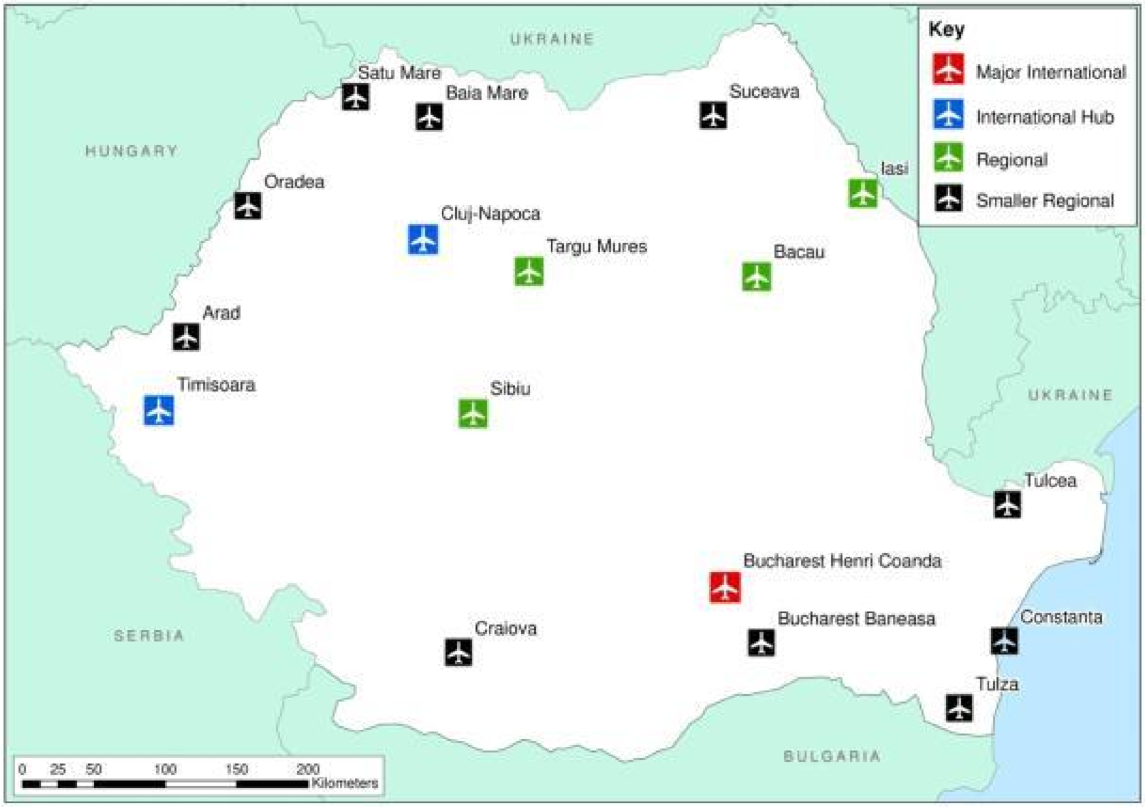
7.1.6 In line with the Primary Economic Networks defined for road and rail modes, we believe that it is important to develop a hierarchy of airports within Romania, based on their roles and future potential to attract both international and domestic traffic.

7.1.7 In Romania the current airports fall into four categories, airports are allocated to category based on 2011 service patterns:

- Major International Airport (Bucharest Henri Coanda)
- International Hub Airports (Timisoara and Cluj-Napoca)
- Regional Airports (Bacau, Iasi, Sibiu and Targu Mures)
- Smaller Regional Airports (Baia Mare, Constanta, Craiova, Oradea, Satu Mare, Suceava and Tulcea)

7.1.8 Figure 7.1 illustrates the locations and 2011 classifications of the airports.

Figure 7.1: Location and 2011 Classification of Airports in Romania



Source: AECOM Analysis

7.1.9 The number of passenger trips through each of these airport categories is quite different and as such moving an airport from one category to another would have a major impact on the predicted air passenger demand. Using this principle and taking into account the variables above, it has been possible to construct a direct demand model for future airport patronage prediction.

7.1.10 The input data collated for each airport is as follows:

- o City and wider catchment population
- o Total number of flights split by domestic and international (2011 data)
- o Total number of passengers split by domestic and international (2011 data)
- o Car ownership rate in catchment area as an indicator of relative income levels

7.1.11 The future airport classification is based on the catchment area. Table 7.2 sets out the catchment population and the future classification. With a catchment population above 5 million population the airport is classified as a Major International Airport, between 1 million and 5 million as an International Hub Airport, between 500,000 and 1 million as a Regional airport and below 500,000 as a Smaller Regional Airport.

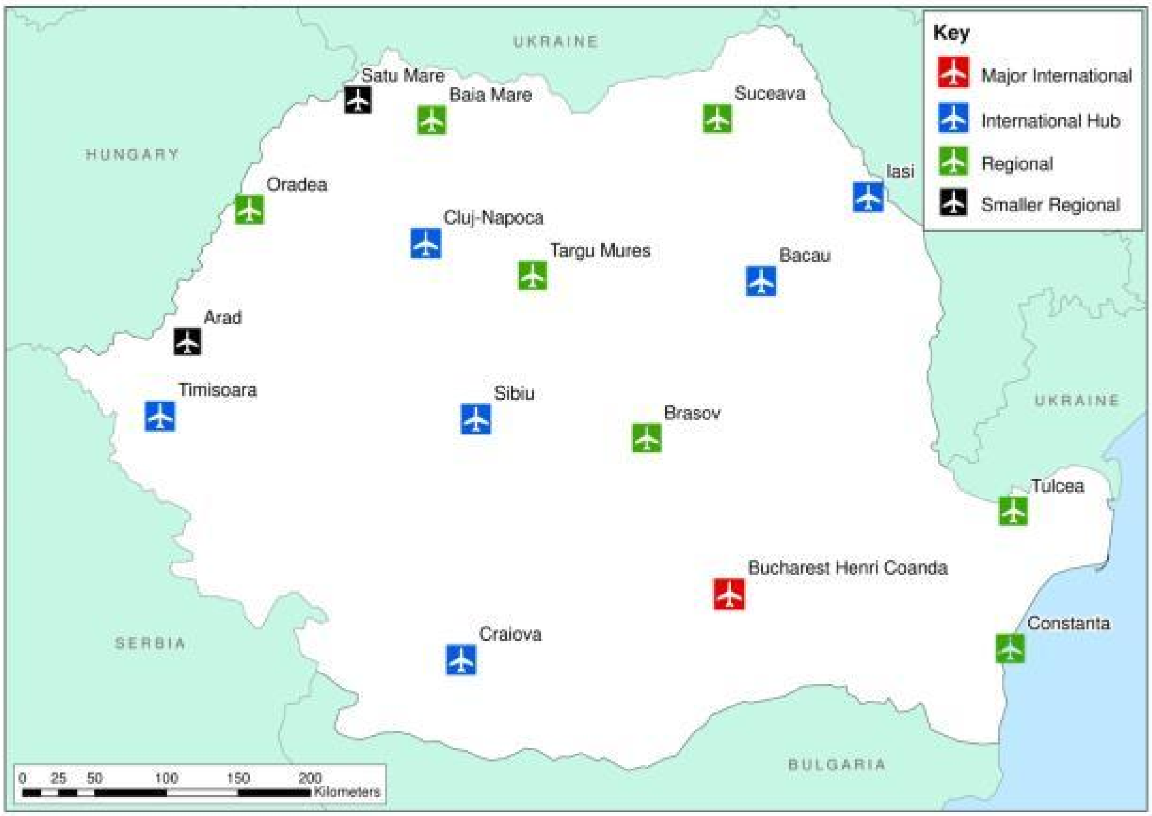
Table 7.2: Airport catchment area and proposed future classification

Airport	Catchment Population	Future Classification
Bucharest	6,170,897	Major International Airport
Craiova	2,146,082	International Hub Airport
Timisoara	1,466,773	International Hub Airport
Sibiu	1,302,866	International Hub Airport
Cluj	1,031,213	International Hub Airport

Airport	Catchment Population	Future Classification
Bacau	1,702,721	International Hub Airport
Iasi	1,040,752	International Hub Airport
Targu Mures	710,953	Regional Airport
Oradea	653,170	Regional Airport
Brasov	595,543	Regional Airport
Constanta	664,680	Regional Airport
Suceava	972,480	Regional Airport
Tulcea	911,819	Regional Airport
Baia Mare	640,587	Regional Airport
Arad	371,077	Smaller Regional Airport
Satu Mare	368,169	Smaller Regional Airport

7.1.12 The new airports classifications are set out in Figure 7.2.

Figure 7.2: Location and Future Classification of Airports in Romania



Source: AECOM Analysis

Air Forecasts

7.1.13 A bespoke aviation model has been developed to provide a basis forecasting future levels of air travel demand in Romania. Air passenger demand by airport is a function of:

- o The size of the catchment area of the airport in terms of population, and also attractions in terms of tourism;
- o The average income of the catchment area as higher income areas generate more air travel per capita;

o The nature of the flights that are available from the airport in terms of the type, domestic/international, and the number of flights;

o Future air demand has been shown to be strongly linked to GDP growth; and

o The capacity of the airport in terms of flights that can be handled and the terminal capacity for passenger throughput

7.1.14 The derivation of a model to predict future air demands therefore needs to take each of the above into consideration in developing the modal parameters and the forecasting processes. One of the main drivers of major changes in demand through an airport is due to a change in category of airport as a result of investment in facilities and success in attracting new airline operators to run new services from the airport. It should be emphasized that the growth of an airport is not only dependent on the increase in capacity and facilities but depends on services committed to an airport.

7.1.15 Tables 9.3 and 9.4 set out the 2020 and 2025 forecasts per airport, their TEN-T status and the proposed airport classification.

Table 7.3: Romanian Airports' 2020 Forecasts, TEN-T Classification and Future AECOM Classification

Airport	TEN-T Classification	2020 Forecasts			AECOM
	Core/ Comprehensive	Domestic	International	TOTAL	Classification
Bucharest	Core	861,945	8,850,387	9,712,332	Major International Airport
Craiova	Comprehensive	437,186	1,574,902	2,012,088	International Hub Airport
Timisoara	Core	444,687	1,349,157	1,793,844	International Hub Airport
Sibiu	Comprehensive	329,746	1,187,865	1,517,612	International Hub Airport
Cluj	Comprehensive	253,842	1,094,722	1,348,564	International Hub Airport
Bacau	Comprehensive	258,620	931,641	1,190,261	International Hub Airport
Iasi	Comprehensive	155,122	558,807	713,929	International Hub Airport
Targu Mures	N/A	13,954	288,159	302,113	Regional Airport
Oradea	Comprehensive	52,305	185,671	237,976	Regional Airport
Brasov	N/A	52,199	185,297	237,496	Regional Airport
Constanta	Comprehensive	51,479	182,740	234,219	Regional Airport
Suceava	Comprehensive	51,390	182,425	233,816	Regional Airport
Tulcea	Comprehensive	42,081	149,378	191,459	Regional Airport
Baia Mare	Comprehensive	39,405	139,882	179,287	Regional Airport
Arad	N/A	24,147	12,475	36,621	Smaller Regional Airport
Satu Mare	N/A	26,241	4,308	30,550	Smaller Regional Airport
		3,094,350	**16,877,817**	**19,972,167**	

Source AECOM Analysis

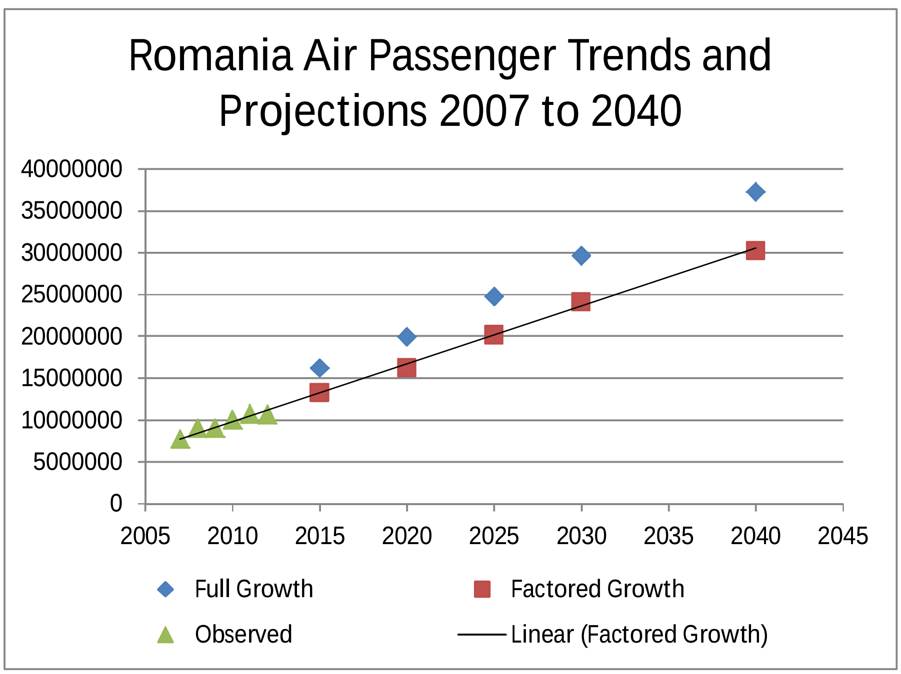
Table 7.4: Romanian Airports' 2025 Forecasts, TEN-T Classification and Future AECOM Classification

Airport	TEN-T Classification	2025 Forecasts			AECOM
	Core/ Comprehensive	Domestic	International	TOTAL	Classification
Bucharest	Core	1,067,966	10,965,787	12,033,752	Major International Airport
Craiova	Comprehensive	555,340	2,000,536	2,555,877	International Hub Airport
Timisoara	Core	549,561	1,667,339	2,216,900	International Hub Airport
Sibiu	Comprehensive	409,844	1,476,408	1,886,252	International Hub Airport
Cluj	Comprehensive	317,455	1,369,059	1,686,514	International Hub Airport
Bacau	Comprehensive	320,053	1,152,948	1,473,002	International Hub Airport
Iasi	Comprehensive	194,879	702,024	896,903	International Hub Airport
Targu Mures	N/A	17,343	358,155	375,498	Regional Airport
Oradea	Comprehensive	65,574	232,774	298,348	Regional Airport
Brasov	N/A	64,510	228,997	293,507	Regional Airport
Constanta	Comprehensive	64,220	227,967	292,186	Regional Airport
Suceava	Comprehensive	63,848	226,648	290,496	Regional Airport
Tulcea	Comprehensive	52,005	184,608	236,613	Regional Airport
Baia Mare	Comprehensive	49,402	175,368	224,771	Regional Airport
Arad	N/A	29,841	15,417	45,258	Smaller Regional Airport
Satu Mare	N/A	32,861	5,395	38,256	Smaller Regional Airport
		3,854,703	**20,989,429**	**24,844,132**	

Source AECOM Analysis

7.1.16 Figure 7.3 provides an illustration of the full growth compared to the factored past trends growth.

Figure 7.3: Air Forecasts Compared with Past Trends



Airport Infrastructure, Future Demand and Capacities

Airside constraints – aprons, taxiways and runways

7.1.17 Table 7.5 sets out the assumptions in calculating the demand for apron stands.

Table 7.5: Assumptions in Determining Apron Space

Airport Classification	Pax Per Code D Aircraft (70% load)	Code C Percentage Of Flights	Pax Per Code D Aircraft (70% load)	Code C Percentage Of Flights	Pax Per Code D Aircraft (90% load)	ATR Percentage Of Flights
Major International Airport	210	70%	126	20%	45	10%
International Hub Airports	210	50%	126	40%	45	10%
Regional Airports	210	40%	126	40%	45	20%
Smaller Regional Airport	210	0%	126	10%	45	90%

7.1.18 Table 7.6 sets out the current number of apron stands as well as the demand for 2020. Again the peak hour passengers were used to determine the number of aircraft that will be required within the peak hour. A 20% factor has been assumed and added to include aircraft from before or after the peak hour that will still occupy apron stands at the airport.

Table 7.6: Airports Peak Hour Apron Space Requirement (2020)

Airport Name	Current Number of Apron Stands	Peak Hour Passengers	Code D Apron Stands	Code C Apron Stands	ATR Apron Stands	Total Number Of Stands
Bucharest	62	4,310	15	7	10	45
Craiova	12	1,786	5	6	4	**18**
Timisoara	26	1,592	4	6	4	17
Sibiu	16	1,347	4	5	3	15
Cluj	14	1,197	3	4	3	12
Bacau	4	1,056	3	4	3	**12**
Iasi	10	634	2	3	2	9
Targu Mures	9	358	1	2	2	6
Oradea	10	282	1	1	2	5
Brasov	0	281	1	1	2	**5**
Constanta	7	277	1	1	2	5
Suceava	6	277	1	1	2	5
Tulcea	4	227	1	1	2	**5**
Baia Mare	5	212	1	1	1	4
Arad	9	54	0	1	2	4
Satu Mare	2	45	0	1	1	**3**

7.1.19 From Table 7.6 it is clear that the following airports will run out of apron stand capacity by 2020: Craiova, Cluj-Napoca, Bacau, Tulcea and Satu Mare. Funding has recently been approved for Iasi and Oradea airports for the extension of apron space and taxiways.

7.1.20 Table 7.7 sets out the apron stands demand for 2025.

Table 7.7: Airports Peak Hour Apron Space Requirement (2025)

Airport Name	Current Number of Apron	Peak Hour Passenger	Code D Apron Stands	Code C Apron Stands	ATR Apron Stands	Total Number Of Stands
Bucharest	62	5,340	18	9	12	55
Craiova	12	2,269	6	8	6	**24**
Timisoara	26	1,968	5	7	5	21
Sibiu	16	1,674	4	6	4	**17**
Cluj	14	1,497	4	5	4	**16**
Bacau	4	1,307	4	5	3	**15**
Iasi	10	796	2	3	2	9
Targu Mures	9	444	1	2	2	6
Oradea	10	353	1	2	2	6
Brasov	0	347	1	2	2	**6**
Constanta	7	346	1	2	2	6
Suceava	6	344	1	2	2	6
Tulcea	4	280	1	1	2	**5**
Baia Mare	5	266	1	1	2	5
Arad	9	67	0	1	2	4
Satu Mare	2	57	0	1	2	**4**

7.1.21 From Table 7.7 it is clear that the following airports will run out of apron stand capacity by 2025: Craiova, Cluj-Napoca, Bacau, Oradea, Tulcea and Satu Mare.

7.1.22 Table 7.8 sets out the Navigational Aids, Approach Lighting and Aircraft Rescue and Firefighting (AFFR) at the various airports.

Table 7.8 – Technical Characteristics of Romanian Airfields

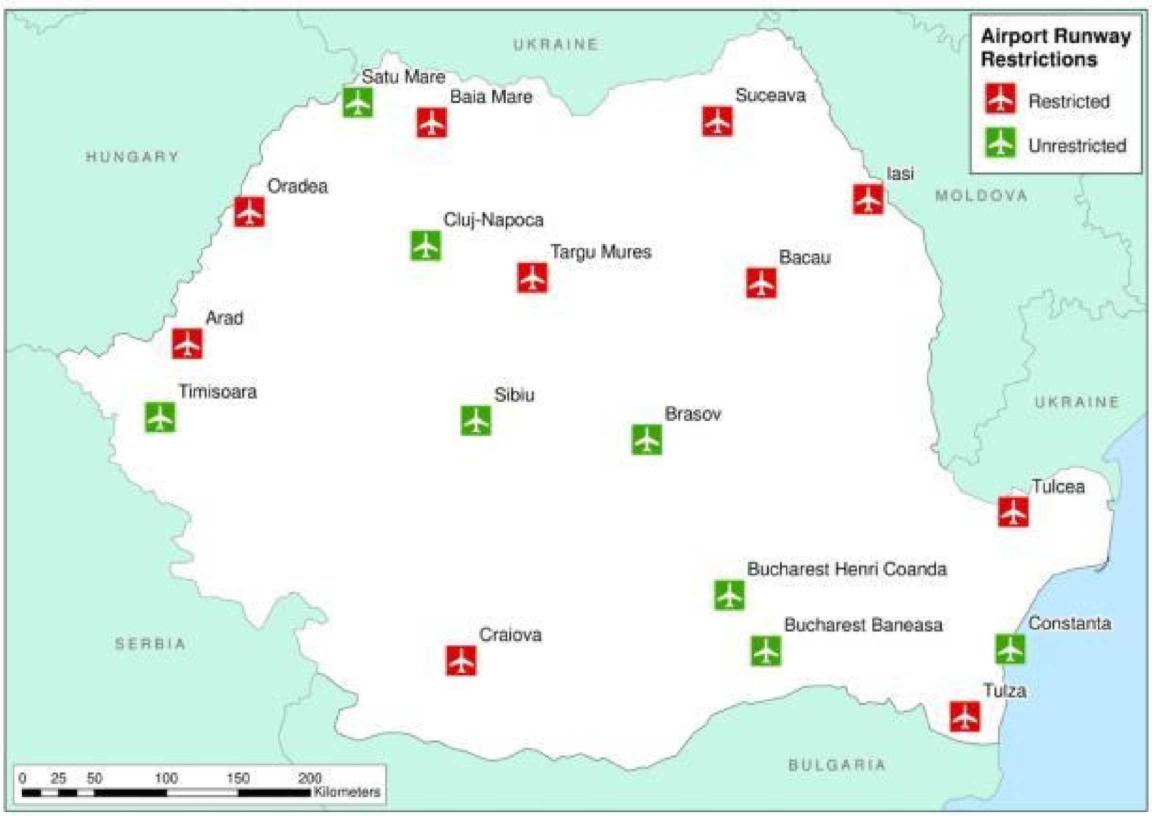
Airport Name	Highest PCN	Navigational Aids	Approach Lighting	ARFF Category
Bucharest Henri Coanda	78 R/D/W/T	NDB, DME, ILS Cat. III	Cat. I, ALSF-II	9
Timisoara	42 R/B/W/T	NDB, DME, ILS Cat. III	Cat. I, ALSF-II	8
Cluj	36 R/D/W/T	DVOR/DME, ILS Cat. I	Cat. I	8
Iasi	24 R/D/W/T	NDB, DME, ILS Cat. II	Cat. I	5 (6)
Craiova	29 R/A/W/T	DVOR/DME, ILS Cat. I	Cat. I	7
Bacau	19 R/C/W/T	DVOR/DME, NDB	Cat. I	6
Constanta	62 R/D/W/T	VOR/DME, NDB, ILS Cat. II	ALS II	7 (8)
Targu Mures	45 R/D/W/T	NDB, DME, ILS Cat. II	Cat. III	7
Sibiu	56 R/D/W/T	DVOR/DME, NDB, ILS Cat. II	ALS II	7 (8)
Oradea	14 R/D/W/T	NDB, DME, ILS Cat. II	Cat. I	6

Airport Name	Highest PCN	Navigational Aids	Approach Lighting	ARFF Category
Brasov	Not open yet			
Suceava	14 R/D/W/T	DVOR/DME	Cat. I	5
Arad	41 R/C/W/T	VOR, NDB	Cat. II	7
Satu Mare	61 R/C/W/T	DVOR/DME, ILS Cat. II	Cat. I	5 (7)
Baia Mare	22 R/D/W/T	NDB, DME, ILS Cat. II	Cat. II	5 (6)
Tulcea	36 R/C/W/T	NDB(LO)	ALS-II, SALS	5 (6)

DVOR/DME – Doppler VHF Omni-directional Range ILS – Instrument Landing System
NDB – Non-directional Beacon ALSF – Approach Lighting System with Sequenced Flashing Lights
ALS – Approach Lighting System

7.1.23 Figure 7.4 summarises the current situation regarding runway constraints. The restriction is primary due to the relatively low PCN of the airfields and the fact that 8 out of 14 are rated the lowest possible, in terms of the strength of the material underlying the pavement. This does mean that it may be possible for an A310 (Code 4D aircraft) to be operated at greater number of airfield if restrictions were imposed (for example, if the payload or fuel weight was reduced).

Figure 7.4: Airports with Runway Constraints



7.1.24 Table 7.10 sets out the detailed dimensions of the longest runway at each airport (width and length), and the ICAO (International Civil Aviation Organization) reference code. This code is calculated by examining the airport's runway length (forming the number), as well as the maximum wing span and outer main gear wheel span of aircraft that the airfield can safely accommodate (forming the letter). Table 7.11 details the precise technical characteristics taken into account in this calculation.

Table 7.10 - Romanian Airports Detailed Runway Characteristics and ICAO Reference Codes

Airport Name	Longest Runway (Length x Width) in metre	ICAO Reference Code
Bucharest Henri Coanda	3,500 x 45	4D
Timisoara	3,500 x 45	4D
Cluj	2,100 x 45	4C
Iasi	1,800 x 45	4C
Craiova	2,500 x 45	4C
Bacau	2,500 x 80	4D
Constanta	3,500 x 45	4D
Targu Mures	2,000 x 45	4C
Sibiu	2,630 x 45	4D
Oradea	2,100 x 45	4D
Brasov		
Suceava	2,460 x 45	4C
Arad	2,000 x 45	4C
Satu Mare	2,500 x 45	4D
Baia Mare	1,790 x 30	3C
Tulcea	2,000 x 30	4C

Table 7.11 - Calculating an Airfield's ICAO Reference Code

Code Number	Reference Field Length (m)	Code Letter	Wing Span (m)	Outer Main Gear Wheel Span (m)
1	< 800	A	< 15	< 4.5
2	800 < 1,200	B	15 < 24	4.5 < 6
3	1,200 < 1,800	C	24 < 36	6 < 9
4	> 1,799	D	36 < 52	9 < 14
		E	52 < 65	9 < 14
		F	65 < 80	14 < 16

Table 7.12 - Airfield Requirements of Popular Commercial Aircraft
(*Italics indicate a type currently operated by TAROM*)

Aircraft	ARFF Category	Aircraft Classification Number (ACN)				ICAO Ref. Code	Max. Runway Requirement (m)
		A	B	C	D		
A310-300	*8*	*40-47*	*48-56*	*57-66*	*65-75*	*4D*	*2,608*
A318	*6*	*31*	*34*	*36*	*38*	*3C*	*2,082*
ATR42-500	*4*	*10*	*11*	*12*	*12*	*3C*	*1,327*
ATR72-500	*5*	*13*	*14*	*14*	*15*	*3C*	*1,518*
737-300	*6*	*40*	*42*	*44*	*46*	*4C*	*2,619*
737-700	*6*	*43*	*46*	*48*	*50*	*4C*	*1,822*
737-800	*7*	*51*	*53*	*55*	*57*	*4C*	*2,733*
A320	6	19-46	23-49	27-51	31-53	4C	2,380
A321	7	47-56	50-59	52-62	54-64	4C	2,915
757-200	7	32	38	45	52	4D	3,315
A330-200	8	48-53	56-61	66-73	78-85	4E	3,872
A330-300	9	46-54	54-62	64-74	75-86	4E	3,758
767-300ER	8	40	47	57	66	4D	2,881
777-200ER	9	50	63	82	101	4E	3,849
747-400	9	53	62	74	85	4E	3,644
747-8	10	64	71	89	112	4F	3,749
A380-800	10	55	64-67	76-88	88-110	4F	3,132

7.1.25 While the ICAO reference code is able to offer a straightforward insight as to whether a particular aircraft would be able to operate at a particular airfield (by comparing the airfield's reference code with the aircraft's reference code), there are also further operational aspects which must be considered. Table 7.12 details the airfield requirements of a number of popular commercial aircraft.

7.1.26 The majority of low-cost carriers' fleet include aircraft such as the A320 and B737-800. Taken that into consideration Tulcea Airport's runway needs to be upgraded, not only because of the length of the runway but the width of 30 metres put an additional restriction to the airport's operations. All other airports have a runway width of 45m.

Passenger terminal capacity constraints.

7.1.27 In determining the passenger terminal capacity demand, we have analysed airport flight schedules to establish the number of passenger flights within the peak hour to calculate the peak hour capacity. During our consultation process we sent out questionnaires to the various airports to get the current peak hour capacities of the airports. We then compared the existing peak hour capacities of the various airports with the current peak hour capacity demand to determine which airports have passenger terminal constraints. The only airport that will need upgrade is Bacau as its PCN is only 19 R/C/W/T and being classified as an International Hub Airport the runway will need upgrading.

7.1.28 Table 7.13 sets out the 2011 peak hour passenger terminal capacity as well as the peak hour capacity demand.

Table 7.13 – Airports Peak Hour Capacity (2011)

Airport Name	Peak Hour Capacity (Passengers)[1]	Daily Passengers	Percentage of Flights within the Peak Hour	Peak Hour Capacity Demand
Bucharest Henri Coanda	4,500	20,056	15%	3,000
Timisoara	1,200	3,715	36%	**1,337**
Cluj	1,500	2,753	16%	440
Iasi	300	505	22%	111
Craiova	600	86	29%	25
Bacau	Not available	897	30%	269
Constanta	Not available	209	100%	209
Targu Mures	580	621	40%	249
Sibiu	300	485	13%	63
Oradea	600	166	100%	166
Brasov	Not open yet			
Suceava	150	75	100%	75
Arad	200	41	100%	41
Satu Mare	200	62	100%	62
Baia Mare	100	51	100%	51
Tulcea	Not available	0	100%	0

[1] Completed Questionnaires

7.1.29 To determine the peak hour passenger demand for the 2020 do nothing scenario we have assumed that the following percentage of flights within the peak hour for each airport category:

- Major International Airports – 15%
- International Hub Airports – 30%
- Regional Airports – 40%
- Smaller Regional Airports – 50%

7.1.30 It is important to note that the busier an airport gets in terms of passenger and air traffic movements, the more spreadout the flights are during the day and hence a lower percentage of flights within the peak hours.

7.1.31 Table 7.14 sets out the Airport Passenger Terminal Demand for 2020.

Table 7.14 – Airports Peak Hour Passenger Terminal Capacity Requirements (2020)

Airport Name	Peak Hour Capacity (Passengers)[1]	Daily	Percentage of Flights within the Peak Hour	Peak Hour Passengers (Passenger Demand)
Bucharest	4,500	28,735	15%	4,310
Craiova	600	5,953	30%	**1,786**
Timisoara	1,200	5,307	30%	**1,592**
Sibiu	300	4,490	30%	**1,347**
Cluj	1,500	3,990	30%	1,197
Bacau	200	3,521	40%	**1,056**
Iasi	300	2,112	40%	**634**
Targu Mures	580	894	40%	358
Oradea	600	704	40%	282
Brasov	n/a	703	40%	281
Constanta	n/a	693	40%	277
Suceava	150	692	50%	**277**
Tulcea	150	566	50%	**227**
Baia Mare	100	530	50%	**212**
Arad	200	108	50%	54
Satu Mare	200	90	50%	45

[1] Completed Questionnaires

7.1.32 From Table 7.14 it is clear that the following airports will run out of or reach the existing passenger terminal capacity by 2020: Craiova, Timisoara, Sibiu, Bacau, Iasi, Suceava, Tulcea, Baia Mare.

7.1.33 Table 7.15 sets out the Airport Passenger Terminal Demand for 2025.

Table 7.15 – Airports Peak Hour Passenger Terminal Capacity Requirements (2025)

Airport Name	Peak Hour Capacity (Passengers)[1]	Daily Passengers	Percentage of Flights within the Peak Hour	Peak Hour Passengers (Passenger Terminal Demand)
Bucharest	4,500	35,603	15%	**5,340**
Craiova	600	7,562	30%	**2,269**
Timisoara	1,200	6,559	30%	1,968
Sibiu	300	5,581	30%	**1,674**
Cluj	1,500	4,990	30%	1,497
Bacau	200	4,358	40%	**1,307**
Iasi	300	2,654	40%	**796**
Targu Mures	580	1,111	40%	444

Airport Name	Peak Hour Capacity (Passengers)[1]	Daily Passengers	Percentage of Flights within the Peak Hour	Peak Hour Passengers (Passenger Terminal Demand)
Oradea	600	883	40%	353
Brasov	n/a	868	40%	347
Constanta	n/a	864	40%	346
Suceava	150	859	50%	**344**
Tulcea	150	700	50%	**280**
Baia Mare	100	665	50%	**266**
Arad	200	134	50%	67
Satu Mare	200	113	50%	57

[1] Completed Questionnaires

7.1.34 From Table 7.15 it is clear the the following airports will run out of or reach the existing passenger terminal capacity by 2025: Bucharest Henri Coanda, Craiova, Timisoara, Sibiu, Bacau, Iasi, Suceava, Tulcea and Baia Mare. Due to the military operations and the security issues at Constanta we could not get any peak hour information from the airport.

Availability of airports during extreme weather conditions.

7.1.35 According to TAROM, flights to Sibiu, Targo Mures and Suceava were discontinued from November 2013 due to the lack of infrastructure during winter months at these airports. During the winter of 2012 only 40% of flights scheduled to these airports could land as a result of the combination of the lack of infrastructure and severe weather conditions.

Poor integration between local authorities and airport managers regarding the future planning for future expansion plans.

7.1.36 According to the Romanian Civil Aviation Authority, there is poor integration between local authorities and airport managers regarding the planning for future expansion of airports. Future developments around airports could potentially limit airport extensions. Local plans do not always take into consideration future expansion plans of airport and hence developments permitted around airports jeopardise the future expansion of airports in terms of infrastructure development, safety zones and flight patterns. Air transport to, from and within Romania creates an economic benefit. By limiting airport expansion economic growth within the wider region will be compromised.

Surface access to and from airports.

7.1.37 There is currently a lack of good public transport links connecting urban areas and Bucharest Henri Coanda Airport with no direct rail, light rail or express bus connections to facilitate ease of movement. This coupled with the relatively long journey times between conurbations and the airport can create a significant access problem and could cause major delays.

7.1.38 A detailed feasibility study is required as part of Sustainable Urban Mobility Plan to determine the need for a dedicated link.

Lack of cargo terminal facilities/intermodal freight facilities.

7.1.39 Few airports have any recognised cargo handling facility, with the exception of Henri Coanda International Airport, with most cargo hubs based in other European countries. This situation arises despite Romania's central location between the Middle East, North Africa, Western Europe and Russia. Coupled with the poor transport connections, it means Romania becomes an end destination for air freight, rather than a hub.

7.1.40 A lack of cargo facilities could deter investments from companies that specialise in freight and logistics or manufacturing companies requiring complex or rapidly moving supply chains such as electronics or pharmaceuticals. It also limits the ability of airlines to spread their risk through the offer of air freight services both in terms of dedicated freighters and belly hold cargo.

7.2 Strategic Objectives

7.2.1 The aviation sector in a country is directly linked the GDP, and hence an important part of a country's economy. One of the key objectives of the aviation industry is to provide a safe and secure mode of transport for passengers. The aviation sector in Romania should provide a network of domestic routes within the country but also provide linkage between other European countries and the rest of the world.

7.3 Operational Objectives

7.3.1 The operational objectives for the aviation sector in Romania are to ensure that all airports in Romania provides the infrastructure capacity and operational facilities required for the 2020 and 2025 demand.

7.3.2 It is important to note that the air sector differs from other modes in that demand is heavily dependent on both landside and airside facilities and services. An airport without appropriate flights does not generate air traffic, but in turn an airline will not start services unless suitable ancillary facilities are available on the ground. The relationship is symbiotic, and large numbers of passengers can be "generated" when the relationship is successful.

7.4 Interventions

7.4.1 To reach the operational objectives for the various airports, the following interventions are proposed:

Upgrade programme for Bucharest Henri Coanda Airport

Proposal Description

7.4.2 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

- Major International Airport
- International Hub Airport
- Regional Airport
- Small Regional Airport

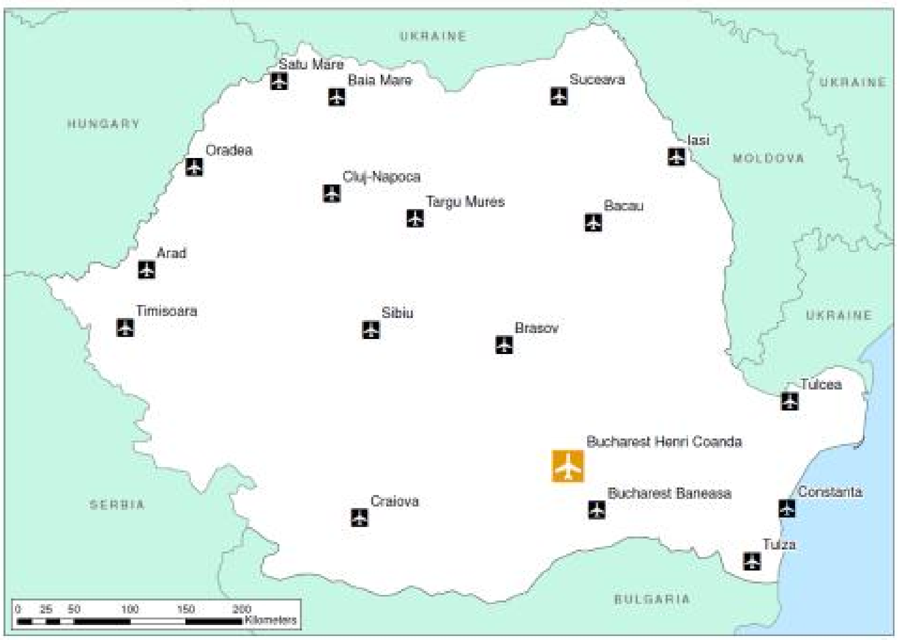
7.4.3 According to the airport classification set out above, Bucharest is classified as the only Major International Airport in Romania.

7.4.4 The upgrade project for Bucharest Henri Coanda aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- o The development or extension of a new passenger terminal and infrastructure by 2025 in order to maintain a Class C Level of Service.
- o Extension of the taxiway system and development of 56 new apron stands by 2020.
- o Rehabilitation of apron, taxiway and runways.
- o New ground transportation connection
- o Analyse the opportunity to develop a cargo terminal.

7.4.5 Figure 7.5 sets out the location of Bucharest Henri Coanda Airport in relations to the other Romanian airports.

Figure 7.5: Location of Bucharest Henri Coanda Airport



Problems Addressed

7.4.6 This intervention addresses the following issues:

- o To facilitate growth in passenger numbers in order to maintain a level of service C.
- o The airport will run out of apron capacity by 2020.
- o International connectivity will generate increased freight flows.
- o Inadequate dedicated bus and rail links.

7.4.7 Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		Description
CAPEX	247.3	Includes: • Development of a new passenger terminal or extension of the current terminal • Construction of new apron stands and the rehabilitation and extension of existing apron stands • Extension of taxiway • New ground transport systems • Feasibility of developing a cargo terminal
OPEX	12.4	Additional operating costs
Total	**259.6**	(2020-25 projects combined)

Outcomes

PVC (€ (2014 Prices))	273,472,534
PVB (€ (2014 Prices))	1,017,104,744
NPV (€ (2014 Prices))	743,632,210
BCR	3.72
EIRR	12%

7.4.8 In 2011 the airport handled 7,320,566 (649,682 domestic and 6,670,884 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 9,712,332 by 2020 (861,945 domestic and 8,850,387 international) and 12,033,753 by 2025 (1,067,966 domestic and 10,965,787 international).

Implementing Organisation

7.4.9 This scheme would be implemented by National Company Bucharest Airports.

Implementation Years

Project	Implementation Year
Develop passenger terminal	2025
Extension of apron space	2020
Extension taxiway and apron space	2025
Rehabilitation of aprons, taxiways and runways	2020
New ground transport system	2020

Upgrade programme for Craiova Airport

Proposal Description

7.4.10 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

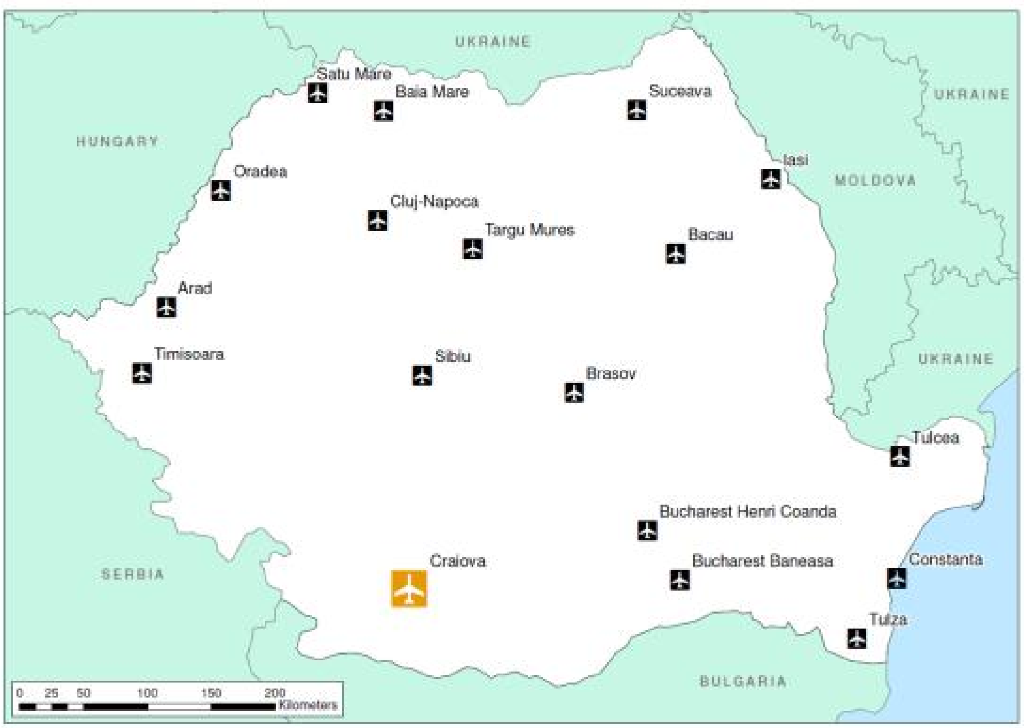
- o Major International Airport
- o International Hub Airport
- o Regional Airport
- o Small Regional Airport

7.4.11 According to the current airports classification system, Craiova Airport is classified as a Small Regional Airport but due to its location and catchment area might have the opportunity to grow into and International Hub Airport in future. The upgrade project for Craiova Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- o Extension of passenger terminal by 2020
- o Extension of passenger terminal by 2025
- o The extension of apron stands by 2020
- o The extension of apron stands by 2025
- o Analyse the opportunity to develop a cargo terminal

7.4.12 Figure 7.6 sets out the location of Craiova Airport in relations to the other Romanian airports.

Figure 7.6: Location of Craiova Airport



Problems Addressed

7.4.13 This intervention addresses the following issues:

- o The airport will run out of passenger terminal capacity by 2020
- o The airport will run out of apron capacity by 2020
- o International connectivity will generate increased freight flows.

Undiscounted Costs

7.4.14 It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	46.6	Includes: • Extension of the current passenger terminal • Extension of existing apron stands • Feasibility of developing a cargo terminal
OPEX	2.3	Additional operating costs
Total	**49**	(2020-2025 projects combined)

Outcomes

PVC (€ (2014 Prices))	57,367,483
PVB (€ (2014 Prices))	248,711,856
NPV (€ (2014 Prices))	191,344,373
BCR	4.34
EIRR	15.7%

7.4.15 In 2011 the airport handled 31,269 (19,397 domestic and 11,872 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 2,012,088 by 2020 (437,186 domestic and 1,574,902 international) and 2,555,876 by 2025 (555,340 domestic and 2,000,536 international).

Note: When the BCR is set to 3, the total annual passenger demand is 340,624 (74,011 domestic and 266,613 international) by 2020.

Implementing Organisations

7.4.16 This project would be implemented by Craiova Airport / Craiova Local Authority.

Implementation Years

Project	**Implementation Year**
Extension of passenger terminal	2020
Extension of passenger terminal	2025
Extension of apron	2020
Extension of apron	2025
Analyse opportunity to develop a cargo terminal	2020

Upgrade programme for Timisoara Airport

Proposal Description

7.4.17 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

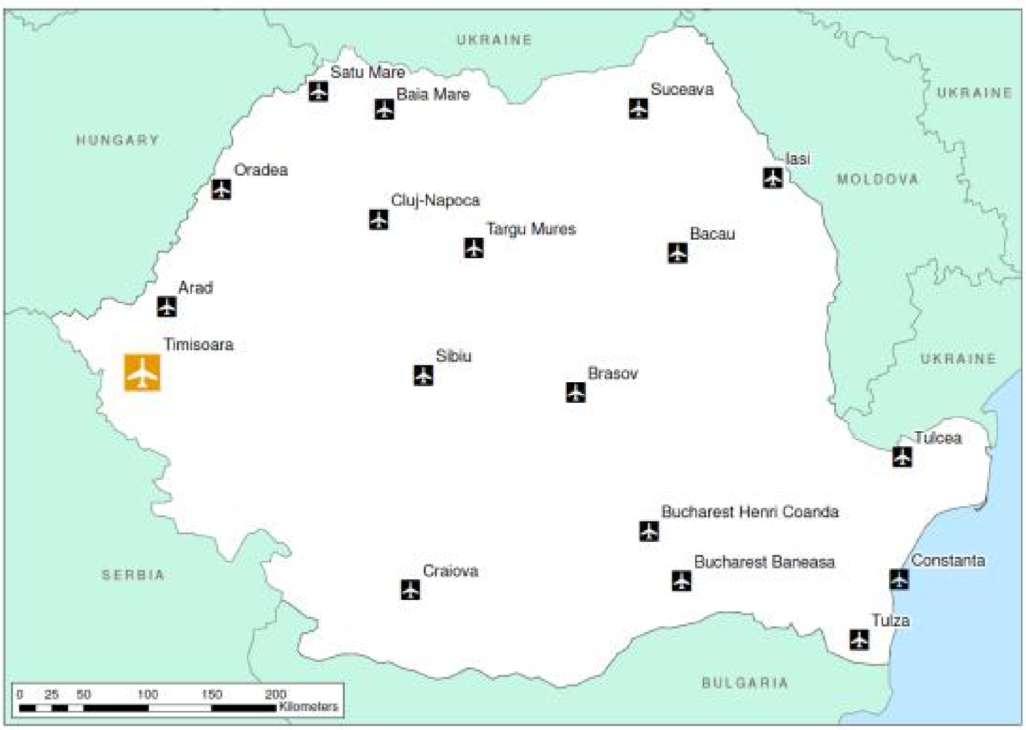
- o Major International Airport
- o International Hub Airport
- o Regional Airport
- o Small Regional Airport

7.4.18 Timisoara Airport is classified as a International Hub Airport. The upgrade project for Timisoara Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- o Extension of passenger terminal by 2020
- o Extension of passenger terminal by 2025
- o Analyse the opportunity to develop a cargo terminal

7.4.19 Figure 7.7 sets out the location of Timisoara Airport in relations to the other Romanian airports.

Figure 7.7: Location of Timisoara Airport



Problems Addressed

7.4.20 This intervention addresses the following issues:

- The airport will run out of terminal capacity by 2020
- International connectivity will generate increased freight flows.

Undiscounted Costs

7.4.21 It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	78.3	Includes: • Extension of the current passenger terminal • Feasibility of developing a cargo terminal
OPEX	4	Additional operating costs
Total	**82.2**	(2020-2025 projects combined)

Outcomes

PVC (€ (2014 Prices))	100,403,866
PVB (€ (2014 Prices))	165,568,470
NPV (€ (2014 Prices))	65,164,605
BCR	1.65
EIRR	5.7%

7.4.22 In 2011 the airport handled 1,356,019 (336,152 domestic and 1,019,867 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 1,793,844 by 2020 (444,687 domestic and 1,349,157 international) and 2,216,900 by 2025 (549,561 domestic and 1,667,339 international).

Implementing Organisations

This project would be implemented by Timisoara Airport / Ministry of Transport.

Implementation Years

Project	**Implementation Year**
Extension of the passenger terminal	2020
Extension of the passenger terminal	2025
Analyse the opportunity of developing a cargo terminal	2020

Upgrade programme for Sibiu Airport

Proposal Description

7.4.23 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

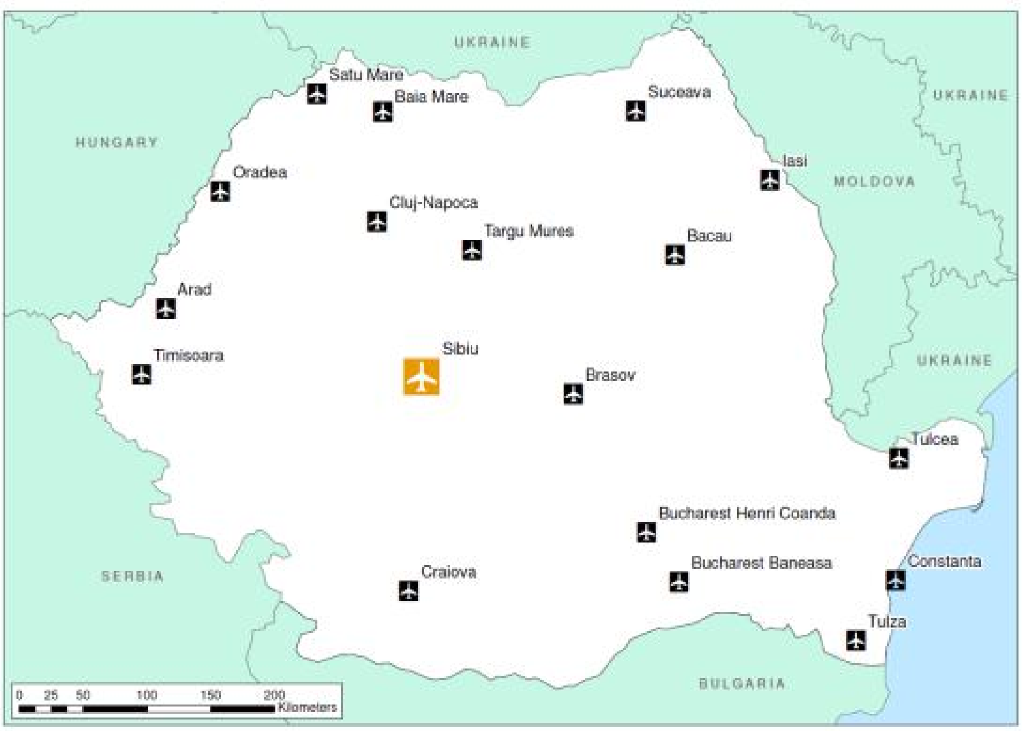
- o Major International Airport
- o International Hub Airport
- o Regional Airport
- o Small Regional Airport

7.4.24 Sibiu Airport is currently classified as a Regional Airport but is forecasted to develop into an International Hub Airport. The upgrade project for Sibiu Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- o Extension of passenger terminal by 2020
- o Extension of passenger terminal by 2025
- o Extension of taxiways by 2020
- o Analyse the opportunity to develop a cargo terminal by 2020
- o Upgrade lighting system from CAT I to CAT II by 2020
- o Acquire de-icing equipment by 2020
- o Install a beaconing system at the November Taxiway

Figure 7.8 sets out the location of Sibiu Airport in relations to the other Romanian airports.

Figure 7.8: Location of Sibiu Airport



Problems Addressed

7.4.25 This intervention addresses the following issues:

- The airport will run out of terminal capacity by 2020
- International connectivity will generate increased freight flows
- In previous winters a significant proportion of flights scheduled to Sibiu have been unable to land due to a lack of infrastructure and severe weather conditions

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		Description
CAPEX	51	Includes: • Extension of the current passenger terminal • Extension of taxiway • Feasibility of developing a cargo terminal • Upgrade lighting system, install de-icing equipment and install a beaconing system
OPEX	2.5	Additional operating costs
Total	**53.5**	(2020-2025 projects combined)

Outcomes

PVC (€ (2014 Prices))	64,912,841
PVB (€ (2014 Prices))	651,827,026
NPV (€ (2014 Prices))	586,914,185
BCR	10.04
EIRR	34.9%

7.4.26 In 2011 the airport handled 176,906 (26,482 domestic and 150,424 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 1,517,611 by 2020 (329,756 domestic and 1,187,865 international) and 1,886,252 by 2025 (409,844 domestic and 1,476,408 international).

Implementing Organisations

This project would be implemented by Sibiu Airport.

Implementation Years

Project	Implementation Year
Extension of Passenger Terminal	2020
Extension of Passenger Terminal	2025
Analyse the opportunity of developing a cargo terminal	2020
Upgrade from CAT I to CAT II lighting system	By 2020
Acquire de-icing equipment	By 2020
Installing of beaconing system at the November Taxiway	2020

Upgrade programme for Cluj-Napoca Airport

Proposal Description

7.4.27 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

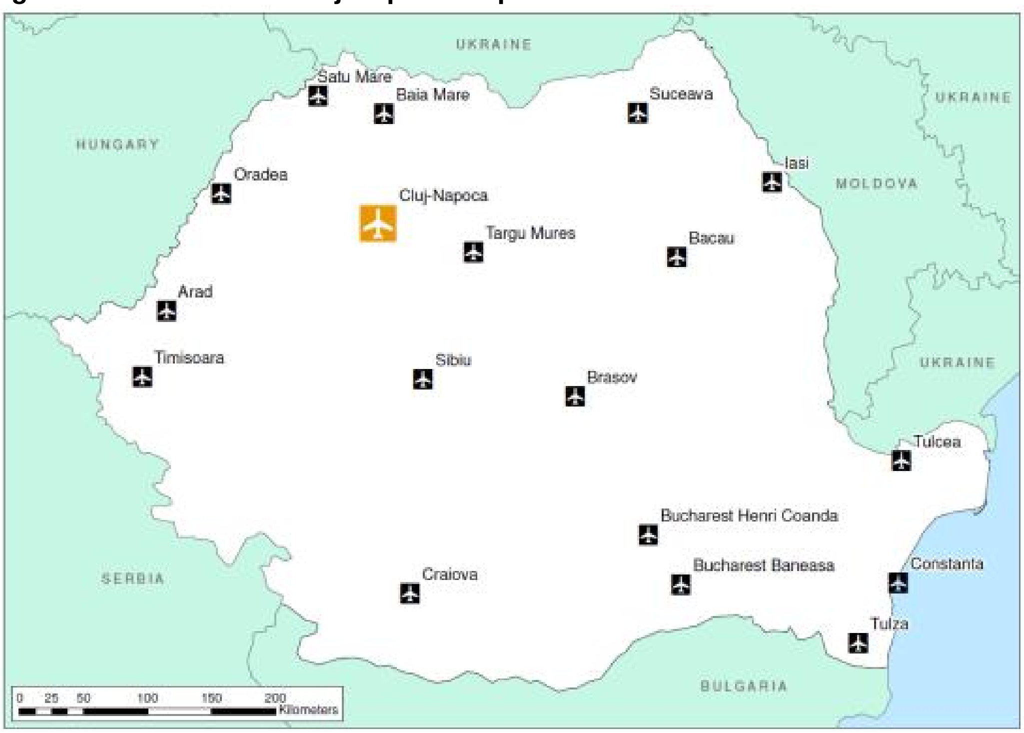
- o Major International Airport
- o International Hub Airport
- o Regional Airport
- o Small Regional Airport

7.4.28 Cluj-Napoca Airport is classified as a International Hub Airport. The upgrade project for Cluj-Napoca Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- o Expansion/construction of new taxiways and apron space
- o Analyse the opportunity to develop a cargo terminal

7.4.29 Figure 7.9 sets out the location of Cluj-Napoca Airport in relations to the other Romanian airports.

Figure 7.9: Location of Cluj-Napoca Airport



Problems Addressed

7.4.30 This intervention addresses the following issues:

- o The airport will run out of apron capacity by 2020
- o International connectivity will generate increased freight flows

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	38.1	Includes: • Construction of new aprons and taxiways • Analyse opportunity to develop a cargo terminal
OPEX	1.9	Additional operating costs
Total	**40**	(2020-2025 projects combined)

Outcomes

PVC (€ (2014 Prices))	49,744,906
PVB (€ (2014 Prices))	136,137,415
NPV (€ (2014 Prices))	86,392,510
BCR	2.74
EIRR	8.1%

7.4.31 In 2011 the airport handled 1,004,821 (189,139 domestic and 815,682 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 1,348,564 by 2020 (253,842 domestic and 1,094,722 international) and 1,686,515 by 2025 (317,455 domestic and 1,369,059 international).

Implementing Organisations

This project would be implemented by Cluj-Napoca Airport.

Implementation Years

Project	**Implementation Year**
New taxiway and expansion of apron space	2020
Expansion of apron space	2025
Analyse the opportunity of developing a cargo terminal	2020

Upgrade programme for Bacau Airport

Proposal Description

7.4.32 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

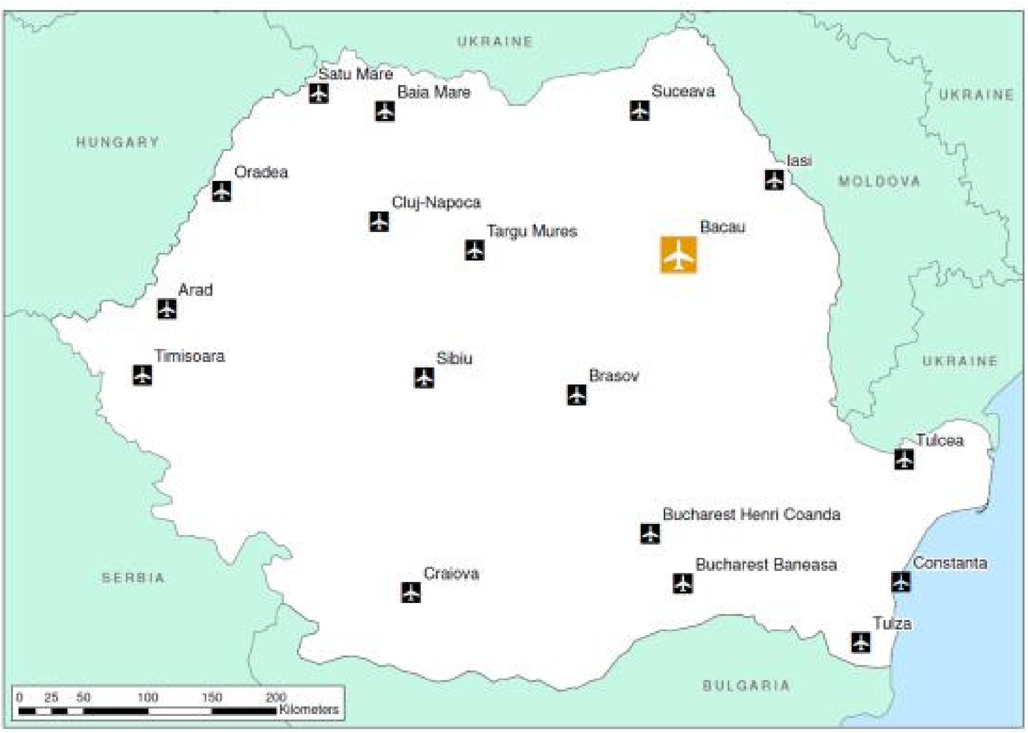
- Major International Airport
- International Hub Airport
- Regional Airport
- Small Regional Airport

7.4.33 Bacau Airport is currently classified as a Regional Airport but could be developed into an International Hub Airport due to its catchment area. The upgrade project for Bacau Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- Extension of passenger terminal
- Expansion of apron space
- Increase runway bearing capacity
- Analyse the opportunity to develop a cargo terminal

Figure 7.10 sets out the location of Bacau Airport in relations to the other Romanian airports.

Figure 7.10: Location of Bacau Airport



Problems Addressed

7.4.34 This intervention addresses the following issues:

- The airport will run out of terminal capacity by 2020
- The airport will run out of apron space by 2020
- The runway has a very low PCN value and needs to be upgraded to handle more flights
- International connectivity will generate increased freight flows

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	86.6	Includes: • Expansion of passenger terminal • Expansions of apron space • Increase runway bearing capacity • Analyse opportunity to develop a cargo terminal
OPEX	4.3	Additional operating costs
Total	**91**	(2020-2025 projects combined)

Outcomes

PVC (€ (2014 Prices))	111,719,869
PVB (€ (2014 Prices))	367,635,291
NPV (€ (2014 Prices))	255,915,421
BCR	3.29
EIRR	10.9%

7.4.35 In 2011 the airport handled 327,414 (21,106 domestic and 306,308 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 1,190,261 by 2020 (258,620 domestic and 931,641 international) and 1,473,001 by 2025 (320,053 domestic and 1,152,948 international).

Implementing Organisations

This project would be implemented by Bacau Airport.

Implementation Years

Project	**Implementation Year**
Extension of Passenger Terminal	2020
Extension of Passenger Terminal	2025
Expansion of Apron space	2020
Expansion of Apron space	2025
Increase the bearing capacity of the runway	2020
Analyse the opportunity of developing a cargo terminal	2020

Upgrade programme for Iasi Airport

Proposal Description

7.4.36 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

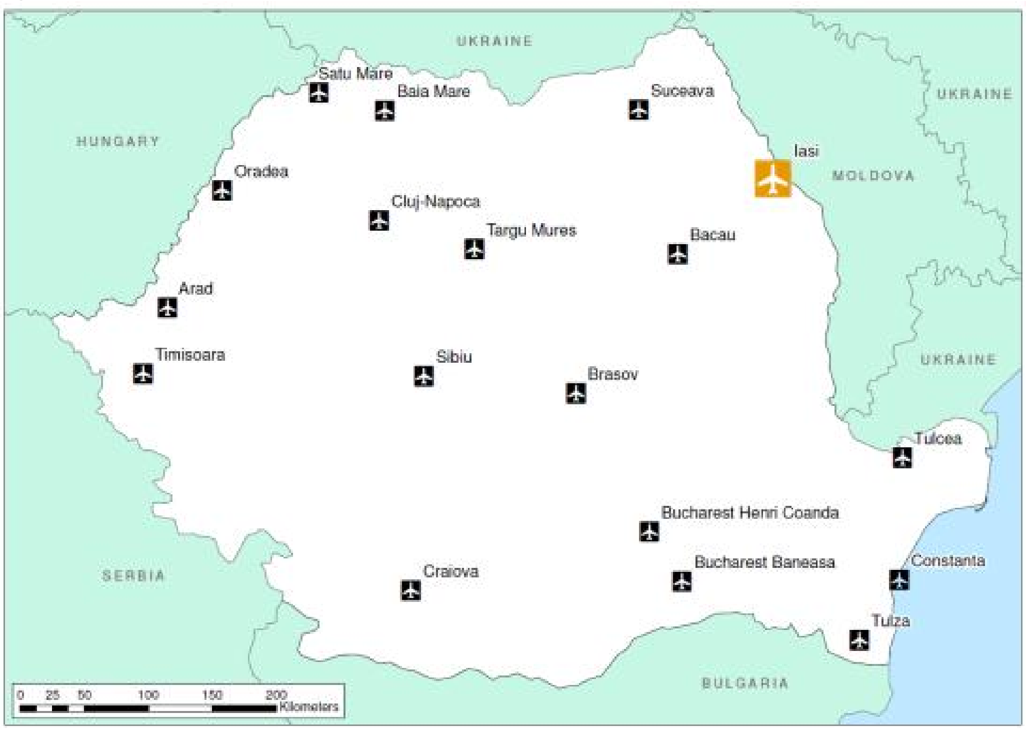
- o Major International Airport
- o International Hub Airport
- o Regional Airport
- o Small Regional Airport

7.4.37 Iasi Airport is currently classified as a Regional Airport but has the potential to be developed into a International Hub Airport. TAROM Airlines is already using Iasi Airport as their second hub. The upgrade project for Iasi Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- o Extension of passenger terminal
- o Increase runway bearing capacity
- o Analyse the opportunity to develop a cargo terminal

7.4.38 Figure 7.11 sets out the location of Iasi Airport in relations to the other Romanian airports.

Figure 7.11: Location of Iasi Airport



Problems Addressed

This intervention addresses the following issues:

- o International connectivity will generate increased freight flows

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	10.8	Includes: • Analyse opportunity to develop a cargo terminal
OPEX	0.5	Additional operating costs
Total	**11.3**	

Outcomes

PVC (€ (2014 Prices))	14,183,156
PVB (€ (2014 Prices))	78,948,864
NPV (€ (2014 Prices))	64,765,707
BCR	5.57
EIRR	17.4%

7.4.39 In 2011 the airport handled 184,483 (139,185 domestic and 45,298 international) per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 713,729 by 2020 (155,122 domestic and 558,807 international) and 896,903 by 2025 (194,879 domestic and 702,024 international).

Implementing Organisations

This project would be implemented by Iasi Airport.

Implementation Years

Project	**Implementation Year**
Analyse the opportunity of developing a cargo terminal	2020

Upgrade programme for Targu Mures Airport

Proposal Description

7.4.40 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

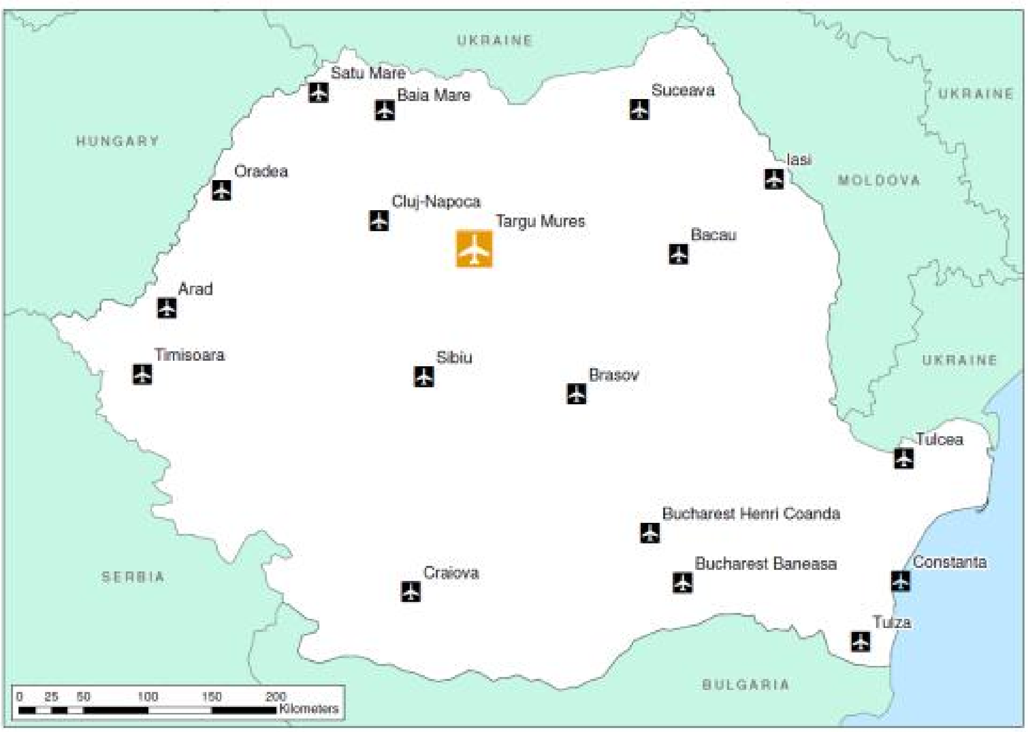
- o Major International Airport
- o International Hub Airport
- o Regional Airport
- o Small Regional Airport

7.4.41 Targu Mures Airport is classified as a Regional Airport. The upgrade project for Targu Mures Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- o Extension of apron
- o Upgrade lighting system
- o Acquire de-icing equipment

7.4.42 Figure 7.12 sets out the location of Targu Mures Airport in relations to the other Romanian airports.

Figure 7.12: Location of Targu Mures Airport



Problems Addressed

7.4.43 This intervention addresses the following issues:

- o The airport will run out of apron capacity by 2020

- o In previous winters a significant proportion of scheduled flights have been unable to land due to inadequate infrastructure and severe weather conditions

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	4.2	Includes: • Upgrade lighting system and acquire de-icing equipment
OPEX	0.2	Additional operating costs
Total	**4.4**	(2020-2025 projects combined)

Outcomes

PVC (€ (2014 Prices))	5,531,431
PVB (€ (2014 Prices))	48,254,371
NPV (€ (2014 Prices))	42,722,940
BCR	8.72
EIRR	14.5%

7.4.44 In 2011 the airport handled 226,838 (10,477 domestic and 216,361 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 302,113 by 2020 (13,954 domestic and 288,159 international) and 375,498 by 2025 (17,343 domestic and 358,155 international).

Implementing Organisations

This project would be implemented by Bacau Airport.

Implementation Years

Project	**Implementation Year**
Upgrade of lighting system and navigational aids	2020
Acquire de-icing equipment	2020

Upgrade programme for Constanta Airport

Proposal Description

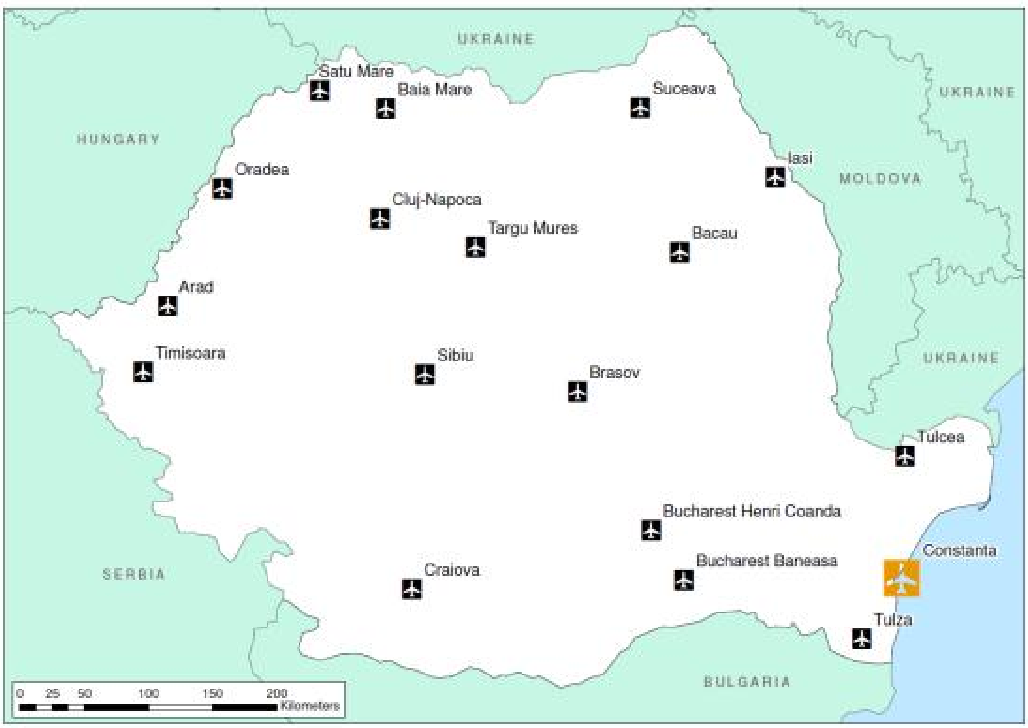
7.4.45 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

- Major International Airport
- International Hub Airport
- Regional Airport
- Small Regional Airport

7.4.46 Constanta Airport is currently classified as a Small Regional Airport but has the potential to be developed into a Regional Airport. The upgrade project for Constanta Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes turning facilities at Threshold 18.

7.4.47 Figure 7.13 sets out the location of Constanta Airport in relations to the other Romanian airports.

Figure 7.13: Location of Constanta Airport



Problems Addressed

7.4.48 This intervention addresses the following issues:

o Due to the fact that the airport is also used for military operations the turning facility will increase the number of traffic movements.

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	1.6	Includes: • Turning facilities at Threshold 18
OPEX	0.1	Additional operating costs
Total	**1.7**	

Outcomes

PVC (€ (2014 Prices))	2,127,473
PVB (€ (2014 Prices))	6,513,377
NPV (€ (2014 Prices))	4,385,903
BCR	3.06
EIRR	10.0%

7.4.49 In 2011 the airport handled 76,464 (11,647 domestic and 64,817 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 234,219 (51,479 domestic and 182,740 international) and 292,187 by 2025 (64,220 domestic and 227,967 international).

Implementing Organisations

This project would be implemented by Constanta Airport.

Implementation Years

Project	**Implementation Year**
Construction of a turning facility at Threshold 18	2020

Upgrade programme for Suceava Airport

Proposal Description

7.4.50 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

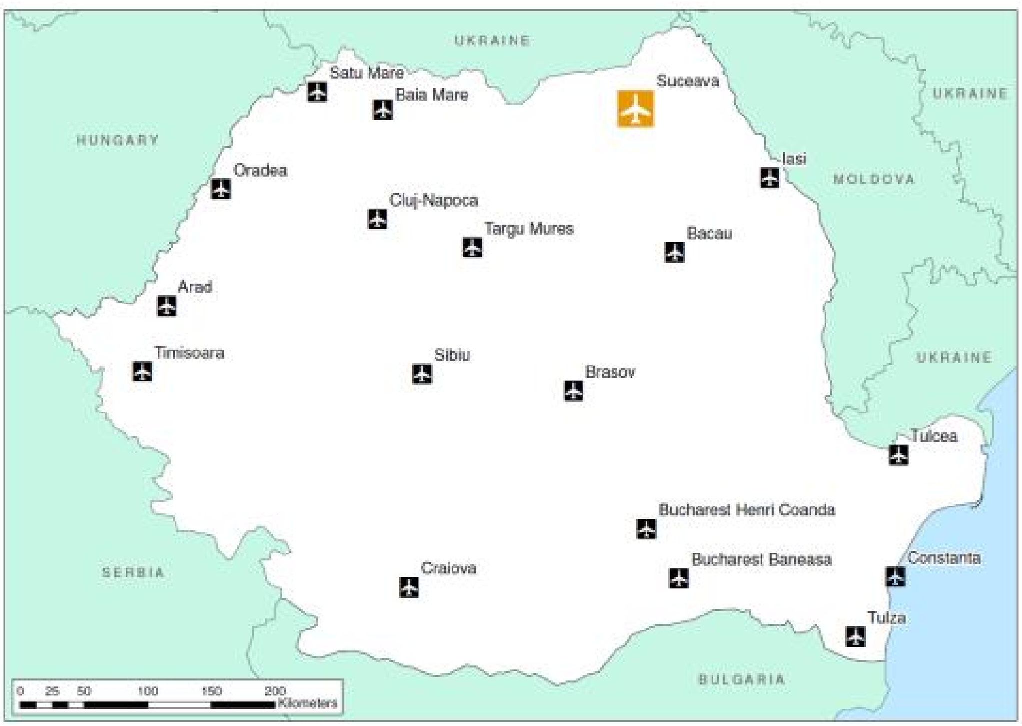
- Major International Airport
- International Hub Airport
- Regional Airport
- Small Regional Airport

7.4.51 Suceava Airport is currently classified as a Small Regional Airport but has the potential to be developed into a Regional Airport. The upgrade project for Suceava Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- Extension of passenger terminal
- Acquire de-icing equipment

7.4.52 Figure 7.14 sets out the location of Suceava Airport in relations to the other Romanian airports.

Figure 7.14: Location of Suceava Airport



Problems Addressed

7.4.53 This intervention addresses the following issues:

- The airport will run out of terminal capacity by 2020

- o In previous winters a significant proportion of scheduled flights have been unable to land due to inadequate infrastructure and severe weather conditions

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		**Description**
CAPEX	3.2	Includes: • Expansion of terminal • Acquire de-icing equipment
OPEX	0.2	Additional operating costs
Total	**3.4**	

Outcomes

PVC (€ (2014 Prices))	3,922,913
PVB (€ (2014 Prices))	31,065,173
NPV (€ (2014 Prices))	27,142,260
BCR	7.92
EIRR	31.8%

7.4.54 In 2011 the airport handled 27,228 (26,244 domestic and 984 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 233,815 by 2020 (51,390 domestic and 182,425 international) and 290,496 by 2025 (63,848 domestic and 226,648 international).

Implementing Organisations

This project would be implemented by Suceava Airport.

Implementation Years

Project	**Implementation Year**
Extension of Passenger Terminal	2020
Extension of Passenger Terminal	2025
Acquire de-icing equipment	2020

Upgrade programme for Tulcea Airport

Proposal Description

7.4.55 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

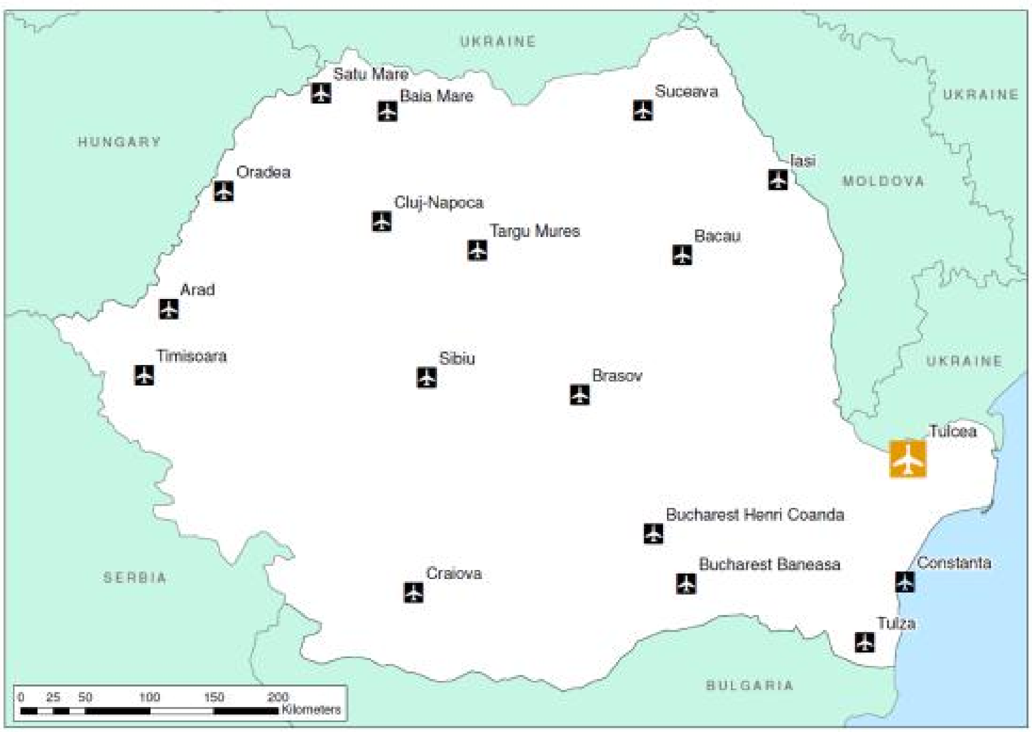
- Major International Airport
- International Hub Airport
- Regional Airport
- Small Regional Airport

7.4.56 Tulcea Airport is currently classified as a Small Regional Airport but has the potential to be developed into a Regional Airport. The upgrade project for Tulcea Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- Extension of passenger terminal
- Extension of apron
- Upgrading of the runway and taxiways

Figure 7.15 sets out the location of Tulcea Airport in relations to the other Romanian airports.

Figure 7.15: Location of Tulcea Airport



Problems Addressed

7.4.57 This intervention addresses the following issues:

- The airport will run out of terminal capacity by 2020

- o The airport will run out of apron capacity by 2020

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		Description
CAPEX	17.7	Includes: • Extension of passenger terminal • Extension of apron space
OPEX	0.9	Additional operating costs
Total	**18.6**	

Outcomes

PVC (€ (2014 Prices))	22,957,376
PVB (€ (2014 Prices))	97,491,792
NPV (€ (2014 Prices))	74,534,416
BCR	4.25
EIRR	13.8%

7.4.58 In 2011 the airport had no scheduled flight, during recent years airlines have started to fly from Tulcea. If the upgrade programme is undertaken fully, passenger numbers could grow to 191,459 by 2020 (42,081 domestic and 149,378 international) and 236,613 by 2025 (52,005 domestic and 184,608 international).

Implementing Organisations

This project would be implemented by Tulcea Airport.

Implementation Years

Project	Implementation Year
Extension of passenger terminal	2020
Extension of passenger terminal	2025
Expansion of apron space	2020
Upgrading of runway and taxiways	2020

Upgrade programme for Baia Mare Airport

Proposal Description

7.4.59 In line with the Primary Economic Networks defined for road and rail modes, it is important to develop a hierarchy for Romanian airports, based on their role and potential to attract both international and domestic traffic in the future. The airport classifications are:

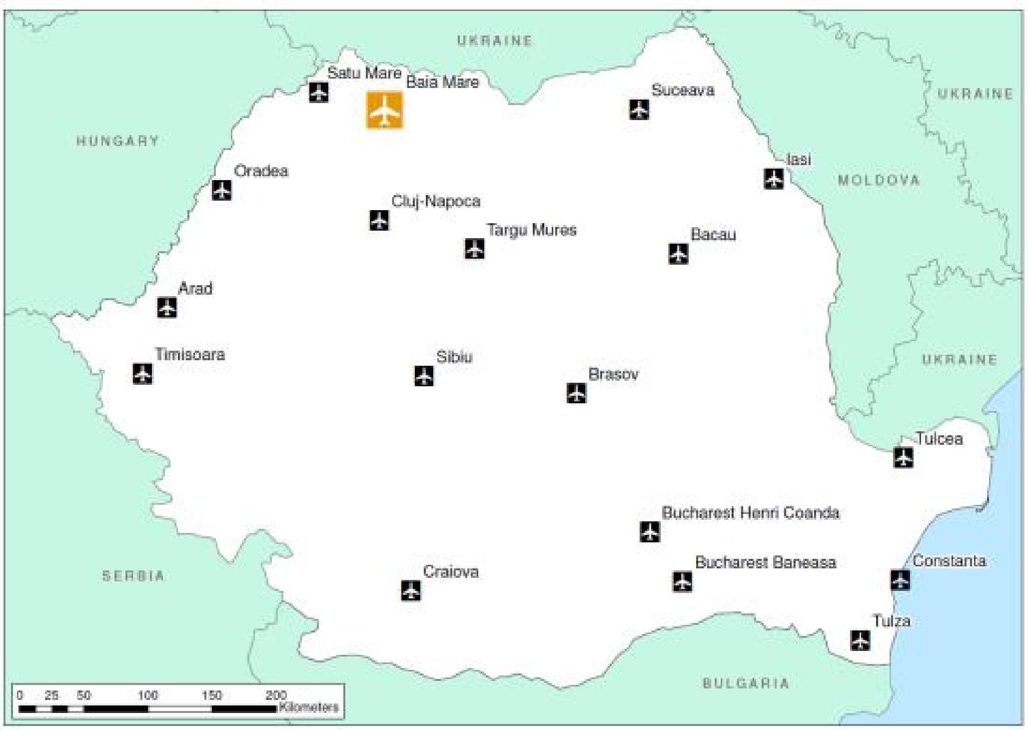
- Major International Airport
- International Hub Airport
- Regional Airport
- Small Regional Airport

7.4.60 Baia Mare Airport is currently classified as a Small Regional Airport but have the potential to be developed into a Regional Airport. The upgrade project for Baia Mare Airport aims to ensure that infrastructure capacity and operational facilities are able to deal with demand increase for 2020 and 2025. The project includes:

- Extension of passenger terminal

Figure 7.16 sets out the location of Baia Mare Airport in relations to the other Romanian airports.

Figure 7.16: Location of Baia Mare Airport



Problems Addressed

7.4.61 This intervention addresses the following issues:

- The airport will run out of terminal capacity by 2020

Undiscounted Costs

It has been estimated that the project will incur in the following costs

Undiscounted costs (Million €, 2014 prices)		Description
CAPEX	2.3	Includes: • Extension of terminal
OPEX	0.1	Additional operating costs
Total	**2.4**	

Outcomes

PVC (€ (2014 Prices))	2,769,760
PVB (€ (2014 Prices))	7,698,694
NPV (€ (2014 Prices))	4,928,934
BCR	2.78
EIRR	10.4%

7.4.62 In 2011 the airport handled 18,568 (18,017 domestic and 551 international) passengers per annum. If the upgrade programme is undertaken fully, passenger numbers could grow to 179,287 by 2020 (39,405 domestic and 139,882 international) and 224,770 by 2025 (49,402 domestic and 175,368 international).

Implementing Organisations

This project would be implemented by Tulcea Airport.

Implementation Years

Project	Implementation Year
Extension of Passenger Terminal	2020
Extension of Passenger Terminal	2025

7.5 Results of Testing

7.5.1 Table 7.16 sets out the project testing results

Table 7.16: Project Testing Results

Airport	Type of Projects	Year to be Implemented	Cost 2014 prices (Euros) (CAPEX)	OPEX 2014 prices (Euros)	BCR
Bucharest Henri Coanda	Rehabilitation of aprons, taxiways, runway; New Passenger Terminal, Extension of apron and taxiways	2020/2025	247,300,00	12,400,000	3.72
Craiova	Passenger Terminal, Extension of apron and cargo terminal	2020/2025	46,600,000	2,330,000	4.34
Timisoara	Passenger Terminal, Intermodal Cargo Terminal	2020/2025	78,300,000	3,900,000	1.65
Sibiu	Passenger Terminal, Lighting, De-Icing Equipment and Taxiway extensions	2020/2025	51,000,000	2,500,000	10.04
Cluj-Napoca	Apron and Taxiway extensions; Movement Surfaces , cargo terminal	2020/2025	38,000,000	1,900,000	2.74
Bacau	Passenger terminal, runway bearing capacity, cargo terminal	2020/2025	86,600,000	4,300,000	3.29
Iasi	Intermodal cargo terminal	2020	10,800,000	540,000	5.57
Targu Mures	Apron extensions, Lighting and De-icing Equipment	2020	4,200,000	211,000	8.72
Constanta	Runway turning facilities	2020	1,600,000	81,000	3.06
Suceava	Expansion of Passenger Terminal, De-icing Equipment	2020/2025	3,200,000	161,000	7.92
Tulcea	Extension of Passenger Terminal and Apron	2020/2025	17,700,000	900.000	4.25
Baia Mare	Extension of Passenger Terminal	2020/2025	2,300,000	115,000	2.8

Intermodal Transport

8 Intermodal Transport

8.1 Existing Conditions

8.1.1 Before the recession the global logistics industry was estimated at roughly EUR 5.4 trillion, or 13.8% of the global Gross Domestic Product (GDP).

8.1.2 On average, logistics costs account for 10-15% of the final cost of the finished product. Estimates made in 2007 put the share of the logistics industry in Romania at 9.7% of GDP, which is around 50% lower than the average in Europe (close to 14% of GDP). (Source: “Freight Transport Logistics Action Plan”, COM (2007) final, Commission of the European Communities.)

8.1.3 The conclusion is that either the cost base in Romania is much lower than in other EU countries or the logistics industry is not well developed and hence is not serving the economy as well as it could. Our understanding is that both factors are true. Based on the same principles of cost, time and risk reduction, logistics supply chains seek to route goods along “the path of the least resistance”. The countries that minimise the barriers to trade adopt simple and efficient customs procedures and have good transport infrastructure and efficient terminals that attract freight movements.

8.1.4 Containerisation has grown rapidly over the last fifty years and has replaced traditional forms of shipping for many types of commodity but especially manufactured and consumer goods. Trade patterns have also changed during this period and now 70% of all containerised cargo coming to Europe originates mainly from Asia. Romania is in strong competition with many countries in South and Eastern Europe to become a preferred location for feeding goods into the European hinterland, due to its proximity to the Suez Canal in sailing time. Romania is also well placed to attract inward investment especially for the manufacturing assembly and related logistics activities due to relatively low labour rates and being located on the east-west trade route.

8.1.5 Aside from containerised traffic the position of Romania, and the Port of Constanta, on the TRACECA corridor (“Silk route”) puts the country and the port in a good position to operate Ro-Ro services across the Black Sea (e.g. Turkey and Georgia), especially given the time and environmental savings that can be made by these connections. This development could strengthen the competitive position of the Port of Constanţa as a hub serving the Black Sea region. The increasing economic relationships between Europe and the Caucasus region, means that Romania could have an increasingly key role to play as a transport hub on this important trade route. The important point is whether Romania is seen by shippers and freight forwarders as being on a path of least resistance or in other words a cost effective and time sensitive international transport corridor.

8.1.6 From an overall logistics assessment, the Port of Constanţa’s hinterland includes Bulgaria, Serbia, Croatia, Hungary, Austria, Slovak Republic, South Poland, Republic of Moldova, and the Black Sea bordering countries (mainly Ukraine and parts of Russia).

8.1.7 The total market for the Central & Eastern Europe “CEE package” is estimated at over 18 million TEU (Twenty Foot Equivalent Units) in 2020. Expert reports estimate that the Port of Constanţa could attract over 4 million TEU out of this total, on the condition that a “path of least resistance” in and through Romania exists. The business case worked out in the “European Gateway Project” forecasts the volume of transport associated to the new assembly activities to be performed inside Romania at 2.4 million TEU in 2020 (referred to as “New Assembly package”)[36].

8.1.8 Intermodal forecasts for Romania indicate a volume in and through Romania of 1.2 million TEU. In the DIOMIS forecast it is expected that the Port of Constanţa will not have a significant competitive position and thus will not attract the traffic destined to the other CEE countries in significant volumes[37].

8.1.9 The estimates in the paragraphs above are other consultants’ forecasts, and depend on variables such as economic forecasts, the competitive position of Constanta Port vis-a-vis other Black Sea, Mediterranean, and Northern European ports, investment in Constanta Port, pricing, level of service offered by rail and road operators inside Romania, and the commercial agreements between shippers and final customers. Whether such volumes can be realised given the current situation (in 2011 Constanta Port handled 662,000 TEU), is open to debate: nevertheless it seems clear that there is at least potential for greater container throughput at Constanta, and for intermodal transport within, and through, Romania.

Existing Intermodal Operations

8.1.10 The Black Sea Port of Constanta is home to the largest container port in the Black Sea and is strategically situated at the mouth of the Danube Black Sea Canal which feeds freight into the heartland of Central and Eastern Europe. Constanta port handled 1.41 million TEU in 2007 before the economic crisis, contributing to volumes to more than halving to just 557,000 TEU in 2010. This downward trend has reversed slightly with volumes growing to 663,000 in 2011, which is still only 47% of the 2007 volumes.

8.1.11 Constanta is also experiencing competition from the port of Illichivsk in Ukraine. Illichivsk’s inland routes to Russia, the Baltic States and Northern Europe are potentially shorter and quicker than through Romania that has a poorer infrastructure. In 2008, the Port of Illichivsk reached the half-million mark in transhipments of containers, thereby becoming Ukraine's main container port.

8.1.12 The Port of Constanta is reacting to competition and is seeking more partnerships. In the last two years the port has signed a protocol of cooperation in the field of maritime transport and port infrastructure for example with the port of Jebel Ali in Dubai. The cooperation agreement was initiated by DP World, which operates at both ports. It is hoped that the deal will lead to an increase in cargo flows between the two ports, with the facilities agreeing to support initiatives of any operator to establish lines between the two.

Constanta South Container Terminal (CSCT)

8.1.13 DP World is operating around 50 terminals across 30 countries. It decided to invest in Romania as a gateway to Eastern Europe. Since beginning operations in 2004, CSCT has established itself as the principal container hub for the Black Sea. This terminal is by far the biggest container terminal at Constanta but not the only one. The terminal grew to 1,100,000 TEU in 2007 and 2008. Its current terminal capacity is 1.5 million TEU with sufficient land to expand to 4.5 million TEU.

[36] Source: Intermodal Strategy Romania 2020

[37] Source: DIOMIS – Evolution of intermodal rail/road traffic in Central and Eastern European Countries by 2020, UIC, March 2010

Figure 8.1 DP World's Offices at Constanta South Container Terminal (CSCT)

8.1.14 The terminal handles a range of container ships from deep sea vessels to coastal feeders and barges destined to river ports on the Danube. It is understood the biggest vessel that can currently be handled is an 8,000 TEU deep-sea container ship. There are feeder services to all Black Sea container ports. Several regular barge services operate including domestic transit boxes handled at Giurgiu Free Zone and this vessel also serves Svistou (Bulgaria) as required. There are international transit services from Constanta to Belgrade with options for Hungary, Slovakia and Austria.

8.1.15 The main berth is 634 metres long with a feeder berth of 411 metres. The water draught is a minimum of 14.5m allowing large capacity vessels to operate. There are plans for two additional berths (129, 130) giving an extra 510m of mooring.

8.1.16 The container terminal has 8 ship-to-shore cranes, 13 rubber tyred and two rail mounted gantry cranes and these are supplemented by 4 reach stackers and 4 empty handlers. The port also has 55 ITVs (Internal transfer vehicles) for moving boxes within the terminal. The port operated 364 days per year, 24 hours per day in two 12 hour shifts but like most ports does have busier times of the day/week.

8.1.17 DP World has its own rail terminal with 3 rail lines, each 600m long capable of handling 3 complete 30 wagon trains at once. There are several holding sidings with container trains waiting to be handled. There are about 6 to 7 container trains a day according to DP World. From a visit by the project team an observation was that the rail wagons looked old and there were large lengths of wasted space on the trains that could have better productivity. Two rail mounted gantry cranes service their tracks. It was noted in the DP World Handbook that parts of the mainline track network are being upgraded over the next 3 years to accommodate higher speed freight trains. Improvements to the port rail network will have a significant effect on rail transit times. Additional tracks will link the north to the south port.

8.1.18 Road freight is the dominant mode and there are 3 goods inwards bays and 1 goods outwards in regular use but they have extra gates that could be brought into use if additional capacity is needed. They try to turn a truck round in 15 minutes but it can take an hour. The terminal handles about 850 container trucks over a typical day[38]. The period of busy activity is from 2pm

[38] AECOM 24 count, March 2013

until 10pm with the peak hour being 5-6pm which saw 54 container movements. Note that this is based on an observations made over a 24 hour period. They are considering introducing a Vehicle Booking system like that used at Southampton in the UK.

Figure 8.2 Draw-bar container truck in DP World's terminal moving two 20' containers for Mediterranean Shipping Company

8.1.19 According to the terminal operator it handles a mixture of box sizes with about 55% being 20', with the balance being mostly 40' but there are some 30' and 45'. The terminal services include 624 reefer plugs and monitoring for temperature controlled containers, container stuffing and unloading, EDI messaging and office facilities. DP World has a sophisticated IT system to EDIFACT standard and the terminal operating system is provided by Navis.

Maritime

Table 8.1 Constanta port has handled the following tonnages since 2005

Years	2005	2006	2007	2008	2009	2010	2011
Containers (number)	493,214	672,443	912,509	894,876	375,293	353,711	414,096
Containers (TEUs)	768,099	1,037,077	1,411,414	1,380,935	594,299	556,694	662,796

Source: Constanta Handbook

Road

8.1.20 AECOM undertook a traffic count at Constanta's Gates 10 and 14 whereby every HGV entering and leaving the port was classified, to understand what it was carrying. The traffic count took place over 24 hours. 57% of freight vehicles are involved in carrying containers. It is currently possible to drive to Bucharest from Constanta and return in a single day. It is thought that many of the containers that are being transported by road will end up at Bucharest as it is a major population centre.

8.1.21 The A2 is currently being extended with a new junction being built for the port. It is estimated that this will save 30 minutes from a journey time and potentially make road even more attractive as a mode. This could enable road to gain a larger market share.

River

8.1.22 The Danube and other manmade navigations are an important part of Romania's and Europe's infrastructure. Currently there are also long distance domestic flows, as an example there is an established significant iron ore flow by barge from south west Romania to Galati which is a distance of 800kms. There could be potential for increasing domestic intermodal flows providing the terminal infrastructure is built and services are reliable and cost efficient. At the moment the number of containers moving on the Danube is relatively small at around 2% of the number of containers handled at Constanta, but there is potential for growth. Containers can be handled at most river ports using a traditional crane but this is not very fast or efficient. The port of Giurgiu handles some containers that then can go north by road or rail.

8.1.23 The flow of TEUs on the Romanian section of the Danube that start or end at Constanta is listed below. The average tonnage per TEU in 2010 was 10.8 tonnes. These are handled by Romanian carriers.

Table 8.2 – TEUs on Danube River[39]

	2008	2009	2010
TEUs	10,753	8,550	10,057
Tonnes	106,919	80,344	108,783
Ave. Tonnes per TEU	9.9	9.4	10.8

Source: Constanta Handbook

8.1.24 It can be seen that the number of TEUs and the number of tonnes transported dropped in 2009 coincident with the economic crisis in Europe.. The 2010 tonnage recovered to a similar level observed in 2008. The largest carrier of TEUs on the Danube in Romania is Transcanal and in 2010 it handled 77% of TEUs and 75% of the associated tonnes.

8.1.25 Although the Port of Constanta is bar far the biggest generator of intermodal freight in Romania the Port of Galati is trying to attract Black Sea trade in preference to Constanta and is offering cheaper prices. Their aim is to set up bulk and container trains to international destinations, for example Duisberg in Germany. Galati also acts as a transhipment port from barge to coastal ship for onward delivery to Black Sea ports serving Ukraine and Russia. It offers a direct freight train service to Kazakhstan as it is the only Romanian port offering both 1435 (European gauge) and 1520mm (Russian gauge) capability.

Rail

8.1.26 CFR Marfă has provided information for their 14 active intermodal terminals. (12 are inactive). Tables 3 and 4 gives details of these terminals.

[39] Source – Constantza port handbook

Table 8.3 Location of CFR Marfă Intermodal Freight Terminals

No.	Terminal	Crane Equipment	Current Status
1	Bucurestii Noi	4 cranes (1 functioning)	Active
2	Bucuresti Sud (Titan)	3 cranes (1 functioning)	Active
3	Bucuresti Progresu	1 crane in conservation	Closed
4	Ploiesti Crang	3 cranes (1 active)	Not currently active
5	Bradu de Sus	2 cranes functioning	Not currently active
6	Bujoreni Valcea	2 cranes (1 functioning and 1 not functioning)	Not currently active
7	Craiova	3 cranes not functioning (1 in conservation)	Not currently active
8	Semenic	3 cranes (2 functioning)	Not currently active
9	Glogovat	2 cranes not functioning	Closed
10	Cluj Napoca Est	1 functioning	Active
11	Oradea Est	2 cranes (1 in conservation and 1 approved for disposal)	Not currently active
12	Bistrita Nord	1 crane functioning	Active
13	Baia Mare	2 cranes (1 in conservation and 1 approved for disposal)	Closed
14	Turda	1 crane functioning	Active
15	Zalau Nord	1 crane functioning	Active
16	Brasov Triaj	2 crane functioning	Active
17	Medias	1 crane functioning	Not currently active
18	Sibiu	1 crane in conservation	Closed
19	Targu Mures Sud	1 crane in conservation	Closed
20	Socola Marfuri (Iasi)	1 crane functioning	Not currently active
21	Suceava	1 crane functioning	Active
22	Bacau	1 crane functioning	Active
23	Botosani	No crane	Closed
24	Galati Marfuri	3 cranes in conservation	Not currently active
25	Buzau Sud	2 cranes (one functioning and one in conservation	Not currently active
26	Constanta Marfuri	No crane, 3 cranes were moved	Closed

Source: CFR Marfă, March 2013

8.1.27 There are some other public terminal owners or operators mostly associated with ports and the following table gives the location of these terminals. DP World, APM, SOCEP and UMEX are private operators at the publically owned Port of Constanta.

Table 8.4 Location of ports and their intermodal operations in Romania

No.	Terminal	Location	Operator
1	Port of Constanta	Constanta	DP World Constanta South Container Terminal
			APM Terminals
			SOCEP
			UMEX
2	Port of Galati	Galati	S.C Port Bazinul Nou S.A Galati
			S.C Port Docuri S.A Galati
			S.C Romportmet S.A Galati
			S.C Trans Europa S.A Galati
			S.C Trans Europa Port SRL Galati
			S.C Unicom Oil Terminal S.A Galati
3	Port of Tulcea	Tulcea	S.C Deltanav S.A Tulcea
			S.C Frigorifer Tulcea
			S.C Navrom-Delta S.A Tulcea
4	Port of Braila	Braila	S.C Hercules S.A Braila
			S.C Trans Europe Port SRL Galati
			S.C Cerealcom S.A Braila
			S.C Romanel S.A Braila
5	Port of Giurgiu	Giurgiu	C.N. A.P.D.F. S.A. Giurgiu
6	Port of Calarasi	Calarasi	C.N. A.P.D.F. S.A. Punct Lucru Calarasi
7	Port of Oltenita	Oltenita	C.N. A.P.D.F. S.A. Punct Lucru Oltenita
8	Port of Corabia	Corabia	C.N. A.P.D.F. S.A. Punct Lucru Corabia
9	Port of Drobeta Turnu Severin	Drobeta Turnu Severin	C.N. A.P.D.F. S.A. Drobeta Turnu Severin
10	Port of Calafat	Calafat	C.N. A.P.D.F. S.A. Agentia Calafat
11	Port of Orsova	Orsova	C.N. A.P.D.F. S.A. Punct Lucru Orsova

Source: AECOM Analysis

8.1.28 There are some privately operated rail facilities and intermodal terminals.

Table 8.5 Location of Private Freight Terminals

No.	Terminal	Location
1	Europolis Park/Tibbett Logistics	Bucharest
2	Comat Electro	Bucharest
3	Parcul Industrial Faur	Bucharest
4	Railport Arad	Arad
5	Trade Trans Terminal	Arad
6	DB Schenker Romtrans SA	Arad
7	DB Schenker Romtrans SA	Iasi
8	Unicom Oil Rail Terminal	Galati
9	DB Schenker Romtrans SA	Oradea
10	Unicom Holding Halmeu	Satu Mare
11	Unicom Holding Dornesti	Suceava
12	Unicom Holding	Mehedinti
13	Allianso Group	Ploiesti

Source: AECOM Analysis

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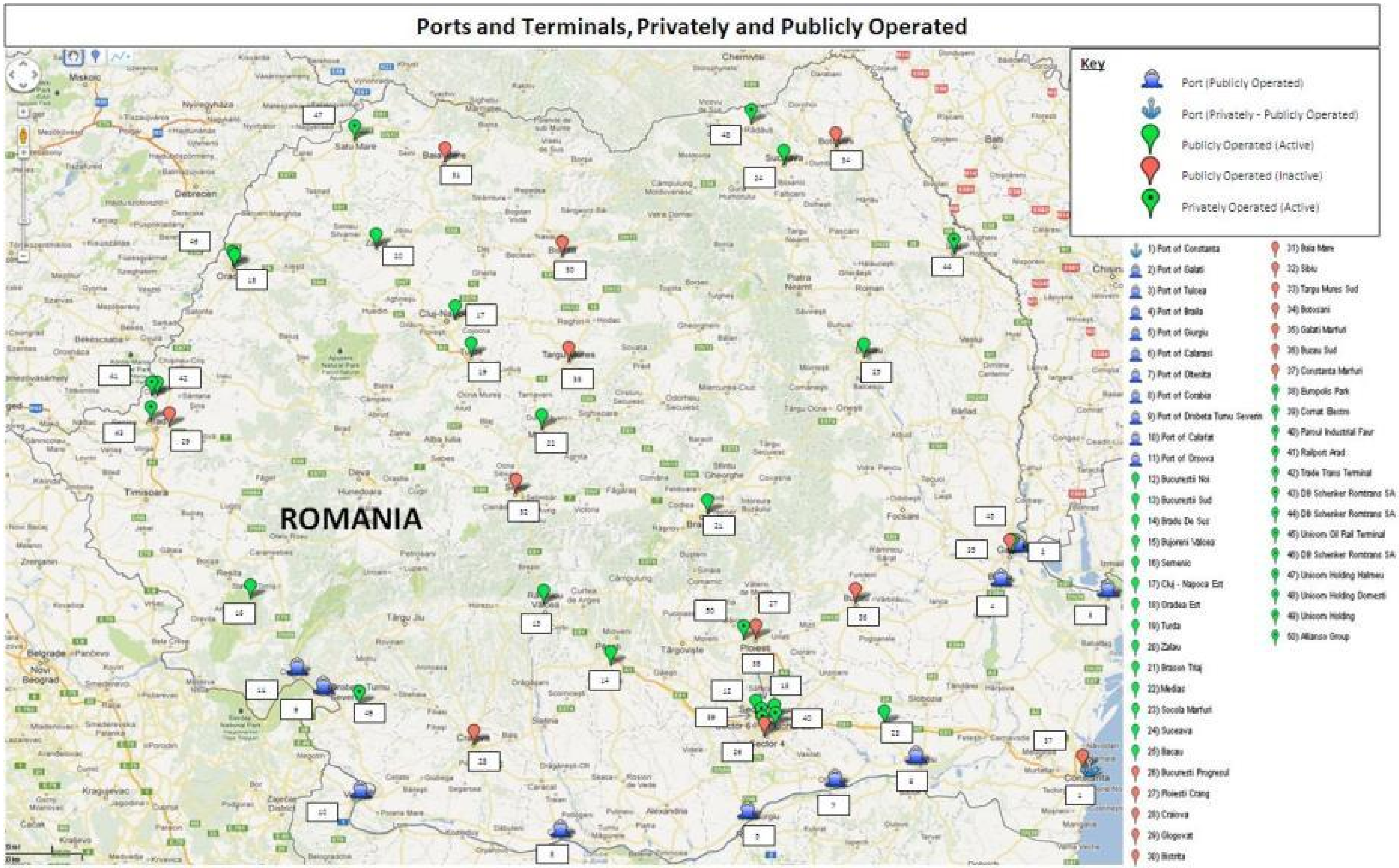


Figure 8.5 – Location of Publicly and Privately Operated Ports and Terminals in Romania

Source: AECOM Analysis

Figure 8.6 A view of many rail sidings at the Port of Constanta

8.1.29 The table below shows the number of containers handled by CFR Marfă in terms of Unitati de Transport Intermodal (UTI) at its terminals in 2011.

Table 8.6 Containers handled (UTI) in terminals owned by CFR Marfă, 2011

No	Name of container terminal	containers handled(UTI)
1	Bucurestii Noi	1,804
2	Bucurestii Titan	360
3	Ploiesti Crang	4,192
4	Bradu de Sus	1,308
5	Bujoreni Valcea	564
6	Semenic	324
7	Cluj Napoca Est	1,412
8	Oradea Est	72
9	Turda	1,780
10	Zalau	1,720
11	Brasov Triaj	3,900
12	Medias	72
13	Socola Marfuri	60
14	Suceava	2,732
15	Bacau	1,604
Total		21,904

Source: CFR Marfă Data

8.1.30 The figures above show that 21,904 containers were handled at CFR Marfa depots, of which 4,192 were at Ploiesti Crang which is now reported to be inactive. Although the information did not give origins and destinations of the containers nor whether they were 20' or 40' boxes the above volumes only represent about 4% of the volume handled at Constanta. Therefore we have used the raw data of commodities on trains provided by CFR Marfă to establish the volume and flows of containers both empty and full on their trains in 2011. Our estimate is that the majority of containers moved by CFR Marfă are to or from industrial customers at their own private terminals. This represents around 19% of the volume handled at Constanta.

Table 8.7 Top 20 Rail Container Movements in Romania by CFR Marfă by tonnage

Rank	Region	Origin	Destination	Total
1	5	VINTU DE JOS	CONSTANTA	362,384
2	6	DORNESTI	CONSTANTA	231,047
3	2	GOVORA	CONSTANTA	83,022
4	5	VINTU DE JOS	CURTICI	75,981
5	5	BRASOV TRIAJ	CONSTANTA	62,499
6	1	PLOIESTI CRING	CONSTANTA	61,701
7	2	CIUMESTI	CONSTANTA	71,648
8	6	DORNESTI	CURTICI	52,436
9	4	POIENI	DILGA	43,528
10	8	CONSTANTA	BUCURESTI	57,078
11	1	BUCURESTI	STAMORA MORAV.	64,714
12	6	BACAU	CONSTANTA	43,058
13	3	CURTICI	CURTICI	35,337
14	7	SUCEAVA	CONSTANTA	34,688
15	8	CONSTANTA	TIRGOVISTE	32,762
16	4	TURDA	CONSTANTA	25,634
17	2	BUJORENI VILCEA	CONSTANTA	25,317
18	4	CLUJ NAPOCA	CONSTANTA	26,061
19	8	CONSTANTA	ZALAU	20,165
20	8	CONSTANTA	CONSTANTA	18,925
Total				1,427,985

Source: AECOM Analysis of CFR Marfă Data

8.1.31 The top 20 laden container routes operated by CFR Marfă represent 87% of all container tonnes moved by CFR Marfă showing that they are consolidated on to certain key corridors. The rail network is divided up into 8 regions with Bucharest being region 1 and Constanta region 8. The above table shows that the top two container flows by tonnage are from regions 5 and 6 which are the central and eastern production areas with goods to Constanta for export. Unsurprisingly the top two flows of empty boxes are from the port to the same regions.

Table 8.8 Top 20 Empty Rail Container Movements in Romania by CFR Marfă by tonnage

Rank	Region	Origin	Destination	Total
1	8	CONSTANTA	VINTU DE JOS	51,588
2	8	CONSTANTA	DORNESTI	34,136
3	8	CONSTANTA	CIUMESTI	16,443
4	3	CURTICI	VINTU DE JOS	15,041
5	6	DORNESTI/VICSAN	CIUMESTI	13,380
6	3	CURTICI	DORNESTI	11,044
7	8	CONSTANTA	BRASOV TRIAJ	8,343
8	8	CONSTANTA	GOVORA	7,551
9	8	CONSTANTA	PLOIESTI CRING	6,729
10	8	CONSTANTA	BUCURESTI	9,478
11	8	CONSTANTA	SUCEAVA	5,158
12	3	CURTICI	CURTICI	4,091
13	8	CONSTANTA	CLUJ NAPOCA	3,343
14	8	CONSTANTA	BACAU	3,696
15	8	CONSTANTA	TIRGU MURES	2,914
16	8	CONSTANTA	BUJORENI VILCEA	2,700

Rank	Region	Origin	Destination	Total
17	1	TIRGOVISTE	CONSTANTA	2,580
18	4	ZALAU	CONSTANTA	2,043
19	8	CONSTANTA	LUNCA DE MIJLOC	1,744
20	8	CONSTANTA	CONSTANTA	1,742
Total				203,744

Source: AECOM Analysis of CFR Marfă Data

Empty Container Movements by Tonnage

8.1.32 There is a clear imbalance in the flow of loaded containers by rail with more loaded with finished products going for export than for import. goods. This necessitates the movement of empty boxes inland to key factory sites.

8.1.33 The highest container flow on trains operated by CFR Marfă is to and from Vintu De Jos. The area is one of the main sources of timber products and Kronospan have a major wood processing plant there employing over 500 staff. It produces a wide range of forest products including fibreboard and furniture and much of it is for export through the Port of Constanta in containers. Vintu De Jos hosts the reception sidings for the various separate parts of the plant. Products arriving at the plant include lumber, chemicals, mineral (nitrogen), and empty containers and generally full containers leave with furniture, fibreboard, and sawn wood.

8.1.34 The other high volume container flows reflect the location of important industrial sites in Romania. Rail lines serve industrial zones such as those near Bacau, Bujoreni, Cluj, Turda and Timisoara close to Stamora. Buhusi, located 28km from Bacau has the biggest textile factory in Eastern Europe. Ploiesti is also one of the key textile manufacturing locations in Romania. Additionally, Comat SA, owns a production facility of various products like electrical appliances, PVC, etc outside of the city. Kronospan, has another factory with direct access for rail near Brasov. One of the biggest chemical factories in Romania is located in Bujoreni while in Cluj, Romanoff Industries have established a site of significant size. Chemical fertilisers company Azomures SA is served with direct access to rail tracks in Targu Mures. Finally, in Targoviste Cromsteel Industries (steel production) and Mechel SA (manufacturing and mining) have production facilities in the city. Thus, the large-volume container flows are aligned with major industries.

8.1.35 The top 20 routes with empty containers operated by CFR Marfă is 90% of all empty container tonnage moved by CFR Marfă. It can be seen that in the top 20 movements for both laden and empty containers, Constanta features highly. As Romania's main deep sea container port this is to be expected. As noted earlier, more loaded containers arrive at Constanta than depart from there. In other words, at present rail-borne containers are used for industrial exports rather than imports of consumer goods. This implies that the rail based logistics do not (yet) offer competitive services for higher value consumer products or FMCGs, and that there is an opportunity to load containers both ways (to and from Constanta) for increased efficiency

Existing and Potential Demand – Future Intermodal Network

8.1.36 Intermodal transport is one of the easiest ways of reducing transport-related emissions through transferring either part of or the entirety of a journey from road transport to more sustainable modes such as rail and water. There are also large efficiency and cost benefits through increased handling speeds, lower handling costs and improved security.

8.1.37 Table 8.9 shows the number of TEUs (twenty foot equivalent units) that moved in 2011 in Romania and what they carried. Rail moved around 45.5% of all recorded containers between inland destinations. The three largest commodity groups were Manufactured Goods, Fertilisers and Metal Products. Manufactured goods include a wide range of products including furniture, chipboard and consumer goods.

Table 8.9: Base year container traffic (TEUs per day)

Code	Commodity	Water	Rail	Road
0	Agricultural Products	0	0	0
1	Foodstuffs	0	12	62
2	Solid Mineral Fuels	0	0	0
3	Crude Oil	0	0	0
4	Ores, Metal Waste	0	0	0
5	Metal Products	0	69	159
6	Building Minerals & Materials	0	0	0
7	Fertilisers	13	220	16
8	Chemicals	0	26	60
9	Machinery & Heavy Manufacturing	0	1	47
10	Petroleum Products	0	21	11
11	Mail & Parcels	0	0	0
12	Manufactured Goods	15	228	161
13	Domestic & Industrial Waste	1	0	15
14	Forestry Products	2	6	137
15	Livestock	0	0	0

Total	31	584	669
Proportion	2.4%	45.5%	52.1%

8.1.38 Although the 45.5% modal share figure is high, it must be noted that the intermodal industry in Romania is currently under-developed: 1,300 TEUs per day is a very low volume. By way of comparison, Table 8.10 demonstrates how Romania compares in terms of containerised rail freight with neighbours and other western countries.

Table 8.10: Annual railway transport of goods (containers and swap bodies) in intermodal transport units and the % of total rail freight containers represent

Country	Total volume of containers and swap bodies ('000 tonnes)		% in containers of total goods transported by rail	
	2011	2012	2011	2012
Austria	16,312	15,806	18.2%	19.0%
Bulgaria	789	664	5.8%	5.6%
Czech Republic	7,321	7,852	8.4%	9.5%
Germany	64,301	66,230	17.2%	18.1%
Italy	34,275	33,985	43.4%	45.1%
Romania	2,611	2,372	4.6%	4.7%
Turkey	7,601	8,264	30.7%	33.2%
United Kingdom	11,098	11,742	11.1%	10.2%

Source: Eurostat

8.1.39 Romania has significantly low levels of freight in containers which is transported by rail compared to other European countries, including lower levels than Bulgaria. If Romania is to meet European recommendations for moving freight to sustainable modes by 2030 then improvements need to be made to encourage this method of transport. Currently, future growth, unless accompanied by interventions on the rail network, will come mainly through road-based transport, particularly given planned improvements to the road network, coupled with the issues affecting the rail network such as speed restrictions.

8.1.40 Rail freight's share of the market is also dramatically affected by the length of the journey. Figure 8.7 shows that after 200km, the choice of rail for container movements increases significantly. This indicates a distance/price trade off in the transport buyer's decision making process, although if rail's offer remains unchanged whilst road freight is improved, the distances involved can be expected to become significantly greater.

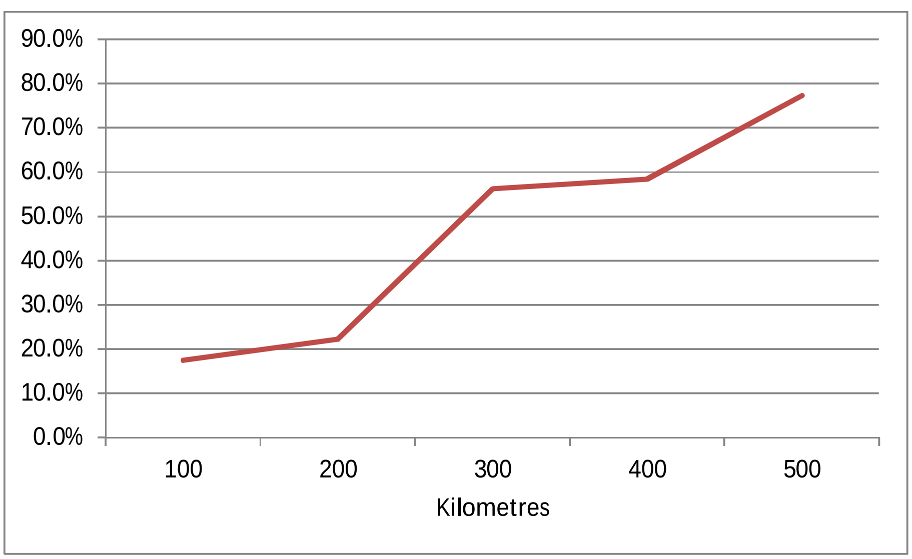


Figure 8.7 – Proportion of Base Year Container Traffic on Rail by distance

8.1.41 However, a lack of development of the container market needs to be accounted for. From the forecast of potential for containerisation by commodity undertaken in the model, Figure 8.8 shows the current container traffic transported by rail as a proportion of the forecasted container market. It shows that maintaining its current level of activity, rail would only account for 18% of the market, essentially losing out on two thirds of potential growth. On the other hand, if rail could maintain its current share of traffic travelling 300kms, (58%), the analysis implies a trebling of container traffic by rail, which could place severe pressure on current infrastructure. Clearly if there was a network of efficient intermodal terminals across Romania then this would ease pressure and better enable the sector to capitalise on any growth.. This intervention is discussed in greater detail later in this note.

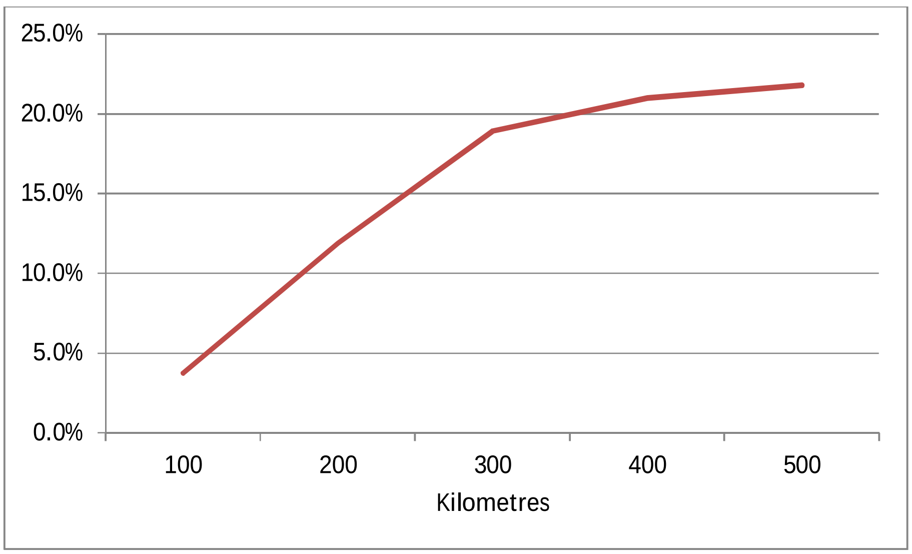


Figure 8.8 – Proportion of Potential Container Traffic on Rail by distance

8.1.42 From an origin and destination perspective, the following is a review of the actual and potential market for containerised freight transport using data from the National Model. All values are average daily tonnes.

Figure 8.9: Existing container rail freight flow 2011, tonnes

8.1.43 Figure 8.9 shows the flow of containerised tonnes on Romania's railways in 2011. The largest cumulative flow is between Bucharest and Constanta. This is understandable as Constanta is Romania's major port and handles 80% of its containers. A lighter flow of containers running between the centre of the country and Constanta on Corridor IV. Another flow of containers heads northwards from the Constanta linking up with Corridor IX.

8.1.44 Contrasting this, Figure 8.10, however shows the maximum potential container flow on Romania's railways. The analysis uses an assumption on the types of goods that are suited to containerisation (see Table 8.11). The plot has two-way flows, and is colour coded showing the existing rail market share compared with the potential.

Table 8.11: Industries suited to containerisation and distances at which rail freight becomes competitive

Code	Commodity	Distance	Code	Commodity	Distance
1	Foodstuffs	60km	9	Machinery and Manufacturing	100km
5	Metal Products	100km	12	Manufactured Goods	130km
7	Fertilisers	100km	13	Domestic & Industrial Waste	100km
8	Chemicals	100km	14	Forestry Products	100km

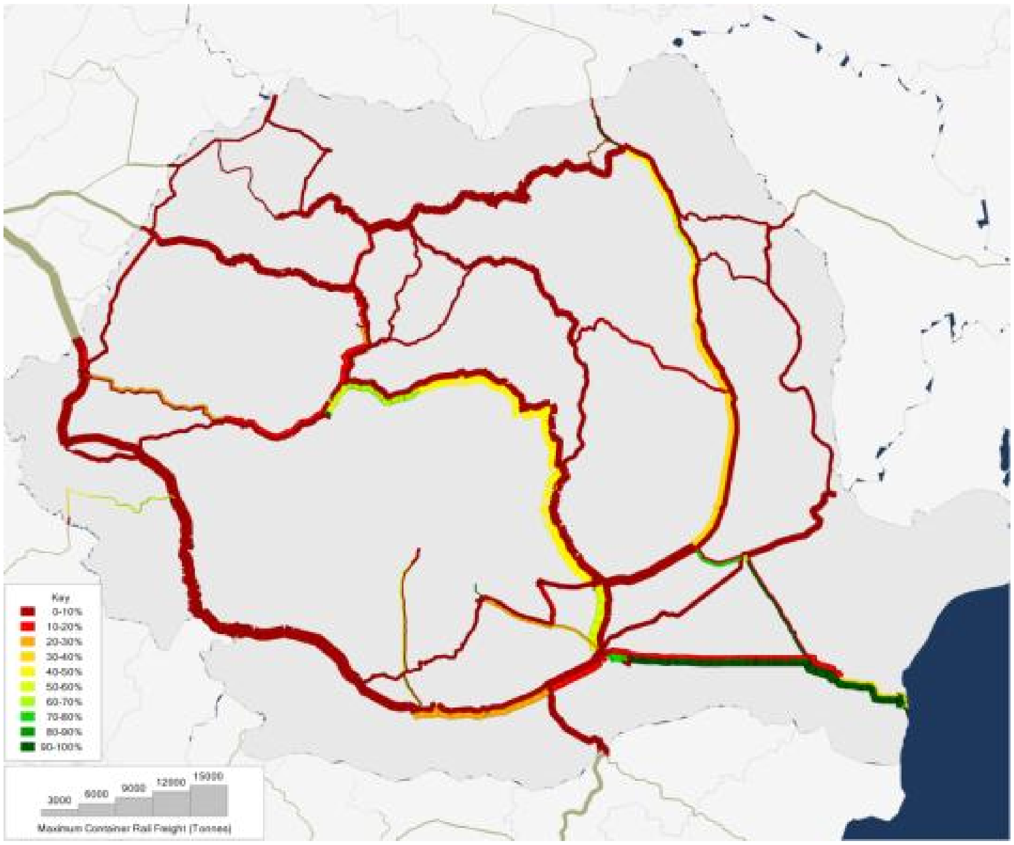


Figure 8.10: Potential container traffic and current mode share by rail flow

8.1.45 This can be further assessed through a quick analysis of each of the potential commodities containerised flows.

8.1.46 *Foodstuffs (1):* Flows of foodstuffs by rail are relatively small, (approximately 1,133 tons per day) of which approximately a third offers the potential for containerisation. This is mostly due to the time requirements of food shipments. However, of that which is suitable, there is potential for improved rail modal share on corridors IV south and IX especially. In the case of the former, modal share (of potential total containerised foodstuffs) is approximately 20 – 30% between Caracal and Carahsebes, with the modal share between there and the border (past Timisoara and Arad) below 10% northbound and 20% southbound. Improved intermodal facilities at Timisoara may help to increase this modal share through reducing handling time and costs, as would improvements to border crossing procedures, line speed and journey time reliability. The use of temperature controlled containers in some countries is enhancing the volume of foodstuffs being moved by rail and is worth further consideration for Romania.

8.1.47 *Metals (5):* Between Bucharest and Constanta rail has already established a modal share dominance, which continues on Corridor IV and Corridor IX. Corridor IV South is affected by the proximity of the rail corridor to the Danube, and improvements made to intermodal terminals here will draw more traffic away from river because of its time sensitivity. However, there is room for growth between Galati, Bucharest, Pitesti and Craiova, where rail's potential modal share (of potential containerised metal products) is low. Metals are a key component of the automotive industry and flows for car production are important. Improvements are also possible at the western end of Corridor IV South between Arad and Caransebes (via Timisoara). The proposed intermodal terminal at Timisoara, along with improvements to line speed, reliability and reduced handling costs will increase the potential for shift to rail from road. The potential flows are shown in Figure 8.11 below:

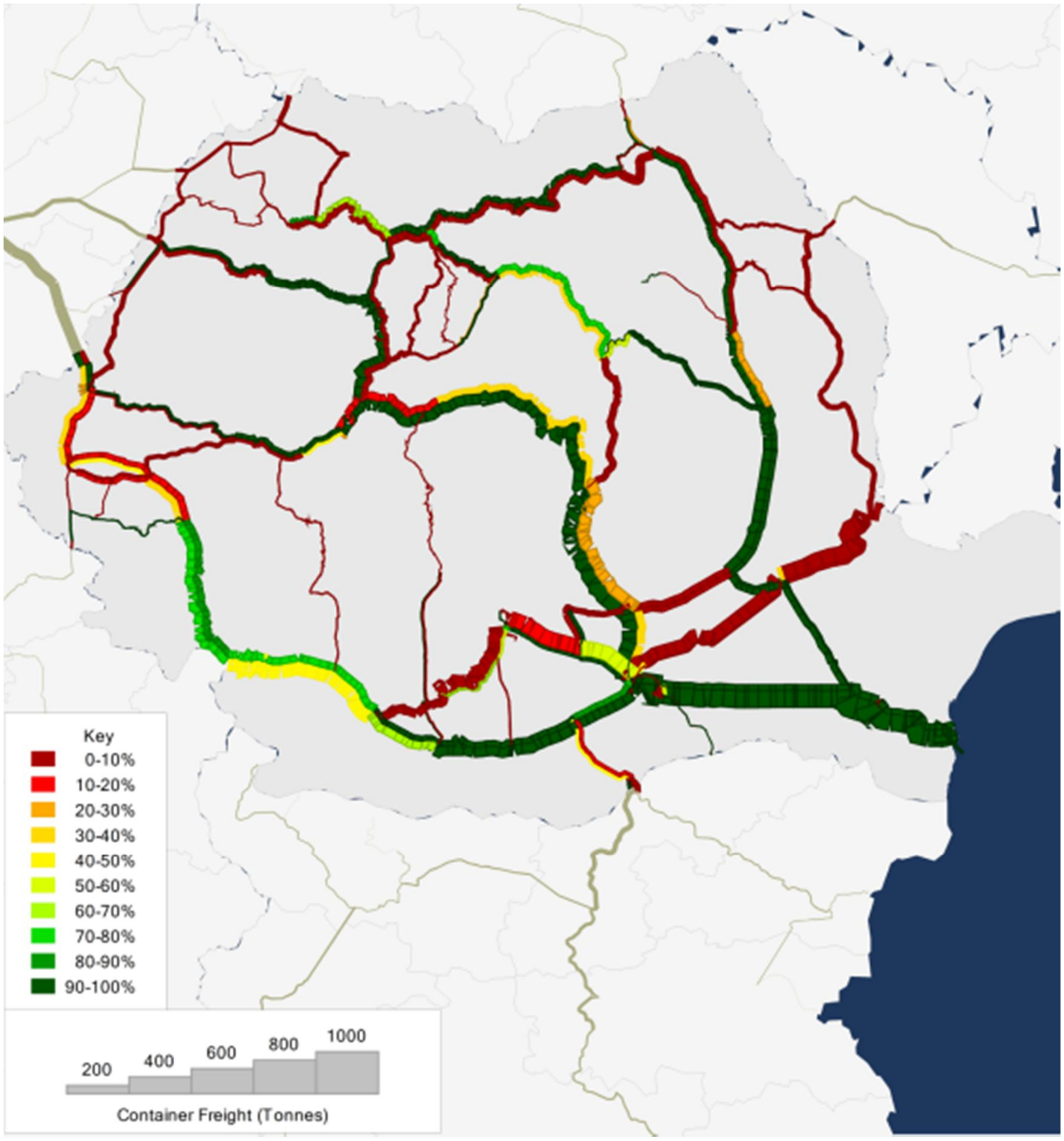


Figure 8.11: Potential Containerised Metal Flows and Rail Modal Share

8.1.48 *Fertiliser (7):* There are nine fertiliser production plants in Romania and the country both imports and exports the commodity. The sector has been expanding in line with positive growth in cereal production. A key flow with regard to (potentially containerised) fertiliser is that from the large plant near Targu Mures through to the port of Constanta along Corridor IV. The plant currently produces around 900 tonnes per day and future investment is projected to increase this flow to over 1,400 tonnes per day by 2015. Rail has a large share of this market, although it has a poorer share of the return flow from Bucharest, past Targu Mures to Cluj-Napoca. Improving rail's share of the industry on this return leg would enable better utilisation to be made of the rolling stock within this industry. Modal share is also high on the much smaller flows operating on Corridor IX (southbound) and on Corridor IV South (both directions), although this latter corridor has smaller potential than the others due to competition from water freight on the Danube. This is demonstrated in Figure 8.12 below:

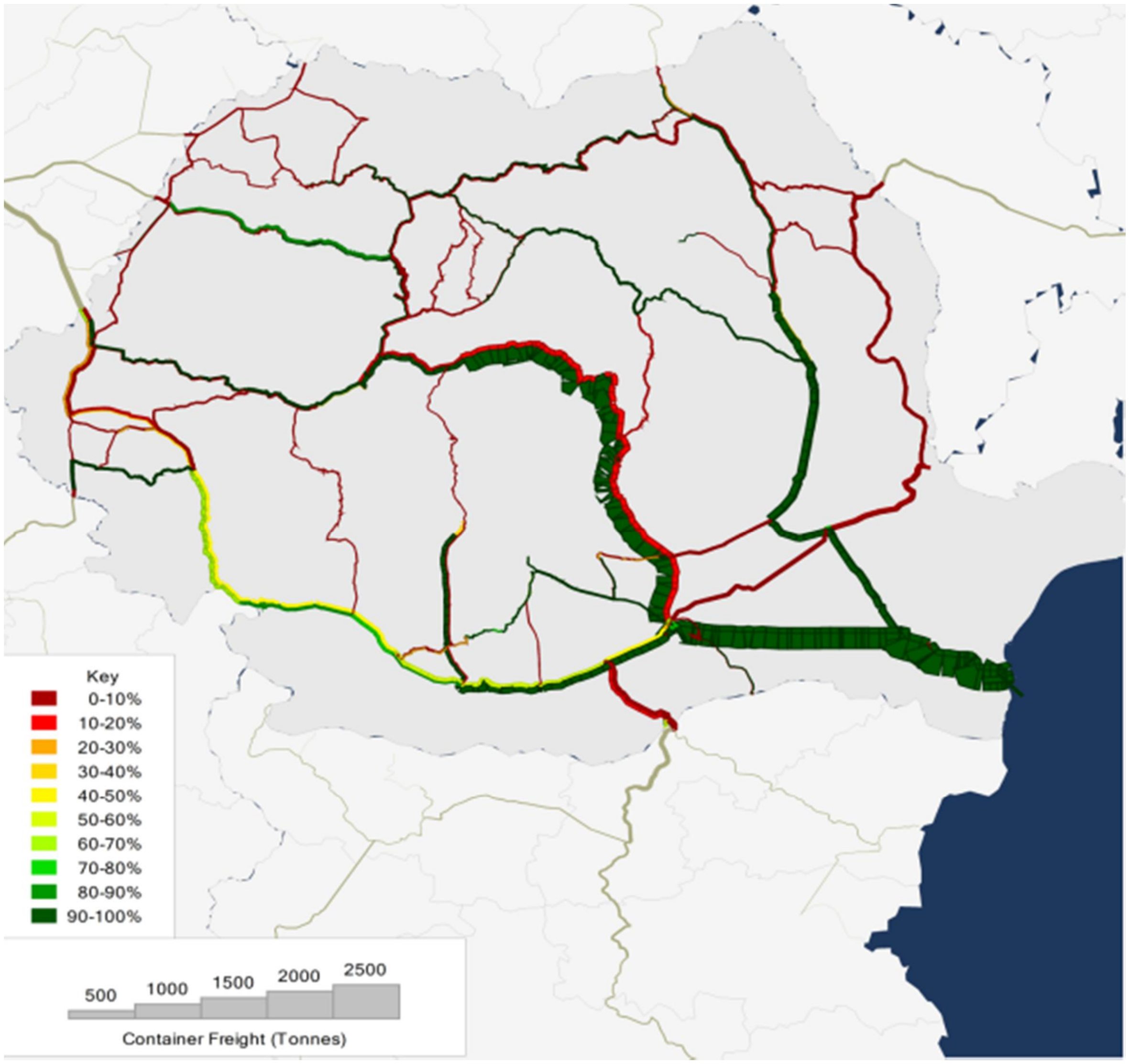


Figure 8.12: Potential Containerised Fertiliser Flows and Rail Modal Share

8.1.49 *Petrochemicals (8 & 10):* On Corridor IV rail has a large modal share of potential eastbound flows, from the border at Curtici all the way to Constanta. Flows on Corridor IV south are affected by competition from water freight on the Danube, although improved links between modes at the Danube ports will offer opportunities to increase tonnage handled. On Corridor IV the amounts handled (under the potential containerised scenario) are low, although rail has a relatively high modal share on southbound movements, although northbound the modal share is significantly lower (under 10%).

8.1.50 Machinery, Manufactured Goods and Heavy Manufactures (9 & 12): Corridor IV South is noticeable when looking at this commodity type due to water freight taking a large modal share of this important flow. However, there are also significant volumes travelling on corridors IV and IX, of which rail has a large share of the potential containerised exports. However, there is significant room for improvement on domestic movements, particularly with regard to the large flows moving between Suceava (on Corridor IX) and Dej in the north. There is also a significant flow of this commodity type over the border with Ukraine, most of which currently travels by alternative modes.

8.1.51 Forestry Products (14): It is estimated that around 20% of all forestry products are suitable for containerisation, and that rail has a good potential modal share (above 80% of this hypothetical traffic) on all three of the relevant corridors (IV, IV South and IX). Already one of the largest flows in containers is from Kronospan's production plants to the Port of Constanta. However, at both the northern and southern extremities of Corridor IX (within Romania) rail's modal share is projected at below 10%. Improved border crossings, axle weight loadings and journey time reliability will help rail to compete more effectively against road in these locations.

Conclusions

8.1.52 Regardless of commodity type, all of the rail network in Romania would be more attractive to intermodal freight as a result of improved maintenance, efficiency and lower costs. As such, any intervention that improves the speed of freight trains and lowers the cost (in time and money) of modal transfer are to be welcomed, whether these are maintenance and rehabilitation works, improved line speeds, new locomotives and rolling stock or increased axle weights. However, certain corridors will benefit from more targeted interventions, and these are outlined below.

8.1.53 Corridor IV South: There is significant potential for improvements to Corridor IV South that result in a notable increase in the amount of container traffic moving on the railway. In particular, improvements to this route would facilitate the growth of transit traffic along this corridor. Furthermore, this is not taking into account the extra benefits which would come from improving links with certain key ports along the Danube itself, including Drobeta-Turnu-Severin (recommended for a new intermodal terminal elsewhere in this strategy) and the new railway bridge at Calafat-Vidin (and the access it provides to the proposed Vidin tri-modal terminal). Supporting better connections between the Danube and the rail network will enable increases in the amount of intermodal freight that can be moved and its penetration (on sustainable modes) into areas further away from the Danube and Corridor IV South. This latter goal will be particularly assisted by the creation of an intermodal terminal at Craiova and the creation of a new terminal in Bucharest. Due to this connectivity, and the ability of the line to link with Bucharest, Constanta and the western border whilst avoiding much of Romania's mountainous interior, Corridor IV South is perhaps best suited to benefit from; improved line speeds, larger axle weights and more modern infrastructure, rolling stock and locomotives that will increase the amount of international freight handled by rail, as well as domestic traffic which currently goes by road.

8.1.54 Corridor IV (North): In Romania this runs from the Hungarian border crossing near Arad (Curtici) in the west through Bucharest to the port at Constanta in the southeast. As such it passes near several important towns and cities such as Ploiesti and Brasov, in addition to providing the key link between Bucharest and the Black Sea. Whilst this latter trade is well developed (with rail having a relatively high modal share) the links further inland are less so. Interventions which improve journey times, lower costs and improve efficiency (particularly at border crossings) will assist, alongside targeted interventions such as the new terminal in Bucharest and the potential rehabilitation of terminals in central and western Romania. It is the rehabilitated routes such as Corridor IV between Constanta and Bucharest that would benefit most from the instigation of a two-tier speed limit for intermodal freight trains (and an improvement in their relative priority versus some passenger trains), although this will benefit all of the corridors to some extent.

Similarly, this applies to other interventions such as allowing modern trains to be more energy efficient through the use of regenerative braking for example.

8.1.55 Corridor IX: The main north-south corridor in the east of the country, this corridor links onto corridor IV near Ploiesti to the north of Bucharest. It also links with the important ports of Galati, Braila and Giurgiu, and has border connections with Moldova, Ukraine and Bulgaria. It is mostly a freight line, and there is potential to build on the current flow of containers from Suceava (generally travelling towards Bucharest and Constanta) and develop international intermodal flows with the other countries on the corridor. As already established, the border crossing with Ukraine at Dornesti is CFR Marfa’s second busiest, and Corridor IX has great potential for future growth of transit traffic as a result of Project Viking. This ambitious project plans to move up to 1,000 trains a year on the corridor from the Baltic States to Bulgaria, Turkey and possibly Greece via Ukraine and Romania. However, for this to happen and be an ongoing success, significant interventions to improve axle weight loadings, line speed and journey time reliability would be needed. Furthermore, Corridor IX also links with Galati which is well-located as a transhipment point from water or Russian gauge railways for onwards connections. As on Corridor IV, there is generally a poor modal share of inbound containers, which could be aided through the rehabilitation of intermodal terminals in the northeast, such as at Suceava and Iasi. Again, the line would benefit from improved maintenance and the other identified interventions which apply to all corridors.

8.1.56 Building on these foundations then, a clear programme of interventions with regard to rehabilitating the route to facilitate higher axle weights and faster intermodal trains is clear. The proposed rail network enhancements are discussed in Section 5.

Intermodal Terminals - Factors for Success

8.1.57 From AECOM’s experience the key success factors for intermodal services are:

- Availability of frequent, scheduled, reliable and punctual services;
- Schedules geared to the movement of business and consumer goods;
- Flexible door-to-door solutions, including trucking alternatives;
- Control and management of a secure door-to-door supply chain;
- Fast handling at terminals to ensure efficient round-trip schedules for trucking companies (road collection and delivery), including efficient road access infrastructure;
- Consistency of delivery;
- Seamless international intermodal services (interoperability, synchronization of processes between railways and operators, data interchange);
- Infrastructure access charges ensuring a level playing field between intermodal solutions and road transport;
- Presence of a significant number of customers close as possible to the intermodal terminals;
- Availability of efficient terminals;
- Availability of empty container depots at strategic hubs;
- Supportive activities by authorities;
- Transparency and accountability
- Market awareness of the possibilities of intermodal transport;

- o Experience of the intermodal market; and
- o Competitive end to end pricing.

8.1.58 In order to achieve this, each terminal will need to have some (if not all) of the following:

Typical Requirements for an Intermodal Rail Freight Terminal
The following are typical requirements that need considering when setting up a new terminal.

Security

- Security office
- Security Fencing
- Good lighting
- Electronic gates
- CCTV

Systems

- Central Control Room with communication to operatives and handling equipment
- Modern IT systems with internet based train management
- Automated electronic document control
- Modern Train control system
- Modern Communication systems
- Integrated Train Signalling
- Latest customs checking systems that can verify goods even whilst moving

Handling Equipment

- Electric gantry cranes for container handling with minimum 4 track reach and lorry loading capability
- Reach stackers
- Possibly cross dock for cargo wagon (box car) loading/unloading with sufficient space for fork-truck turning circle and through roads
- Handling equipment recharging/refuelling facilities

Road Facilities

- Lorry Parking area with electronic calling mechanism to instruct driver when to approach designated loading bay
- Lorry road movement is one-way for safety and smooth operational reasons
- Lorry driver rest area, cafe etc.
- Lorry garage/maintenance facilities
- Road fuel service stations

Staff Facilities

- Train driver rest area, cafe etc.
- Staff rest area, cafe etc.

Train Operations

- Locomotive refuelling facilities recognising that many trains are likely to be electric powered

- Cripple sidings for defective trains
- Train maintenance area
- Reception sidings for train arrivals
- Sidings for spare trains waiting for next duty
- The loading/unloading sidings should accommodate a maximum length train (minimum of 80 wagons long), consider future proofing this length
- Ideally all tracks will be capable of handling container trains
- Some sidings may be equipped for box cars/cargowagons for loose, bagged and palletised goods
- Some sidings may be equipped for bulk products such as grain

Customs (may be appropriate for some inland terminals)

- Customs office
- Customs checking warehouse
- Customs reception sidings
- Customs impounded goods area

Storage Area

- Small secure storage area
- Temperature Controlled container plug in points
- Inbound train unloading storage stacks
- Outgoing train preparation area for stacking containers
- Assumes that most of the containers handled will continue their journey by road.

Institutional Issues – Operation of Intermodal Terminals

8.1.59 Intermodal terminals generally work more efficiently when operated by the private sector as they are able to be entrepreneurial in operations, staffing, costing and reinvesting in modern technology and handling equipment. Some terminals offer added value services such as stuffing and destuffing containers, box repairs and local deliveries as ways of maximising revenue. It is recommended that Romanian terminals are operated on a commercial basis that gives operators and customers the flexibility they need to be successful.

8.2 Operational Objectives

8.2.1 The proposed interventions will support the following operational objectives as indicated in Figure 8.13.

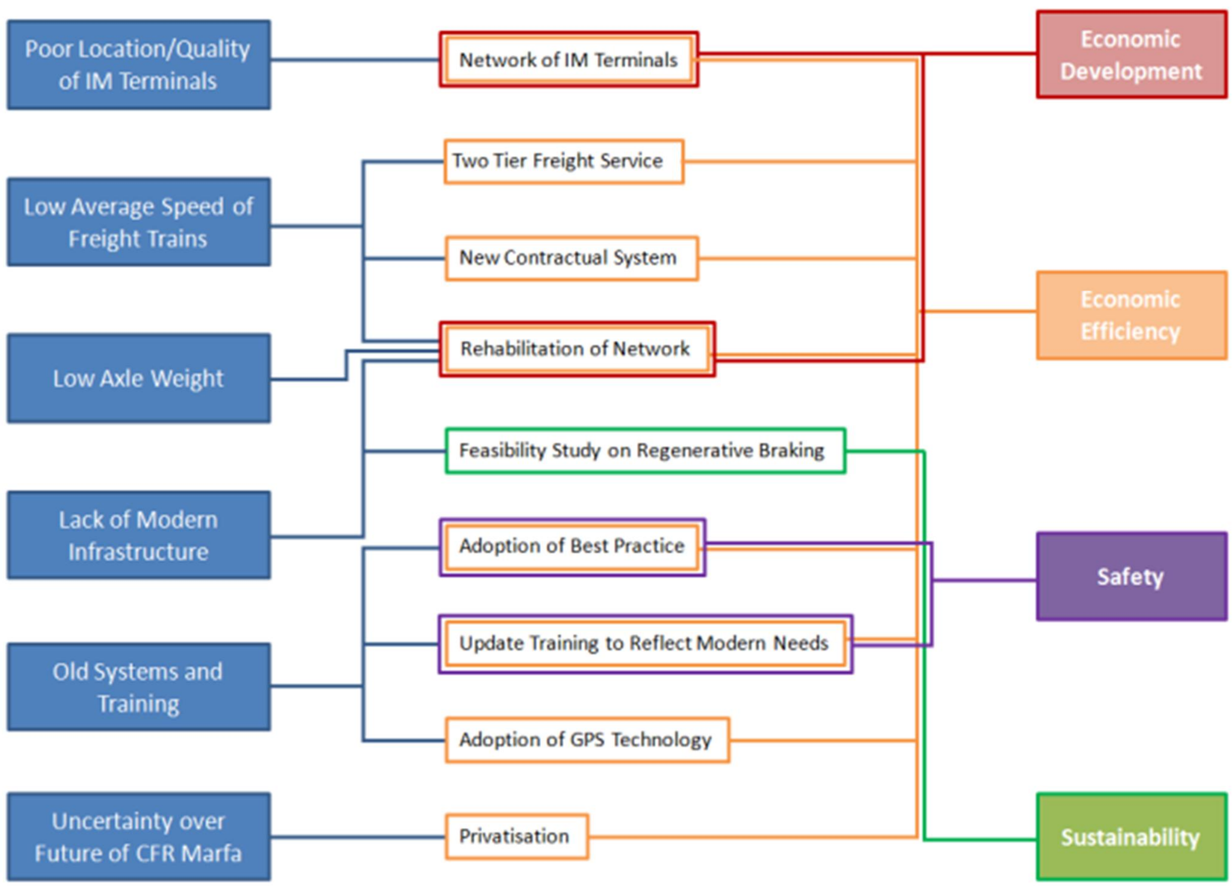


Figure 8.13: Links Between Problems, Interventions and Operational Objectives

8.3 Interventions

8.3.1 The location of the proposed intermodal terminal network is a function of the following five factors:

- o Connectivity with other modes
- o Geographic distribution of ports and population centres throughout Romania
- o Current road/rail Infrastructure
- o Current and Potential Containerised Freight Flows
- o Population within a short drive by Heavy Goods Vehicle (One hour for inland rail terminals, two hours for ports)

8.3.2 The most crucial of all the judged criteria was the ease with which a terminal location enabled interchange between road and rail, and also between road, rail and water modes. These latter tri-modal terminals are considered first.

8.3.3 Currently there are a limited number of containers moving inland by water freight. There are only a few ports handling this type of cargo on a regular basis. Containerisation has been growing on a worldwide basis and significant growth is expected to continue in Romania. It is important for sustainability and environmental reasons that any growth is shared around the most appropriate mode of transport - road, rail and barge depending on customer requirements and suitability. To facilitate this it is important to have a network of inland “rail to road” terminals and also river ports strategically located to act as tri-modal terminals. These terminals should be able to accommodate any combination of modal transfer between water, road and rail.

8.3.4 To meet the needs of industry, a successful intermodal terminal is likely to realize the following capital requirements.

- Secure, well lit perimeter (i.e. fencing, flood lighting, CCTV coverage etc)
- Good access to road network as well as internal roads system
- Two rail sidings with a platform length of (ideally) 750m (EU standard) with a run-round loop
- Reach Stacker (electric gantry cranes for busier sites)
- Hard-standing with a minimum 750x20m to allow reach stacker to manoeuvre, cleared to 22.5 tonne axle weights
- Additional space for container storage
- Administrative/Control Office
- Welfare Facilities for staff and drivers

8.3.5 It is these facilities that have been included in the GTMP model. An increasingly common approach to the construction of these intermodal terminals is for the government to provide the land and drive for the terminal's construction, with construction and operation often being tendered to the private sector in order to minimise risks for the government and maximise innovation and value for money through private sector expertise. This model should also encourage low costs for handling containers, which will help rail freight to compete with road transport.

8.3.6 Operational requirements such as labour have not been factored in. However, they may include:

- Site Maintenance
- IT
- Security Personnel
- Drivers
- Terminal Manager
- Administration
- Mechanics
- Fuel
- Support Vehicles

8.3.7 Based on the following assumptions, building such a facility will provide a capacity of approximately 129,000 TEUs per siding, per annum or a total of 358,000 TEU overall, with an additional reach stacker.

Table 8.12: Assumptions for terminal capacity estimates

Attribute	Meters	Comments
Wagon Length	19.7	Astra Rail SGnss 60' bogie wagon
Loco Length	21.4	Typical electric/diesel locomotive
TEU per wagon	3	
Siding Length	750	
Working Days	300	
Trains per day	4	Based on 6 hours load/unload per train
Wagons per Train	36	

8.3.8 Bigger sites are likely to have an electric gantry crane in addition to a reachstacker, e.g. Bucharest. Space should be safeguarded to extend both rail and road facilities as the terminal grows in the future. Bucharest, for example, will probably require three tracks to enable two trains to be handled simultaneously, boosting capacity to feasibly the aforementioned 358,000 TEU annually. This would also provide capacity for immediate onward transhipment from international trains to trains destined for Constanta.

8.3.9 Although the movement of containers by river is likely to remain a relatively small percentage of total water freight, currently around 1%, it is expected to grow in volume in proportion with the market. Only around 2% of the containers being handled at Constanta move inland by barge and this compares to ports such as Rotterdam and Antwerp where significant volumes, around 35%, go by barge. Indeed the GTMP model shows that tonnage will grow by 70% by 2020 when it is entirely possible that daily sailings of container barges leave Constanta either destined for Galati or for a central and western feeder service connecting two or three Romanian ports with other ports in Hungary and Serbia.

8.3.10 An added incentive for the development of water freight is that goods are not counted as being imported until they are landed; thus a transhipment to barge at Constanta and then landing at Drobeta could provide a day or two’s steaming where VAT on transport costs would not be applicable. This could reduce costs and encourage increased use of water freight quite substantially, as such a reduction (c. 20%) in costs will induce increased traffic from less sustainable modes.

Tri-Modal Terminals

8.3.11 It is recommended that as well as having port terminals at Constanta, which is the main generator/attractor of maritime containers there should be intermodal terminals serving the east, central and western parts of Romania. This provides customers with an access point to the hinterland. These are explored fully below.

East Romania

8.3.12 It is considered that the most likely point for a tri-modal terminal at the eastern end of the Danube is at the Port of Galati. The reasons are that this is already the biggest port on the River Danube in Romania, it has land available for refurbishment and expansion, it has 2 million people within 100kms and it is the best located port to serve the North East which is the least prosperous part of Romania. Galati is the only port in Romania with both Russian and European gauge internal rail track and is well connected to serve Moldova and Ukraine and it has a Free Trade Zone, thus a terminal here could attract significant amounts of tonnage. In addition, due to the reduction in volume of commodities, traditionally handled at the port, the facility now needs restructuring to handle emerging flows.

AECOM recommend that the eastern tri-modal terminal is therefore built at Galati.

Central Southern Romania

8.3.13 There are two ports well located to serve the southern central section of the Danube; Giurgiu and Oltenita. The Port of Giurgiu is on TEN-T Corridor IX which runs from the Baltics to Greece and Turkey. It is adjacent to the border crossing to Ruse and Bulgaria. Various routes within Bulgaria linking Ruse to their coastal ports and Sofia are being upgraded. Giurgiu already handles some containers but does not have modern, purpose built facilities for this, hence the potential scheme. Giurgiu is within an hour's drive by truck to Bucharest on National road DN5 and as such has over 3 million people within a catchment area of 100kms. Giurgiu is well located for freight and raw materials coming from the west along the Danube.

8.3.14 The Port of Oltenita is also within an hour's drive by truck to Bucharest, on National road DN4 and similar to Giurgiu has over 3 million people within a catchment area of 100kms. As the port is nearer to the larger feeder ports of Constanta and Galati than Giurgiu it has attracted some tonnage destined for the Bucharest area. The distance by barge between Oltenita and Giurgiu is around 100kms or about 8 hours sailing time upstream and hence is likely to attract cheaper shipping rates from the east than Giurgiu. However the opposite is also true from the west. More time sensitive containers are likely to travel by road or rail in the future so barge traffic needs to cater for less urgent traffic. A fuller discussion of both these ports can be found in the Port Assessment.

AECOM recommend that the central tri-modal terminal is built at Giurgiu

Western Romania

8.3.15 There are a number of ports which would provide a suitable geographic location for a western intermodal terminal; these are assessed briefly below, with a summary of useful details in Table 8.13. Further details are discussed in the ports chapter.

Table 8.13: Summary of Distances to Western Hubs from Selected Danube Ports

Port Name	**Timisoara**		**Craiova**		**Rail Connection**
	Distance	HGV Driving Time	Distance	HGV Driving Time	
Orsova	97km	3h 00m	144km	2h 15m	✓
Drobeta	23km	3h 20m	114km	2h 00m	✓
Calafat	23km	5h 00m	90km	1h 40m	✓

8.3.16 Orsova has both a large natural harbour and a rail connection, and whilst it handles a large range of different bulk materials, it currently handles little container tonnage. Whilst it is one of the better located ports for an intermodal terminal given the onward journey times, this location also means it is located above the Iron Gate II hydroelectric power plant, dam and border crossing, making it less attractive for traffic coming from the east and Constanta than ports below the Iron Gates, assuming that the vessel is not continuing upstream beyond Romania.

8.3.17 The port of Drobeta-Turnu-Severin is located downstream of the Iron Gate II dam and is located on Corridor IV (S) electrified rail route, as well as being on the E70 road corridor. The port is capable of being developed to handle a growing amount and range of tonnage. Although the port is surrounded by the city of Turnu-Severin, there is room for rationalisation and re-arrangement of port facilities to create a suitable space for an intermodal terminal. The port is able to serve both Craiova and Timisoara.

8.3.18 Calafat, although currently a small port focusing on bulk transport has potential for growth following the construction of the Calafat-Vidin crossing of the Danube. This will be accompanied with an upgrade and rehabilitation of the currently, unelectrified rail link to Corridor IV (S) making this a potentially suitable location. However, it is envisaged that the port will continue to specialise in bulk goods, especially given that the port of Vidin across the Danube is developing a container terminal. This combined with its long journey time to Timisoara, means that it is not recommended as a location for a western intermodal terminal.

AECOM propose that the western tri-modal terminal is located at Drobeta.

8.3.19 This would result in the following tri-modal terminals (Figure 8.14):

Figure 8.14: Map of Tri-Modal Terminals in Romania (Current and Proposed)

Inland Terminals

8.3.20 As the Danube only serves the extreme south of the country, for a truly comprehensive network it will also be necessary for several inland rail/road intermodal terminals to be built. The location of the terminals was led by a consideration of the nearby population and industry (hence the current and potential containerised flows) and on the basis of existing infrastructure which was suitable for rehabilitation as an intermodal terminal. It was also important that these terminals provided suitable geographic coverage of Romania to encourage the use of rail freight for long-distance trunking movements within the country. The main population centres in Romania were assessed with regard to their population, economy and existing facilities.

8.3.21 Potential demand for these sites was based on the potential maximum containerised flow (2011) from the National Transport Model, which took into account potential movements given a higher rail modal share for each commodity group that was suitable for containerisation. These movements were calculated on the existing rail network regarding speeds and terminals. Although the flows thus produced are a current “best case” scenario given the state of the rail network in 2011 (the base year), they are a fair representation of what could be expected from flows in these commodities in other countries with better developed inter-modal infrastructure.

8.3.22 There is significant room for growth in containerised freight, particularly as it plays a key role in boosting efficiency and lowering costs for transport. Romania’s population is set to decline by approximately 1.5m people by 2035, whilst current trends point towards de-urbanisation occurring across the country. Containerisation will provide an important way to maintain and improve standards of living through lowered costs of this distribution network which will need to serve more places more cheaply. However, the current facilities do not offer scope for efficient and orderly increases in container traffic, and would indeed struggle to meet demand if more industry utilised rail given their current operating conditions and locations.

8.3.23 This is demonstrated by the inclusion of the figures for “potential rail freight”, which estimates the amount of traffic which would utilise each terminal assuming that significant containerisation of freight had taken place across the country, in response to the improved network and infrastructure for its distribution. It should be noted that the potential containerised rail freight *is explicitly not a forecast*, but an indication of the significant role which containerised rail freight could play in distributing goods and manufactures around Romania, given better conditions than current and a more competitive offer compared with road haulage.

8.3.24 The current capacity of existing terminals was developed based on the assumption that the terminal would operate for 300 days a year, with twenty metre wagons being used carrying upto 3 TEUs each. Limitations apart from the rail sidings and handling equipment are not considered, for example, the state of the hard-standing. The full length of each siding can be used twice a day for either loading or unloading by any operational cranes at any given site. The crane operates on the current CFR Marfa average of seven minutes per TEU movement for the existing 12 hours of operational time per day.

8.3.25 By contrast the “best practice” capacity, developed as part of the potential rail demand scenario, proposed that each siding could be used up to six times per day, with all extant cranes restored to full working order moving a box in three minutes, in line with international best practice. This was to assess whether or not the facilities would be able to cope with a significant increase in utilisation even with improved operational conditions.

8.3.26 For situations where there was a significant shortfall of capacity over potential demand under these varied conditions then a rehabilitation scheme was considered. Furthermore, major centres which had a terminal mothballed were modelled to see if the capacity of these facilities is adequate and if so they are recommended for rehabilitation and re-opening as the intermodal market expands. In these instances it is suggested that the sites, after rehabilitation, are operated by private logistics operators to ensure open access on equal terms for all users. Various operating approaches have been utilised across Europe with success, and a study of which approach is most suitable for Romania should be undertaken as part of the rehabilitation programme.

8.3.27 These interventions create the following network of rehabilitated and/or modern terminals:

Figure 8.15: Map of Proposed Interventions

8.3.28 When this is combined with the existing terminals which have been assessed as not requiring significant rehabilitation under the aegis of the masterplan, the network of inland terminals which results is as follows:

Figure 8.16: Map of Inland Terminal Network

8.3.29 This in turn can be further augmented through the addition of the proposed tri-modal terminals as outlined above to create a comprehensive intermodal network across the country:

Figure 8.17: Proposed Inter- and Tri-Modal Network

8.3.30 As can be seen, comparing this network with a map of the largest population centres in Romania demonstrates that this is a 'good fit' in terms of providing access to population and industrial heartlands for potential containerised flows. Population centres are shown in Figure 8.18.

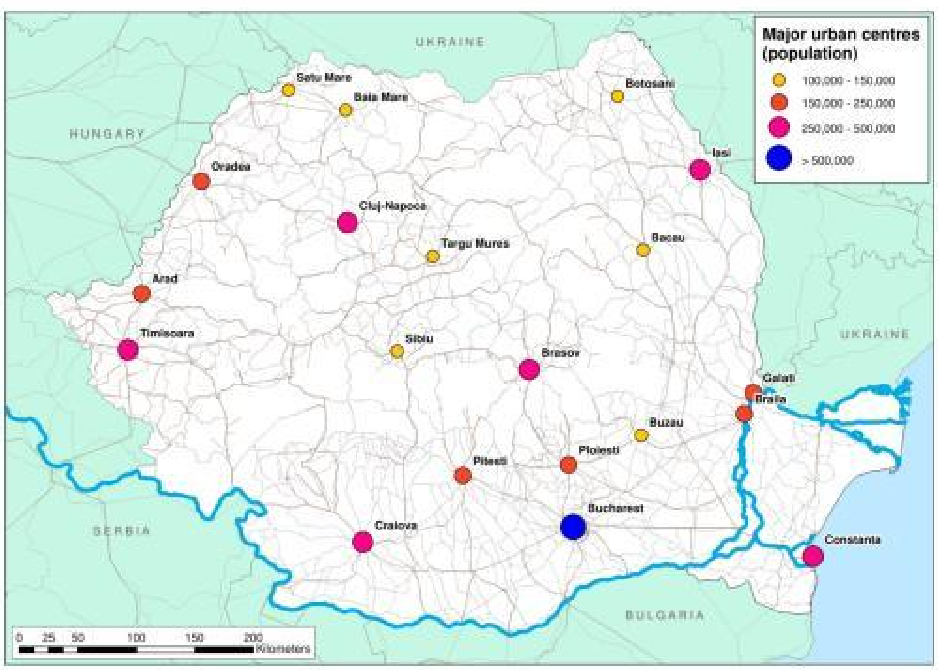


Figure 8.18: Twenty Largest Population Centres in Romania

8.3.31 Having arrived at these sites as a result of analysis and potential demand assessment, it is worthy to compare the proposal with those of other stakeholders who have assessed the problem. The proposed network is shown in Table 8.14, and we have considered the suggestions of other parties are shown in Table 8.15. As can be seen, the proposed inland network matches up well with those suggested elsewhere by either other consultants or train operators themselves.

Table 8.14: Proposed Network of Intermodal and Tri-modal Terminals

Inland Terminals			Tri-Modal Terminals	
Extant	*Refurbished*	*New Build*	*Extant*	*New Build*
Arad Zalau Bistrita Brasov Ploiesti Pitesti	Timisoara (Semenic) Cluj-Napoca Turda Suceava Iasi (Socola) Bacau Oradea	Craoiva Bucharest	Constanta	Galati Giurgiu Drobeta

8.3.32 The tri-modal terminals, whilst not necessarily located in the centre of large population catchments, are an important link in providing a joined up intermodal network between water, road and rail, and as such should be built despite this in order to enable movement of containers by water freight.

8.3.33 This combination of intermodal and tri-modal terminals provides not only for large retail demand in population centres, but also potential industrial containerised flows in important industrial sectors. Furthermore, it offers an opportunity for a coherent, comprehensive sustainable transport network for containers across the nation which should promote significant modal shift from road to more sustainable rail and water modes.

8.3.34 According to the national transport model, the recommended set of intermodal terminals do indeed promote modal shift, with approximately 900,000 fewer road tonne kilometres, over 100,000 additional rail tonne kilometres, over 1.1 million additional water freight tonne kilometres and approximately 400,000 more freight tonne kilometres than the reference case by 2030.

8.3.35 However, these terminals will need to be accompanied by rehabilitated rail corridors to enable heavier trains (22.5ton axle weight) and also effective pathing of container trains to enable higher speeds and journey time reliability and punctuality. These improvements will also benefit and cater for predicted growth in non-containerised freight, where rail remains more competitive against road.

Table 8.15: Proposed Networks of Terminals from previous studies and Consultation

Reference /Consultee	Year	No. of Terminals		Most Appropriate Locations																										
		Strategic	Small	Bucharest	Arad /Timisoara/Seminic	Ploiesti	Brasov,	Sibiu,	Iasi,	Cluj,	Vidin	Constanta,	Galati,	Giurgiu	Oradea Est	Zalau	Baia Mare	Turda	Medias	Craiova	Buzau	Suceava	Botasani	Bacau	Bujoreni	Bradu de sus	Ciumesti	Vinto de Jos	Slatina	Pitesti
Tri-Modal:											✓	✓	✓	✓																
Syancu	2004	7		x	x		x					x			x					x				x						
Halcrow	2006	4	6	X	X	x		x	x	x		X	X							x									x	
Diomis	2010	4		x	x							x																		x
Kombi Consult	2013	7		x	x				x	x				x				x		x				x						x
IM Strategy – Romania 2020	2010	8		x	x	x	x		x	x		x		x				x		x	x						x			x
Train Operator 1	2013	4	17	X	X	x	x	x	X	x		X	x		x	x	x	x	x	x	x	x	x	x	x	x				
Train Operator 2	2013	5		x			x																	x		x		x		
Train Operator 3	2013	3	*	Not Specified																										
Train Operator 4	2013	5		x	x		x			x	x																			
Train Operator 5	2014	9		x	x	x	x			x										x		x		x			x			
Private Company	2012	12		x	x	x	x	x	x	x	x	x	x	x			x													

* This train operator felt that whilst there should be additional, smaller terminals for domestic traffic spread throughout the country, the specific locations were not necessarily pre-determined but should be demand-led.

8.3.36 A comparison of Tables 10.14 and 10.15 demonstrates that the proposed network has widespread support from a variety of key stakeholders, in particular there is clear support for additional terminals in the Arad/Timisoara/Semenic area, Bucharest, Cluj and Craoiva. All terminal locations which received more than three recommendations were assessed in the course of developing the proposed network, in addition to the other factors discussed above.

8.3.37 The cost of these schemes varies to reflect the different condition of the existing yards available fo use. Therefore in some yards a lighter rehabilitation programme is required, whereas other terminals require the construction of new, bespoke facilities.

8.3.38 However, the resultant proposed network of new and rehabilitated terminals provides both strategic, international terminals and smaller domestic terminals where potential and expected demand supports development. Additionally, the set of terminals proposed will enable direct transshipment from Russian to European gauge at Socola and also encourage use of the Danube for containerised freight through the network of porposed tri-modal terminals. This will result in a more sustainable and cost-efficient distribution network for the country as a whole

8.4 Testing interventions

8.4.1 For ease of understanding, this section is split into two sections. The first section will assess the new and refurbished Intermodal Terminals, whilst the second section will include other interventions.

New and Refurbished Intermodal Terminals

8.4.2 These proposals fall under the High-Level Objective of Improving Economic Efficiency. First the two new terminals are considered followed by the refurbished existing terminals.

Bucharest (New Terminal)

AECOM recommend the closure of the existing Bucarestii Noi facility and the establishment of a new, larger, high-capacity terminal located near the ring road and motorway network which has potential for conversion to a tri-modal terminal in the future alongside the Danube-Bucharest Canal, should this be built at a future date.

Operational Objective

OR16*, Develop a network of “open user” freight terminals to serve Romania’s highest demand potential regions, cities and major EU markets in Bulgaria and Hungary.*

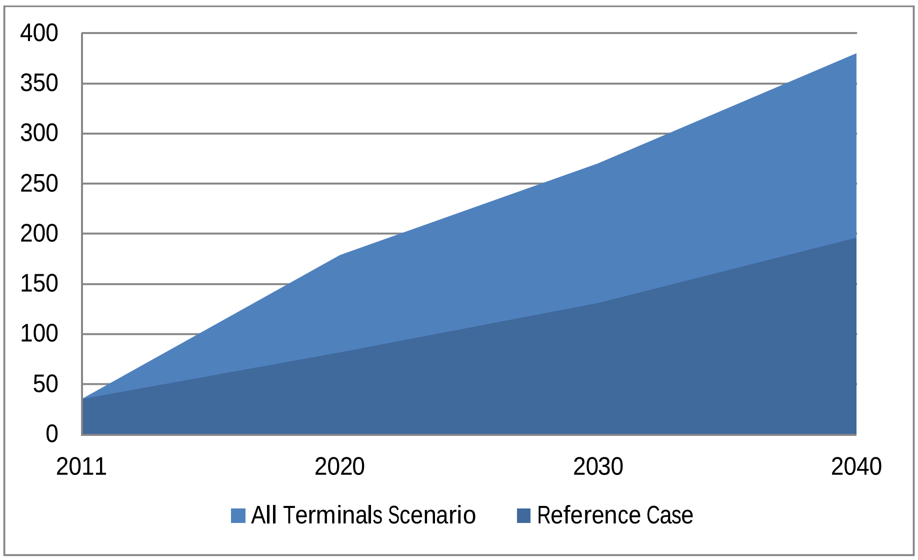
Problem Addressed

Current intermodal freight volumes in Romania are low, and this is partly due to the poor state of the facilities designed to receive them. When combined with expected growth in the intermodal sector, the current facilities at Bucharest are too small for anticipated demand with capacity rapidly being outstripped by supply (see table below under Outcomes) and so a new terminal is recommended.

Outcomes

As demonstrated in the table and chart below, the intervention (in concert with the other intermodal terminals) provides a significant boost to the amount of intermodal freight travelling by rail.

		2011	2020	2030	2040
Reference Case	Daily Demand	35	82	131	196
	Percentage of Capacity (Current)	34%	80%	128%	192%
With Terminal	Daily Demand	35	179	270	380
	Percentage of Capacity (Current)	34%	175%	265%	373%
	Percentage of Capacity (Best Practice)	*8%*	*39%*	*59%*	*83%*



The new terminal has significant economic benefits:

Economic Impact	
Present Value of Costs	12.8
Present Value of Benefits	50.1
Net Present Value (NPV)	37.3
EIRR	13.8%
Benefit/Cost Ratio	3.91

Implementation:

This scheme would be implemented by CFR SA and CFR Marfa, along with the private sector. The development of the intermodal terminals is viewed as being very important for the development of rail freight in Romania as they are integral to allowing rail to compete in a modern and growing sector. The terminal at Bucharest is scheduled for implementation in the period 2015 – 2020.

Craiova (New Terminal)

AECOM recommend the disposal of the existing, mothballed terminal at Craiova and instead the creation of a new terminal with better links to the road network in order to cater for expected growth in the intermodal sector.

Operational Objective

***OR16,** Develop a network of "open user" freight terminals to serve Romania's highest demand potential regions, cities and major EU markets in Bulgaria and Hungary.*

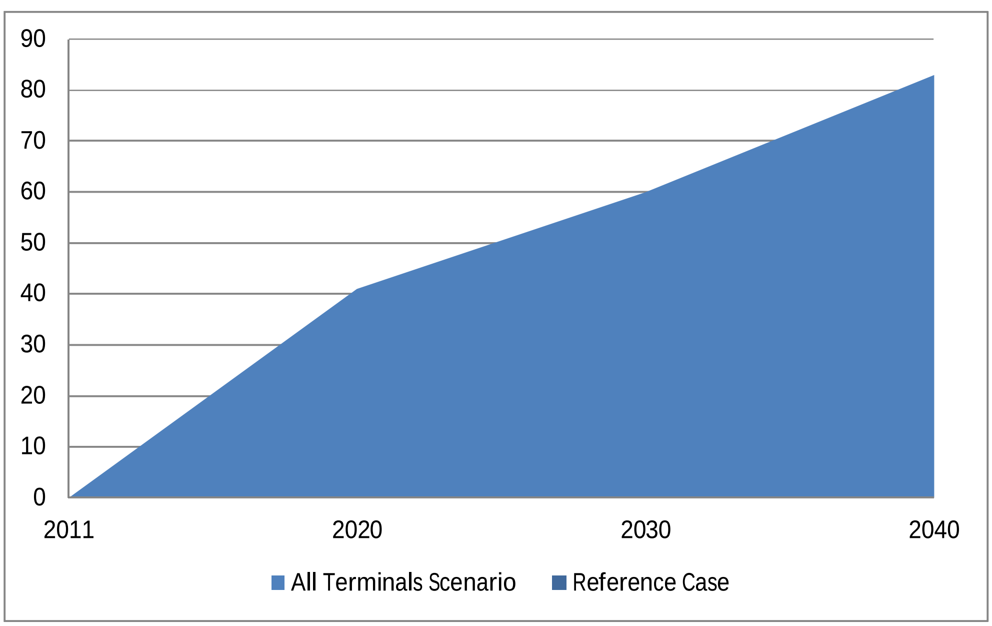
Problem Addressed

Current intermodal freight volumes in Romania are low, and this is partly due to the poor state of the facilities designed to receive them. When combined with expected growth in the intermodal sector and the industrial composition of the area around Craiova, there is potential for demand to outstrip capacity at the existing, dilapidated location.

Outcomes

As demonstrated in the table and chart below, the intervention (in concert with the other intermodal terminals) provides a significant boost to the amount of intermodal freight travelling by rail.

		2011	2020	2030	2040
Reference Case	Daily Demand	0	0	0	0
	Percentage of Capacity (Current)	0%	0%	0%	0%
With Terminal	Daily Demand	0	41	60	83
	Percentage of Capacity (Current)	0%	40%	59%	81%
	Percentage of Capacity (Best Practice)	*0%*	*9%*	*13%*	*18%*



The new terminal has significant economic benefits:

Economic Impact	
Present Value of Costs	13.6
Present Value of Benefits	18.8
Net Present Value (NPV)	5.3
EIRR	6.6%
Benefit/Cost Ratio	1.39

Implementation:

This scheme would be implemented by CFR SA and CFR Marfa, along with the private sector. The development of the intermodal terminals is viewed as being very important for the development of rail freight in Romania as they are integral to allowing rail to compete in a modern and growing sector. The terminal at Craiova is scheduled for implementation in the period 2015 – 2020

Iasi Socola (Refurbished Terminal)

AECOM propose that the Socola Marfuri Terminal is re-opened to take advantage of the potential from transhipping containers from European to Russian gauges and also the ability to handle domestic traffic.

Operational Objective

OR16, *Develop a network of "open user" freight terminals to serve Romania's highest demand potential regions, cities and major EU markets in Bulgaria and Hungary.*

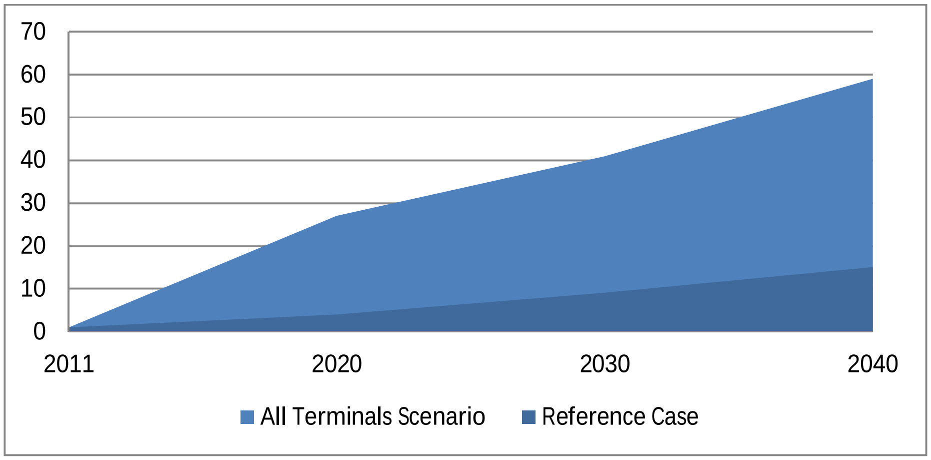
Problem Addressed

Current intermodal freight volumes in Romania are low, and this is partly due to the poor state of the facilities designed to receive them. When combined with expected growth in the intermodal sector and the opportunity to tranship to/from Russian gauge, there is a need for the currently closed terminal to be repaired and reopened.

Outcomes

As demonstrated in the table and chart below, the intervention (in concert with the other intermodal terminals) provides a significant boost to the amount of intermodal freight travelling by rail.

		2011	**2020**	**2030**	**2040**
Reference Case	Daily Demand	1	2	3	5
	Percentage of Capacity (Current)	2%	4%	6%	9%
With Terminal	Daily Demand	1	25	34	47
	Percentage of Capacity (Current)	2%	46%	63%	87%
	Percentage of Capacity (Best Practice)	*0%*	*12%*	*16%*	*22%*



The new terminal has significant economic benefits:

Economic Impact	
Present Value of Costs	3.9
Present Value of Benefits	11.7
Net Present Value (NPV)	7.8
EIRR	12.0%
Benefit/Cost Ratio	3.01

Implementation:

This scheme would be implemented by CFR SA and CFR Marfa, along with the private sector. The development of the intermodal terminals is viewed as being very important for the development of rail freight in Romania as they are integral to allowing rail to compete in a modern and growing sector. The refurbishing of the terminal at Iasi (Socola) is scheduled for implementation in the period 2015 – 2020

Timisoara Semenic (Refurbished Terminal)

AECOM propose that the terminal at Timisoara Semenic is re-opened to take provide Romania's second city with its own intermodal facility as well as relieve pressure on private facilities at Arad from growth in the intermodal sector.

Operational Objective

OR16, *Develop a network of "open user" freight terminals to serve Romania's highest demand potential regions, cities and major EU markets in Bulgaria and Hungary.*

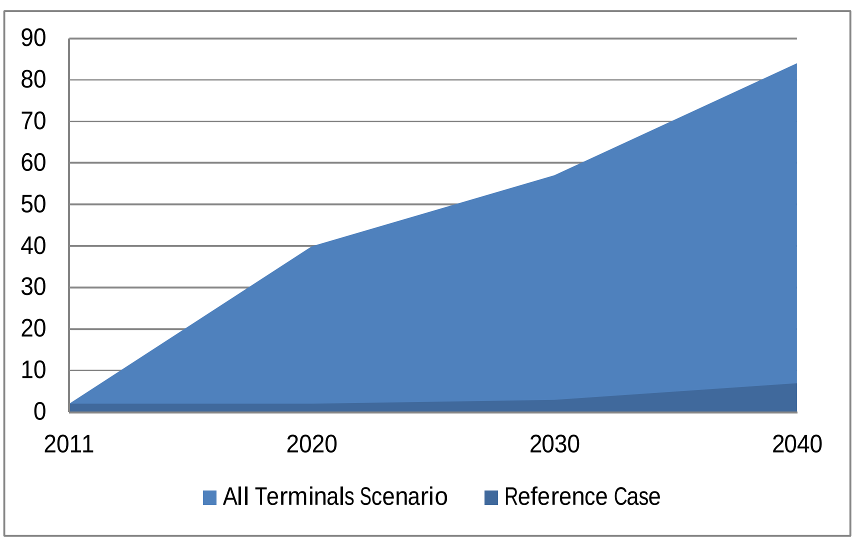
Problem Addressed

Current intermodal freight volumes in Romania are low, and this is partly due to the poor state of the facilities designed to receive them. The opportunity to cater for expected growth in the intermodal sector and to expand facilities near the border in this important economic region of the country together means the rehabilitation of this terminal is recommended.

Outcomes

As demonstrated in the table and chart below, the intervention (in concert with the other intermodal terminals) provides a significant boost to the amount of intermodal freight travelling by rail.

		2011	**2020**	**2030**	**2040**
Reference Case	Daily Demand	2	2	3	17
	Percentage of Capacity (Current)	3%	4%	5%	10%
With Terminal	Daily Demand	2	40	57	84
	Percentage of Capacity (Current)	3%	56%	79%	117%
	Percentage of Capacity (Best Practice)	*1%*	*14%*	*20%*	*29%*



The new terminal has significant economic benefits:

Economic Impact	
Present Value of Costs	2.3
Present Value of Benefits	19.1
Net Present Value (NPV)	16.8
EIRR	24.4%
Benefit/Cost Ratio	8.45

Implementation:

This scheme would be implemented by CFR SA and CFR Marfa, along with the private sector. The development of the intermodal terminals is viewed as being very important for the development of rail freight in Romania as they are integral to allowing rail to compete in a modern and growing sector. The refurbishing of the terminal at Timisoara Semenic is scheduled for implementation in the period 2015 – 2020.

Cluj Napoca Est (Refurbished Terminal)

AECOM propose that the existing terminal at Cluj Napoca Est is refurbished to increase efficiency, lower costs and transit times and to promote growth of the intermodal sector.

Operational Objective

OR16, *Develop a network of "open user" freight terminals to serve Romania's highest demand potential regions, cities and major EU markets in Bulgaria and Hungary.*

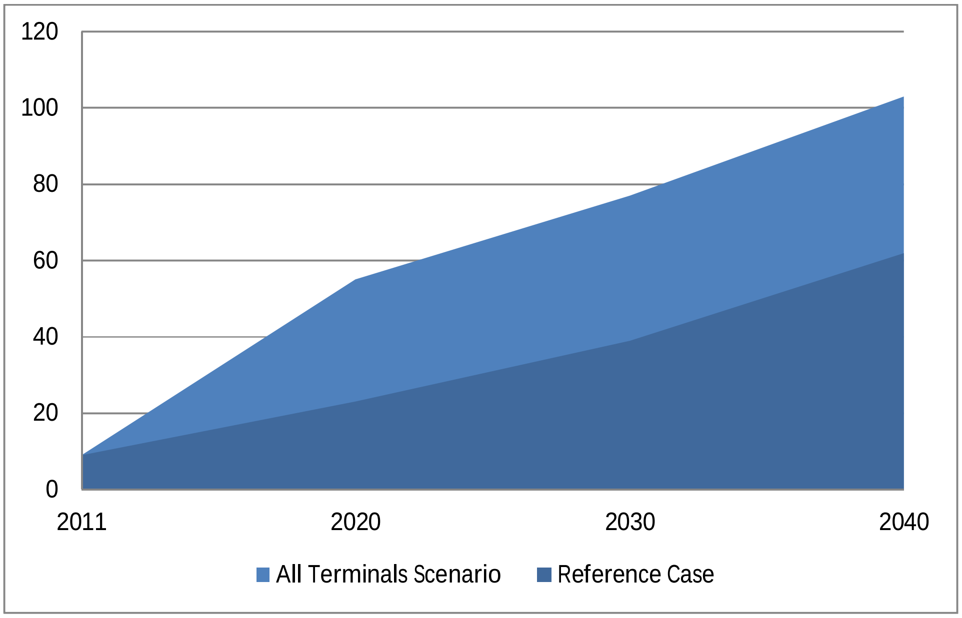
Problem Addressed

Current intermodal freight volumes in Romania are low, and this is partly due to the poor state of the facilities designed to receive them. Expected growth in the intermodal sector means that capacity at this terminal will be outgrown within a short time frame (see Outcomes) and so modernisation is required.

Outcomes

As demonstrated in the table and chart below, the intervention (in concert with the other intermodal terminals) provides a significant boost to the amount of intermodal freight travelling by rail.

		2011	**2020**	**2030**	**2040**
Reference Case	Daily Demand	9	23	39	62
	Percentage of Capacity (Current)	17%	43%	72%	115%
With Terminal	Daily Demand	9	55	77	103
	Percentage of Capacity (Current)	17%	102%	143%	191%
	Percentage of Capacity (Best Practice)	*4%*	*25%*	*36%*	*48%*



The new terminal has significant economic benefits:

Economic Impact	
Present Value of Costs	4.7
Present Value of Benefits	18.0
Net Present Value (NPV)	13.3
EIRR	14.5%
Benefit/Cost Ratio	3.86

Implementation:

This scheme would be implemented by CFR SA and CFR Marfa, along with the private sector. The development of the intermodal terminals is viewed as being very important for the development of rail freight in Romania as they are integral to allowing rail to compete in a modern and growing sector. The refurbishing of the terminal at Cluj Napoca Est is scheduled for implementation in the period 2015 – 2020 so that capacity can be provided before it is outgrown.

Suceava (Refurbished Terminal)

AECOM propose that the existing terminal at Suceava is refurbished to increase efficiency, lower costs and transit times and to promote growth of the intermodal sector. Given the strong growth in tonnage already experienced, Suceava offers an opportunity to further develop and encourage intermodal traffic on corridor IX.

Operational Objective

OR16, Develop a network of "open user" freight terminals to serve Romania's highest demand potential regions, cities and major EU markets in Bulgaria and Hungary.

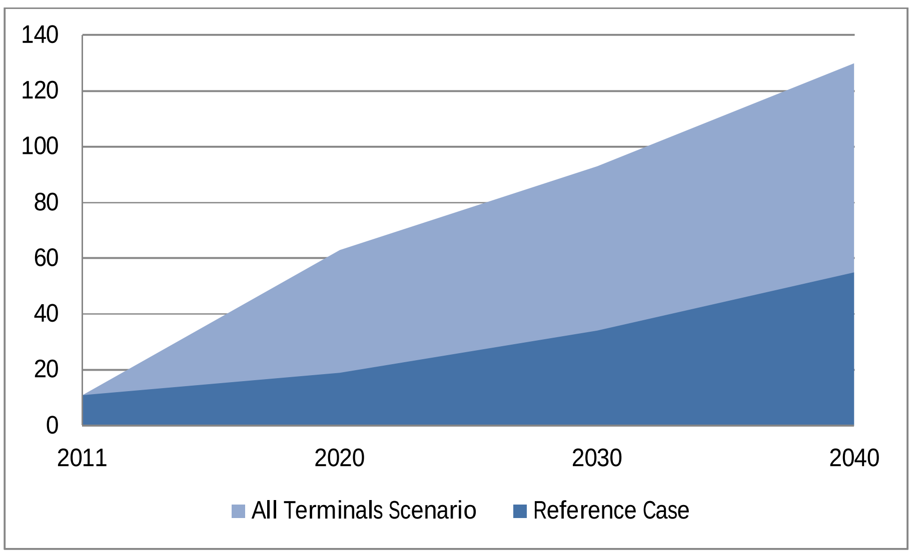
Problem Addressed

Current intermodal freight volumes in Romania are low, and this is partly due to the poor state of the facilities designed to receive them. Expected growth in the intermodal sector means that capacity at this terminal will be outgrown within a short time frame (see Outcomes) and so modernisation is required, particularly given the growth witnessed during the recession.

Outcomes

As demonstrated in the table and chart below, the intervention (in concert with the other intermodal

		2011	2020	2030	2040
Reference Case	Daily Demand	11	19	34	55
	Percentage of Capacity (Current)	26%	45%	81%	131%
With Terminal	Daily Demand	11	63	93	130
	Percentage of Capacity (Current)	26%	150%	221%	310%
	Percentage of Capacity (Best Practice)	*7%*	*38%*	*55%*	*77%*



The new terminal has significant economic benefits:

Economic Impact	
Present Value of Costs	4.7
Present Value of Benefits	18.6
Net Present Value (NPV)	13.9
EIRR	14.3%
Benefit/Cost Ratio	4.00

Implementation:

his scheme would be implemented by CFR SA and CFR Marfa, along with the private sector. The development of the intermodal terminals is viewed as being very important for the development of rail freight in Romania as they are integral to allowing rail to compete in a modern and growing sector. The refurbishing of the terminal at Suceava is scheduled for implementation in the period 2015 – 2020 so that capacity can be provided before momentum from the terminal's current increased use is lost.

Bacau (Refurbished Terminal)

AECOM propose that the existing terminal at Bacau is refurbished and expanded to the south east to increase efficiency, lower costs and transit times and to promote growth of the intermodal sector.

Operational Objective

OR16, Develop a network of "open user" freight terminals to serve Romania's highest demand potential regions, cities and major EU markets in Bulgaria and Hungary.

Problem Addressed

Current intermodal freight volumes in Romania are low, and this is partly due to the poor state of the facilities designed to receive them. Expected growth in the intermodal sector means that the current layout at Bacau will soon be overwhelmed (see Outcomes), and so improvements need to be made to increase throughput and enable greater container storage.

Outcomes

As demonstrated in the table and chart below, the intervention (in concert with the other intermodal terminals) provides a significant boost to the amount of intermodal freight travelling by rail.

<table>
<tr><th colspan="2"></th><th>2011</th><th>2020</th><th>2030</th><th>2040</th></tr>
<tr><td rowspan="2">Reference Case</td><td>Daily Demand</td><td>15</td><td>24</td><td>41</td><td>62</td></tr>
<tr><td>Percentage of Capacity (Current)</td><td>36%</td><td>57%</td><td>98%</td><td>148%</td></tr>
<tr><td rowspan="3">With Terminal</td><td>Daily Demand</td><td>15</td><td>74</td><td>107</td><td>150</td></tr>
<tr><td>Percentage of Capacity (Current)</td><td>36%</td><td>176%</td><td>255%</td><td>357%</td></tr>
<tr><td>Percentage of Capacity (Best Practice)</td><td>9%</td><td>44%</td><td>64%</td><td>89%</td></tr>
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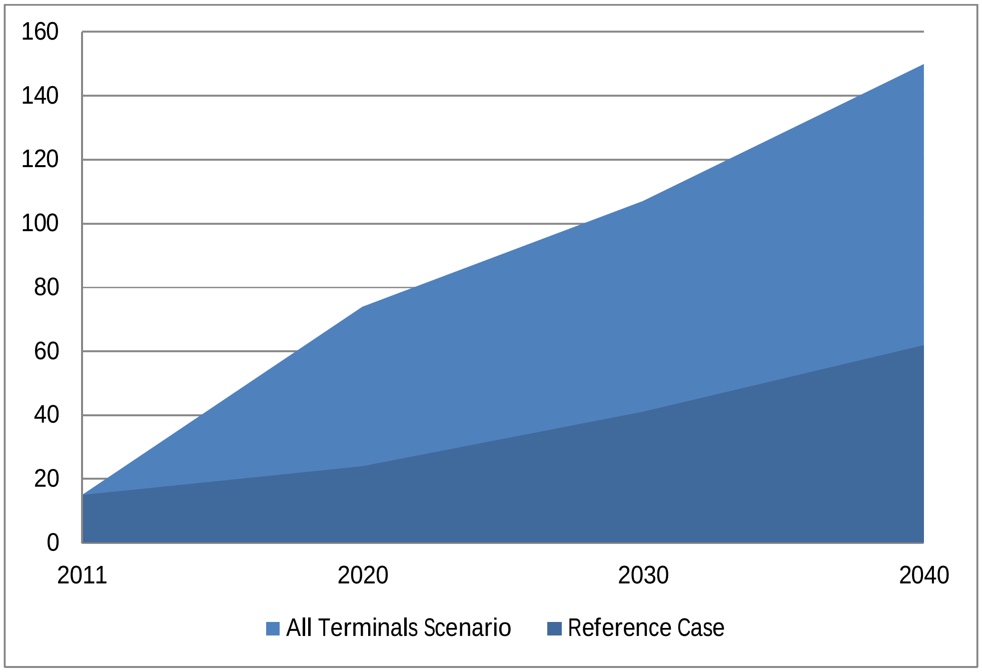


The new terminal has significant economic benefits:

Economic Impact	
Present Value of Costs	4.7
Present Value of Benefits	18.4
Net Present Value (NPV)	13.7
EIRR	14.4%
Benefit/Cost Ratio	3.95

Implementation:

This scheme would be implemented by CFR SA and CFR Marfa, along with the private sector. The development of the intermodal terminals is viewed as being very important for the development of rail freight in Romania as they are integral to allowing rail to compete in a modern and growing sector. The refurbishing of the terminal at Bacau is scheduled for implementation in the period 2015 – 2020 so that capacity can be provided before the existing terminal is over-capacity.

Other Interventions

Developed below are the other interventions which will complement the new and refurbished intermodal terminals.

Allow higher top speed for certain freight trains on rehabilitated lines

AECOM propose that CFR Infrastructure allow a higher top speed for certain freight trains on rehabilitated lines - 120kph for intermodal block trains whilst the 80kph design speed should be achievable for other bulk and mixed traffic.

Operational Objective

OR1 Increase rail speeds to a level consistent with target design speeds

Problems Addressed

This intervention will address the current low average speed of rail freight in Romania (21km/h), which makes rail freight expensive, slow and uncompetitive compared to road transport.

The benefits to freight traffic from this project are included in the rail proposals in Chapter 6.5.

Two tier system to allow intermodal trains to be prioritised.

The creation of a 2 Tier system to allow properly equipped and dedicated intermodal trains to be prioritised over other types of bulk freight and potentially local, stopping passenger services will lower journey times over the core network to compete with road journey times.

Operational Objective

OR13 *Enhance the asset performance of the railway especially opportunities to achieve operational efficiencies*

Problems Addressed

Improved journey times and journey time reliability are integral to making rail freight competitive against the road sector. As such prioritising trains which are capable of higher speeds over slower freight and local services will be of key importance to rail freight's ability to compete in this market.

Outcomes

This intervention will encourage the uptake of rail freight for intermodal transport, significantly reducing carbon emissions by a switch from road.

Implementing Organisation

This scheme would be implemented by CFR SA, CFR Marfa and its successors.

Implementation year(s)

This intervention will enable intermodal transport to expand and grow on the railways, decreasing the network's dependency on old, traditional industries which are in decline. It is, however, dependent upon the rehabilitation of the railway and as such should be implemented in lockstep with the roll out of rehabilitated lines.

Allow 22.5 tonne axle weight for rehabilitation

Project proposal

To encourage international and transit traffic allow 22.5 tonne axle weights on rehabilitated routes. Clearly the whole route needs to be cleared for operators to use this productively. This feature should be integrated into all future route rehabilitation.

Operational Objective

OR13 Enhance the asset performance of the railway especially opportunities to achieve operational efficiencies

Problems Addressed

A 20.5 tonne axle limit is currently in force, but this is less than the EU rail network standard of 22.5t. Many trains and rolling stock are thus sub-optimally utilised.

Outcomes

Upgrading to the larger axle weight will enable more efficient loading of vehicles. For a 30 wagon train this equates to an additional 240 tonnes of product (a 15% productivity enhancement). It will also improve through-running of international trains.

Implementing organisation

This scheme would be implemented by CFR SA.

Implementation year(s)

This should be implemented as part of the rehabilitation programme.

Feasibility of regenerative braking

Undertake a feasibility study with regard to introducing power systems with the capability to return energy generated from regenerative braking to the power network during all future rehabilitation work.

Operational Objective

OR13 Enhance the asset performance of the railway especially opportunities to achieve operational efficiencies

Problems Addressed

There is currently no section of track, for example, where power recovery is possible which could significantly reduce costs and improve the sustainability of the network.

Outcomes

Regenerative braking can save 5% on power use on freight but up to 17% on commuter passenger trains

Implementing organisation

This scheme would be implemented by CFR SA.

Implementation year(s)

This should be undertaken immediately to enable any regenerative technology to installed on key corridors as part of the rehabilitation process.

Ensure companies adopt modern best practice

It has to be ensured that companies adopt modern practice and technologies such as the use of GPS for rolling stock tracking. This needs to be accompanied by the creation of modern training courses in rail operation systems and technology for existing and new staff. It is extremely important for the rail sector to have a good blend of technology and experience.

High level objective

Economic efficiency

Operational Objective

OR13 Enhance the asset performance of the railway especially opportunities to achieve operational efficiencies

Problems Addressed

The intervention addresses the following issues:

- The current level of uptake of more efficient new technologies is low
- Old systems and paperwork based ways of working coupled with lack of training are hindering the development of the modern railway
- Train sheets are filled in manually with every wagon number recorded in handwriting and then where each wagon needed to be moved to.
- There is a requirement to update training to reflect on modern needs, adopt Global Positioning System (GPS) Technology and adopt Best Practice
- There are some modern systems (e.g. ARGOS) but only limited numbers of trained operators.

Outcomes

Improved use of technology will lower costs and reduce staff numbers, enabling more efficient use of infrastructure to be achieved.

Implementing organisation

This scheme would be implemented by CFR SA, CFR Marfa, private operators and training bodies.

Implementation year(s)

Work should begin immediately on the development of new training programmes so that the benefits of new technology and modern working practices can be realised as soon as possible. Therefore this is slated to be undertaken in the period 2015 – 2020.

Privatisation of CFR Marfa

Complete privatisation of CFR Marfa.

Operational Objective

OR7 Increase revenue capture and efficiency by ensuring contracts are more commercially focussed

Problems Addressed

The continued uncertainty and delays regarding CFR Marfă's privatisation mean that rail freight is locked into a cycle of under-investment and short-term contracts, without any long-term view to utilising new technologies and working practices.

Outcomes

The break-up and privatisation of CFR Marfa will enable better competition, more efficient working practices and innovation to reduce the costs of rail freight and make it more competitive compared to other modes.

Implementing organisation

This scheme would be implemented by the Romanian government.

Implementation year(s)

The process has been drawn out and needs to be completed as soon as possible. It is marked to be completed in the period 2015 – 2020.

8.5 Summary of Interventions for Intermodal

8.5.1 Rail freight in Romania has a relatively high modal share, particularly in certain industries. However as old, established industries such as steel-making shrink as part of the economy, rail freight is destined to fall unless it can become more competitive in newer, more dynamic industrial sectors. Rail freight's three largest commodity flows in 2011 were solid mineral fuels, petroleum products and metal products – all linked to more traditional industries within the Romanian economy. Furthermore, similar to rail passenger flows, road has established itself as a strong competitor, offering cheaper prices alongside both lower and more reliable journey times.

8.5.2 Given the shift towards more sustainable distribution methods which are required as a result of man-made global warming and subsequent EU policy, it is imperative that Romania is able to move and distribute goods by rail effectively and cheaply, in order to encourage an increase in modal share. This will also require expanding rail freight's current offer in dynamic and growing market sectors such as intermodal container transport.

8.5.3 Rail's current top three commodity groups are Solid Mineral Fuels, Petroleum Products and Metal Products (see Figure 8.19).

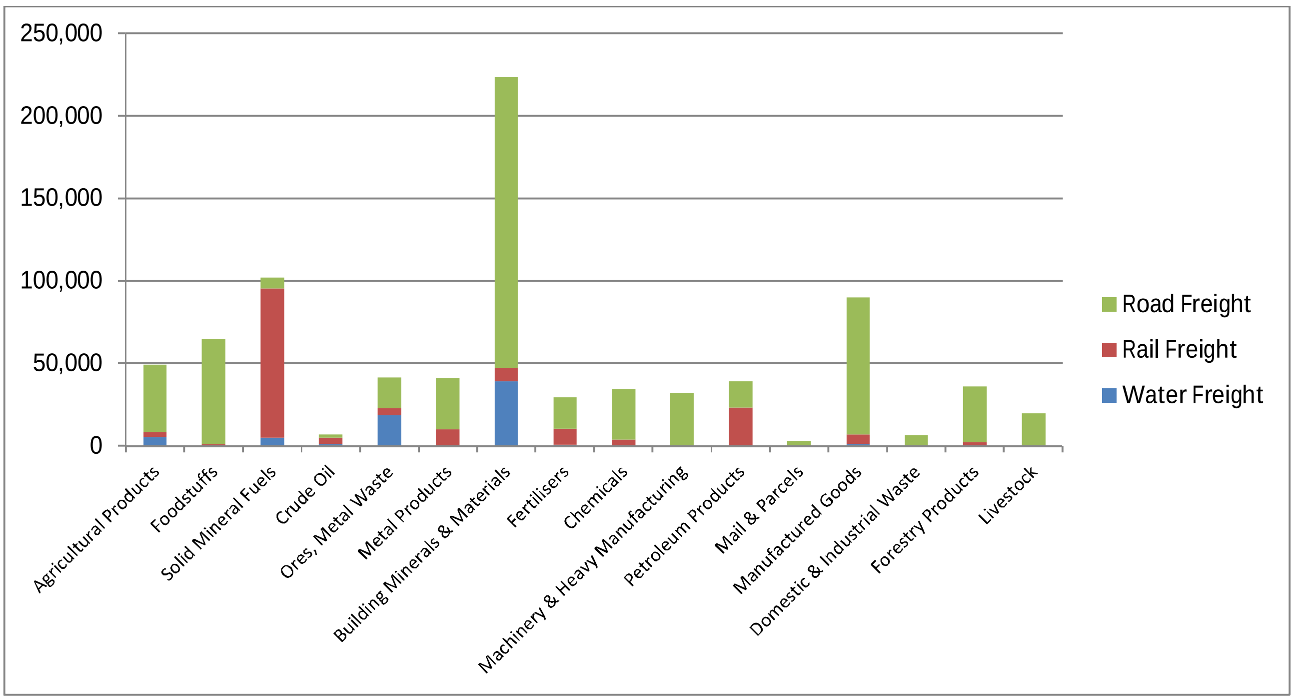


Figure 8.19: Daily Commodity Flows (Tonnes) by Type and Mode Share

8.5.4 The movement of traditional bulk commodities such as these is not as time sensitive as consumer goods, food and automotive products and so having low average commercial speeds on the railway (currently approximately 22km/h) may not have been such an issue to customers where the next load is merely topping up a large stockpile of coal. Apart from ensuring traditional bulk customers are well looked after, however, it is important to learn the lessons from countries where rail freight is growing, such as Germany, Italy and the UK. This is in the shipment of manufactured, consumer and retail goods, often transported in intermodal units such as containers, and these commodities require trains to arrive on time and have competitive journey times and costs with road freight. Between these two extremes are a range of products where improvements in the rail freight offer could advance the percentage of traffic moved by rail. These have been identified through comparison with other rail freight markets. In sectors such as Metal Products and Fertilisers, there is scope for rail to further exploit its current good position to further enhance its modal share through targeted investment on improved journey time reliability and reduced costs on the key corridors where these commodities are moved.

Improvements covered Elsewhere

8.5.5 Freight will be able to benefit from the improvements being made for the passenger network to become more competitive with road, and as such much of its potential growth depends on the rehabilitation of the network and the improved reliability which is outlined in the passenger section. In particular the rehabilitation of key corridors to their full design speed and capacity will remove speed restrictions, reducing journey times whilst simultaneously improving reliability. This is particularly the case given the current operational speed limit for all freight trains being limited to 80km/h. We have seen no compelling evidence why the speed limit for certain freight trains could not be raised to 120 kph on rehabilitated tracks, where line speeds, and gradients, allow.

8.5.6 Journey times will also benefit from the creation of a sound performance accountability system to encourage effective and consistent timetabling and use through a compensatory regime for delays. Similarly, improvements to train handling procedures and administrative systems at borders will also benefit international freight flows. The evidence we have seen suggests that private operators can deal with the border crossing procedures in less than an hour, whereas trains run by the state-owned operator CFR Marfa typically take more than two hours to obtain clearances. Clearly, reducing times for administrative procedures improves track utilisation and reduces the need for additional train storage areas.

Interventions directly for Rail Freight

8.5.7 There are a number of interventions which will provide Romania significant improvements to its rail freight potential and network. International interoperability of trains is an important European aim to facilitate long distance international rail freight and therefore, as part of the rehabilitation programme, it is important that axle weights on all rehabilitated corridors are improved to 22.5 tonnes, in line with European norms. Although a proportion of the existing legacy rolling stock will not be able to make use of higher axle weights, some wagons are already suitable and all new and refurbished wagons would have enhanced capability. This will not only enable better use of most rolling stock (as wagons will not need to be underloaded) but also smooth the flow of trains from other countries as they will not have to be loaded to meet Romania's unique axle weight restrictions but instead be able to travel widely across the EU. On a 30 wagon train, this will improve productivity by approximately 15% due to the increase in tonnage that could potentially be carried (an extra 240 tonnes). This is a key intervention and will carry on throughout the duration of the masterplan, resulting in a network of reliable, more productive freight corridors across the country.

8.5.8 The rehabilitation programme will enable better speeds for freight trains across the network, in particular this should be capitalised on through the creation of a two-tier system differentiating between heavier bulk and lighter intermodal freight trains. It is recommended that containers are run on dedicated block trains rather than the existing procedure of transporting a proportion of containers on the stopping pick-up services or mixed wagon trains. The intermodal block services should be capable of speeds of 120km/h and prioritised over slower freight services and even some slow passenger services in order to ensure lower journey times and improved journey time reliability. Intermodal transport is a key future market sector for rail freight, and offers the best potential to ensure sustainable modal shift from road to rail transport provided that rail's offer is competitive.

8.5.9 There is some infrastructure in place to promote containerisation and intermodal transport such as the presence of three container handling facilities at Constanta, albeit only one has relatively modern equipment. Constanta is home to the largest container port in the Black Sea mainly due to DP World's Constanta South Container Terminal which opened in 2004 and in 2012 handled 97% of container movements at the port. Constanta is strategically situated to potentially feed freight into the heartland of Central and Eastern Europe but due to the poor intermodal infrastructure it is not possible to fully capitalise on this opportunity. As Romania's economy continues to develop, there will be a continued increase in the numbers of containers handled, enabling smoother transfer of goods between modes and therefore potentially lowering carbon emissions and improving sustainability if these increases can be captured by the railway (see Waterways section 8.5 for Constanta specific proposals).

8.5.10 In order to deliver a competitive intermodal offer, it is also necessary for the country's intermodal infrastructure to offer a comprehensive and high-quality network of terminals which reflect and serve the forecast future of intermodal rail freight in the country. In addition to the proposed works at Constanta for the facilitation of the import and export trade (including additional terminal capacity in the next ten years as the market expands), the masterplan also recommend the creation or rehabilitation of several other intermodal terminals. The plan is to establish a network of 'open-user' terminals operated in an efficient manner by the private sector. The network seeks to build on the existing provision of terminals, some of which are already operating actively in the private sector. In other locations it requires major refurbishment or replacement of selected existing terminals previous previously owned and operated by CFR Marfa. In future these should be operated by the private sector. Whilst all of the terminals will enable and encourage international traffic, in particular terminals at Timisoara (Seminic) and Iasi (Socola) will provide gateways to the international network given their locations in the west and east respectively. The latter also provides the opportunity for transhipment to Soviet gauge services for Ukraine, Russia and much of eastern Europe. Other terminals will be located near large centres of the Romanian industrial production, economic activity and population; Craiova, Cluj Napoca, Turdu, Suceava and Bacau. Together with the proposed tri-modal terminals on the Danube at Drobeta-Turnu-Severin, Giurgiu and Galati, rail will be able to offer an extensive intermodal terminal network linked by rehabilitated lines promising reliable, fast freight services – a competitive offer when compared with road haulage. This is outlined in Figure 8.20:

Figure 8.20: Proposed Intermodal Terminal Network

8.5.11 Intermodal and bulk rail freight transport will also benefit from a range of other interventions. There is an opportunity to streamline and increase efficiency through improved training and use of technology. Whilst some modern systems are utilised on the network (ARGOS and the utilisation of GPS tracking by some private rail freight operators for example) this is currently limited. The roll-out of technology is further hampered by the traditional and somewhat out-moded training delivered to workers on the railway, therefore the introduction of new technology should be integrated with a revamped training system to make best use of the new facilities both in the short and long-term.

8.5.12 Furthermore the privatisation of CFR Marfa will enable private operators to develop long-term relationships with key customers. Currently the uncertainty over CFR Marfa's future means that the railway is locked into a cycle of short-term contracts, limited maintenance and an inability to make investment decisions, as there is little long-term thinking in an organisation that is still uncertain over its future.

8.5.13 Such long-term thinking and new technology could also be used on the network to make its use more sustainable. A proportion of current rolling stock is being sub-optimally used. The trains could be used more productively, by being loaded/unloaded quicker, have reduced journey times, carry more payload and generally increase annual revenue per train set per year. An example of a system not used in Romania but fitted to a number of locomotives used by the private sector in the country is regenerative braking, whereby energy used in slowing trains feeds power back into the grid. The life-expired infrastructure is currently unable to accept such inputs. A plan to introduce this technology could significantly lower the cost of providing rail freight services as power use can be reduced by 5% for freight trains and up to 17% on passenger services, and as such a feasibility study into how this could best be implemented is recommended. This should be undertaken immediately as it would be logical to combine this with the other rehabilitation work.

8.5.14 Together the interventions combined provide a blueprint for a successful, sustainable rail freight network in Romania. Not only will the rehabilitation of the rail corridors enable improvements to bulk freight reliability and delivery speeds, but in combination with the other operational interventions it will provide the basis for a strong intermodal offering in competition with road. In particular, this intermodal market has been identified as a key sector for future growth, and this will be encouraged by the proposed network of intermodal and tri-modal terminals which are strategically located to offer comprehensive coverage of Romania's key economic hubs and population centres.

Funding Analysis

9 Funding Analysis

9.1 Basic Assumptions

Context

9.1.1 A key step in the process of drafting the investment plan for 2020 and 2030 is to define the assumptions regarding the funding allocations available for new investments, on all modes of transport.

9.1.2 This will enable the production of a realistic investment plan, as the final result of the process of identifying problems, defining operational objectives and selecting the best interventions to address these objectives.

9.1.3 Although the projects' deliverability (or buildability) is not considered a distinct criterion in the multicriteriate analysis (hence it is not part of the prioritisation), the funding restrictions do represent a key element of the Master Plan process, as the investment needs identified in the Master Plan are far greater than the available financial allocations.

9.1.4 Following the Master Plan process a long list of prioritised potential interventions have been identified; matching these with the financial constraints per mode of transport will lead to a realistic implementation calendar for the periods specified in the Terms of Reference, respectively 2020, 2030 and after 2030.

Approach

9.1.5 A spreadsheet model was produced (Appendix A) to quantify the available funds for Master Plan projects to be implemented by 2020 and 2030. Its key assumptions and the considered methodology are described below.

9.1.6 The European Commission has specified that the Master Plan should be developed based on a hierarchical approach to allocation of funds to expenditure items, with only the remaining funds (after these commitments have been fully funded) being available for new investment and maintenance:

> *The elaboration of the Master Plan[40] shall be based on a clearly endorsed political assumption on the budgetary effort allocated to the transport sector over the next 20 years, including all direct and indirect costs afferent to the construction and maintenance of infrastructures, while taking into account the potential sources from the application of access fees in particular for the railway sector or the tolling revenues if relevant. A letter by the Minister of Finance with these budgetary assumptions has been requested.*
>
> *This assumption will determine the available budget for new investments. From the total available budget shall be deducted the necessary required routine operation and maintenance costs, calculated through general ratios (EUR/km), based on accepted standards, and obligations stemming from recent and on-going projects. Some potential savings can be generated on the maintenance costs, mostly by planning future reduction of the railway network, including stations.*

9.1.7 The mandated expenditures to be allocated as priorities are, as per instructions of DG Regio:

- Maintenance costs for restructured network, based on international standards;

40 Extract from EC DG Regio letter E2/RI/ds (2013) 3331276 on 27/09/2014

- o Liabilities afferent to current investment projects (loans and availability payment instalments);
- o Rehabilitation works for the remaining, economically viable railway network, in order to bring it to the expected standard speed; and
- o National public support to State owned companies, consistent with State Aid rules

9.1.8 A decision of the Romanian Government was issued in December 2013 on the commitment of 2% of GDP for the transport sector[41], as an action to fulfilling the ex-ante conditionalities related to the Partnership Agreement and the Operational Programmes (among, the production of a Transport Master Plan is one key element). It is clearly specified in this commitment that the allocation of 2% of GDP shall be allocated/used only for investments and maintenance works for the transport infrastructure, on all modes of transport.

9.1.9 The Ministry of Transport confirmed that the debt service, availability payments, national subsidies for the public rail service and national public support to state companies are outside this 2% allocation and that the EU allocations are part of this budget[42]. The inclusion of the EU allocations in the 2% of GDP might have a counter effect on the available remaining budget, as their increase will lead to higher national efforts to cover the necessary co-financing.

9.1.10 Following this hierarchical approach, the structure of the financial plan for 2014-2020 and 2021-2030 is described in Table 9.1 attached.

[41] Romanian Government letter no. 57338 submitted to European Commission on 09/12/2013
[42] MT DG SMAE letter no. 8179 on 11.03.2014

Table 9.1. Structure of GTMP Financial Plan 2014-2030

2% from GDP available for the transport sector	**A**		2% of GDP over the 2014-2030 period, in real terms
Maintenance and renewal costs	B_1		Considers a gradual increase in maintenance for the road, rail and waterways networks
Rehabilitation works for the viable road network	B_2		Includes the treatment of backlog road rehabilitation works
Available Public Funds for new investments, from which	**C**	**$=A-B_1-B_2$**	Represents the available funds after the deduction of the mandatory financial allocations related to maintenance, renewals and rehabilitation
EU Contribution	C_1		Estimated total funds are: CF: 3.404 bn EUR, ERDF: 1.728 bn EUR, CEF: 1.200 bn EU (source: MT, according to provisions in 2014-2020 POIM)
National Co-financing[43]	C_2		25% from total eligible costs for projects funded by CF and ERDF 15% from total eligible costs for projects funded by CEF
Sustainability indicator/Net National Funds	**D**	**$=C-C_1-C_2$**	Represents one of the key figures in the financial plan. It shows the available net national funds after the deduction from **C** of the EU funds (**C_1**) and the corresponding national co-financing (**C_2**). If **D** > 0 then the financial plan is sustainable – this means that the EU funded projects can be supported from the National Budget (the 2% of GDP) considering in advance the mandated expenditures included in **B_1** and **B_2**.
Phased projects and Bucharest Metro	E		Includes the investment backlog for projects started in the 2007-2013 operational programme that will continue after 2014 (total estimated budget is 2.489 bn EUR) in addition to the allocations for metro projects (estimated budget of 0.727 bn EUR). Source of the data is MT.
Available for GTMP projects (total incl. EU + national)	**F**	**=C-E**	Represents the available funds for transport investments. Taking in consideration the potential financial corrections and the national overcommitment estimated at 30% the total available funds are equal to **G**.
+ 30% Overcommitment	**G**	**=F*1.3**	Includes the financial corrections and potential projects contracted over the initial budget allocations
Rail rehabilitation backlog	**H**		Not included, as treatment of rail rehabilitation backlog is one of the key requirements identified as part of the Master Plan process. Rail rehabilitation costs are being prioritised and determined as part of the Master Plan and will therefore being funded out of the remaining available budget
Available for GTMP projects excluding rail rehabilitation backlog	**I**	**=G-H**	Represents the available estimated budget for Master Plan projects following the treatment of rail rehabilitation backlog

Source: AECOM, MT

[43] AECOM was informed by MT that the National co-financing for the EU Funded projects (Cohesion Funds and European Regional Development Fund), part of the 2014-2020 Operational Programme – Transport, is to be considered at 25% of the total eligible costs; a national co-financing rate of 15% is to be considered for the CEF programme

Historical Context

9.1.11 As part of the process of identifying the investment needs for the transport sector, MT produced in June 2013 an analysis on the past expenditures for transport[44]. This analysis included the real historical costs for each transport mode, during 2007-2012 and estimations for year 2013.

Table 9.2. Total expenditures for transport and percentage from GDP, 2007-2013 ('000 lei)

Year	Total for transport	GDP	% of GDP
2007	1.613.269	416.006.800	0,39
2008	3.670.717	514.700.000	0,71
2009	6.428.839	501.139.400	1,28
2010	6.502.971	523.693.300	1,24
2011	7.129.614	556.708.400	1,28
2012	8.036.044	587.466.400	1,37
2013	10.562.387	599.215.728	1,76

Source: MT

9.1.12 Based on these historical figures and on the assessment of future investment needs,

- 2015 2.15%
- 2016 2.35%
- 2017 2.00%
- 2018 2.00%
- 2019 2.00%
- 2020 2.00%

GDP Forecast Scenario

9.1.13 The assumptions for the GDP forecast scenario were:

o For the period 2014-2017, the source is the latest available GDP forecasts published by the National Committee of Prognosis[45]. It considers the following real growth rates:

- 2015 2.5%
- 2016 3.0%
- 2017 3.3%

o After year 2017, the National Transport Model central forecasts were used (a real increase of 3.5% p.a.)

9.1.14 The estimated GDP for year 2014, according to CNP, is 664.4 bn Lei, representing a real increase of 2.3% compared to 2013.

9.2 Mandated Expenditure for Maintenance and Renewals

9.2.1 As stated in section 11.1, the available funds for new investments will be determined after the deduction of the necessary expenditures for maintenance and renewals.

[44] MT letter no. 26515 submitted to Ministry of Finance on 11/06/2013
[45] http://cnp.ro/user/repository/prognoza_macroeconomica_2014--2017.pdf

- (**B_1**) Rail maintenance was determined as per AECOM analysis of spend required to cover maintenance and repairs on rail network which retains 55% of entire current network including lines within stations and sidings and 99% of passenger/freight tonne kms Rail network; it comprises a gradual increase from the current expenditure of 324 mill EUR to the desired level of 532 mill EUR, over a period of 6 years (see Section 6.5).
- (**B_1**) Road maintenance considers an estimate of Maintenance and Renewal Costs based on World Bank Cost Recovery Model; it comprises a gradual increase from the current expenditure of 191 mill EUR to the desired level of 679 mill EUR, over a period of 6 years (see Section 5.6);
- (**B_1**) For the Danube fairway maintenance works, a significant increase was considered (up to 25 million EUR per year, according to the needs assessment, based on the analysis of the existing conditions). See Section 8 for additional details.
- (**B_2**) Road rehabilitation backlog was calculated based on AECOM estimates of Rehabilitation Costs (Lifecycle) using World Bank Cost Recovery Financial Model, with current status of pavement based on information provided by CNANDR. It was assumed that rehabilitation/removal of backlog will be completed in 2020, considering a gradual increase over the first 6 years period, with road lifecycle costs post 2020 coming under standard renewals (see Section 5.6). The total estimated corresponding budget is 4.578 bn EUR over the 2014-2020 period, equivalent to 654 mill EUR per annum.
- Rail rehabilitation backlog will be treated part of the Master Plan process of identifying and prioritising interventions. See Section 6.5 for further details.

9.3 Available Expenditure for Investment

9.3.1 Based on the methodology described in section 11.1 and on the committed expenditures estimated in section 11.2, the total available budget for investments in the transport sector is estimated, for the timelines 2020 and 2030.

9.3.2 Following consultations with MT, an assumed distribution on modes was established, considering the provisions of the 2014-2020 Operational Programme for Transport. These were extrapolated further to the 2021-2030 period. The assumed distribution on modes and specific investments for year 2020 is:

- 51% - road transport
  - 90% - construction of new motorways and expressways
  - 2% - safety interventions
  - 3% - construction of bypasses
  - 5% - modernisation of national roads
- 44% - rail transport
- 5% - investments in ports and waterways, aviation and intermodal, out of which:
  - 66% - ports and waterways
  - 21% - aviation
  - 13% - intermodal transport

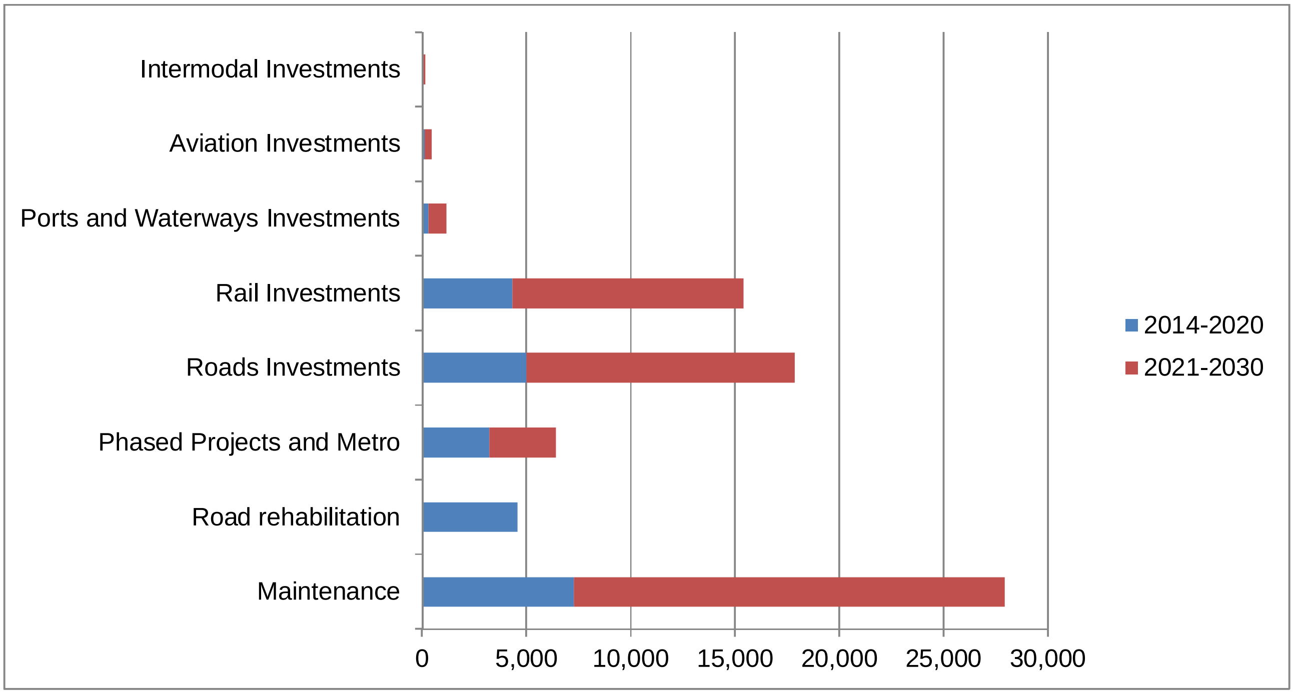
9.3.3 The headline figures of the financial plan are presented in Table 9.3 and illustrated in Figure 9.1.

Table 9.3 Distribution of expenditures in the transport sector for 2014-2020 and 2021-2030 (mill EUR, 2014 fixed prices)

			2014-2020		2021-2030		2014-2030	
2% from GDP available for the transport sector	**A**		**22,599**		**43,216**		**65,815**	
Maintenance and lifecycle costs	B1		7,260	32.1%	20,650	47.8%	27,910	42.4%
Rehabilitation works for the viable road network	B2		4,578	20.3%	0	0.0%	4,578	7.0%
Available Public Funds for investments, including EU and National Contribution, from which	**C**	**=A-B1-B2**	**10,761**	**47.6%**	**22,566**	**52.2%**	**33,327**	**50.6%**
EU Contribution	C1		6,332		9,046		15,378	
National Co-financing	C2		1,922		2,746		4,669	
Sustainability indicator/Net National Funds	**D**	**=C-C1-C2**	**2,507**		**10,774**		**13,281**	
Phased projects and Bucharest Metro	E		3,441		3,200		6,641	
Available for GTMP projects (total inc. EU + national)	**F**	**=C-E**	**7,320**	**32.4%**	**19,366**	**44.8%**	**26,686**	**40.5%**
+ 30% Overcommitment	**G**	**=F*1.3**	**9,516**		**25,176**		**34,692**	
Roads			**4,853**	***51%***	**12,840**	***51%***	**17,693**	***51%***
Construction of Motorways and Expressways			**4,368**	90%	**11,556**	90%	**15,924**	90%
Safety Interventions			**100**	2%	**50**	0%	**150**	1%
Construction of Bypasses			**130**	3%	**834**	6%	**964**	5%
Modernisation of National Roads			**255**	5%	**400**	3%	**655**	4%
Rail			**4,187**	***44%***	**11,077**	***44%***	**15,265**	***44%***
IWT, Aviation, Intermodals			**476**	***5%***	**1,259**	***5%***	**1,735**	***5%***
Ports, IWT			**324**	68%	**832**	66%	**1,156**	67%
Aviation			**89**	19%	**357**	28%	**446**	26%
Intermodal			**63**	13%	**70**	6%	**133**	8%

Source: AECOM GTMP Financial Plan

Figure 9.1. Distribution of funds on expenditure categories and modes (billion EUR, 2014 fixed prices)



Source: AECOM GTMP Financial Plan

9.3.4 Some key conclusions are included below:

- o Between 2014-2030, the committed expenditures for maintenance and treatment of rehabilitation backlog amount to more than 50% of the total available budget. This would require a firm commitment from the Romanian Government to assure the needed financial resources to cover these allocations. This is a critical factor in the development of a sustainable transport sector.
- o 2% of GDP represents a significant increase from historic average of 1.15% for 2007-2013 (Table 9.2).
- o There is a significant increase in the available average budget per annum, from 1.078 bn EUR (2014-2020) to 1.937 bn EUR (2021-2030). This is due to the assumed real increase in GDP.
- o After 2020, treatment of road rehabilitation backlog is included in the maintenance costs.

9.3.5 The funding allocations by sector are then used in the development of the prioritised Investment Plan, discussed in Section 12.

Overall Strategy, 2020 and 2030

10 Overall Strategy, 2020 and 2030

10.1 Introduction

10.1.1 The General Transport Master Plan (GTMP) represents a unique opportunity for Romania. For the first time Romania will have a soundly-based, comprehensive plan for all the major modes of transport, for the period up to 2030. It provides a staged programme of interventions which encompass not only proposals to improve the transport infrastructure, but also dealing with maintenance, management and operations, and safety.

10.1.2 Providing good-quality transport is not an end in itself. Efficient transport is a critical component of economic development, globally and nationally. Transport availability affects global development patterns and can be a boost or a barrier to economic growth within individual nations. Transportation investments link factors of production together in a web of relationships between producers and consumers to create a more efficient division of production, leverage geographical comparative advantage, and provide the means to expand economies of scale and scope.

Existing Situation

10.1.3 The Plan involved a thorough investigation of the existing conditions, problems and their underlying causes. Across all modes, four common themes emerged:

o Romania has a serious **infrastructure deficit**, in terms of its quality: coverage of the transport networks is generally good.

o **Inadequate Maintenance and Renewals,** particularly of the rail networks has been inadequate leading to a decline in level of service and reliability, and contributing to a decline in passenger volumes especially, and to a lesser extent, freight volumes.

o This situation is largely a result of inadequate finance over a long period of time, but it is exacerbated by **Management and Operating practices**, which affect rail, road and water transport, but again rail is particularly adversely affected.

o **Safety** is a concern, particularly on the road network where Romania has the worst safety record in Europe.

10.1.4 In our opinion, it is no exaggeration to say that Romanian Railways are in a crisis situation. Several steps are required. These include:

- serious reforms to the structure of the railway and the PSC,
- substantially increased spending on maintenance and renewals to prevent further deterioration,
- increased investment in rehabilitation to current design speeds, and
- the introduction of regular interval timetable, convenient for passenger needs.

Unless these steps are taken, within 10 years the railway will cease to play a national role in Romania.

10.1.5 Since 1990 passenger kilometres have fallen by 90%, and freight kilometres by 70%, although the position with rail freight has stabilised. Average speeds for passenger trains have fallen to 45kph in 2012 from 60kph in 1990, and the average speed of freight trains is a mere 23kph. Between 60-80% of the track-related assets are life expired, there were 1,800 temporary speed restrictions in 2012, and we estimate that current speeds are 20-30% below the design speed of the track. The track and other fixed assets are under-utilised: about 90% of traffic (both passengers and freight) is transported on 54% of the routes (63% of track-km), whilst about 20% of the routes (14% of track-km) carry only 1% of the traffic. 1,000 stations generate less than 50 trips per day and 533 stations have less than 10 passengers per day.

10.1.6 A trend-based forecast suggests that passenger kilometres would decline by a further 75% by 2030, while the NTM analysis suggests a decline of 21% by 2020 and 40% by 2030. Whichever forecast is assumed, the future is bleak without drastic action.

10.1.7 Road maintenance is also inadequate, with only 50% of the National Road network in good condition. The estimate using the method developed for the World Bank suggests that regular maintenance and renewals expenditure should increase by €560 and rehabilitation and modernisation by €650m per annum to clear the backlog up to 2020.

10.1.8 The level of service provided by the road network is generally poor, in terms of average speeds. These are 66 kph on the National Road network, 44% below the target of 100kph for the EU Core and Comprehensive Netoworks.

10.1.9 For waterways, Romania spends 11,300 EUR per km maintaining the section of the Danube for which it is responsible, compared with 250,000 EUR per km, which is spent by Austria. Romania's Danube users rely on maintenance by Bulgaria on its section, and the latest information we have is that Bulgaria currently spends only 2,100 EUR per km.

Overall Objectives

10.1.10 A series of high-level objectives for the Master Plan were formulated which guided the formulation of interventions proposed for the Plan. These are:

o **Economic Efficiency**: the transport system should be economically efficient as far as transport operations and users themselves are concerned. Specifically, the benefits of investments in transport should exceed the cost of that investment.

o **Sustainability:** the transport system must economically, financially and environmentally sustainable.

o **Safety**: investment in transport should produce a safer transport system. Environmental Impact: Transport investment should minimise negative impact on the physical environment.

10.1.11 Below these objectives, operational objectives were established for each mode based on a detailed, location-specific analysis of the problems which each mode experiences. Extensive consultations were carried with stakeholders in both the public and private sector as part of the problem analysis.

Funding

10.1.12 We invited the Ministry of Transport and stakeholders to submit their proposals and aspirations for their own areas of responsibility. The value of the interventions they proposed, which were predominantly for new or improved infrastructure, amounted to €74.8 bn. The funds available for infrastructure projects are €9.5 bn to 2020, and €24.7 to 2030. Thus the available funds represent less than half of the aspirations of the project sponsors.

10.1.13 The Master Plan cannot generate additional funding, but it can ensure that, in a situation where funding is limited, the available funds are allocated to areas where they provide the greatest benefit. The AECOM team, in conjunction with the Ministry of Transport and JASPERS, developed a series of interventions which include, but are not limited to, infrastructure interventions. The projects and interventions were the outcome of the methodology described in Chapter 2, and are described in full in the modal chapters. In some cases these corresponded to projects proposed by stakeholders, but in many cases the projects were different, or scaled back in scope to meet the determined demand or specific problem.

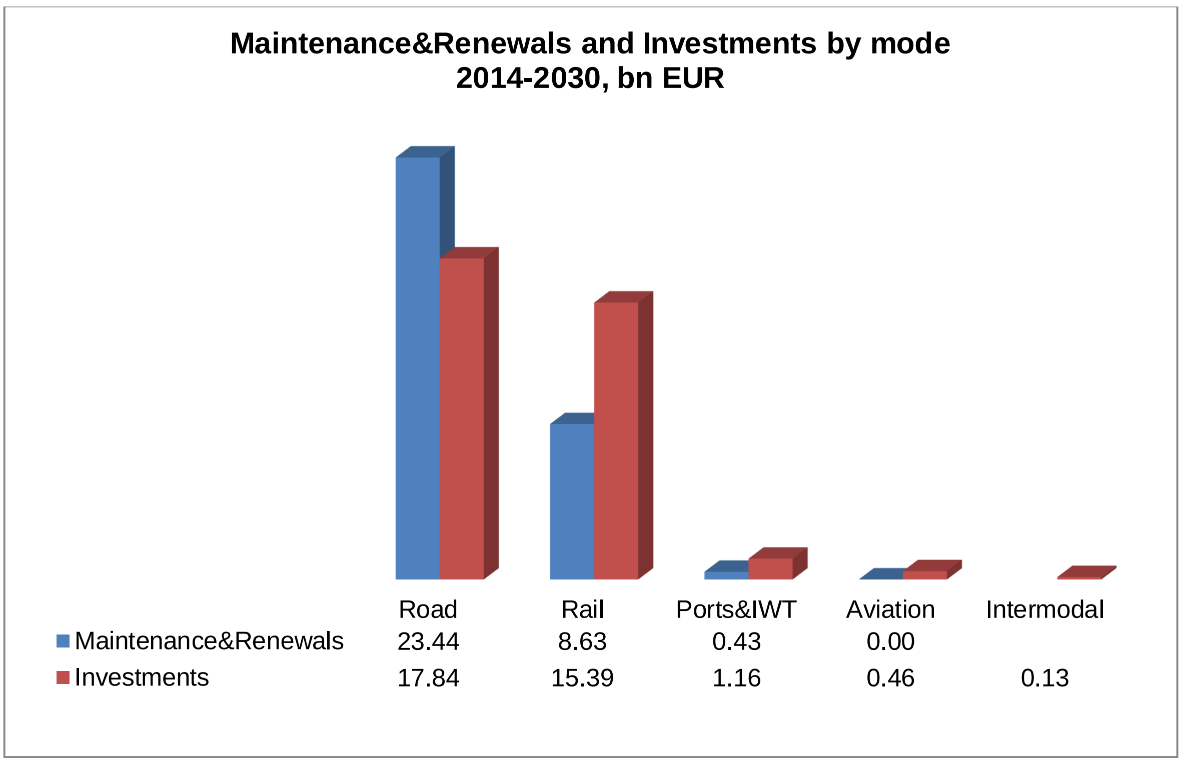
10.1.14 The analysis of the existing and future situations highlighted the serious shortcomings in maintenance and renewals on the railways and roads. The overall strategy therefore has two main pillars:

o The protection of existing assets by ring-fencing long term financing for improved maintenance and renewals. This will benefit all Romanian citizens (and visitors) who use the countries' transport systems; and

o Selected infrastructure improvements, which gave the best value for money, and met the operational objectives.

10.1.15 The budget allocation between these two pillars is split 44% on maintenance and renewals, and 56% on infrastructure improvements. This reflects the importance the Plan places on sustainable, long term financing for maintenance and renewals activities. We have also included the current spending on these activities, as best as we can judge from data supplied by CFR SA and CNADNR.

Figure 10.1 Funding Allocation between Maintenance and Renewals and New Infrastructure



Source: AECOM GTMP Financial Plan

10.1.16 The rehabilitation of rail corridors is included in the allocation for investment. This is because it includes a complete approach to rehabilitation, including the restoration of design speeds, re-signalling, renewal of the power supply, refurbishment of main stations, including the provision of real-time passenger information, and most importantly the provision of regular interval services and additional rolling stock.

10.1.17 The proposals for each mode of transport are described in sections 10.2-7, with an analysis of the complete strategy in 10.8-10.10.

10.2 Road Sector, 2020 and 2030

10.2.1 The process for developing the roads strategy is fully described Chapter 4. The 2020 and 2030 proposals are shown on Tables 10.1-3, for the ES, EES and Core Ten-T scenarios respectively.

Table 10.1 List of road investments – ES Scenario

		Code	Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
		H0	Safety Interventions	n/a	n/a	**18.5%**	150.0	150.0	2014-2020
1	Selected Level 1	H7	Sibiu-Brasov Motorway	Comprehensive TEN-T link	74.3	**17.3%**	689.8	689.8	2014-2020
2		H8	Ploiesti-Comarnic Motorway	Comprehensive TEN-T link	48.7	**12.5%**	310.4	1,000.3	2014-2020
3		H6	Craiova-Pitesti Motorway	Comprehensive TEN-T link	47.3	**12.2%**	870.3	1,870.6	2014-2020
4		H1	Comarnic-Brasov Motorway	Comprehensive TEN-T link	29.3	**8.8%**	1,117.0	2,987.5	2014-2020
5		H12	Brasov-Bacau Motorway	Comprehensive TEN-T link	20.1	**7.1%**	2,067.6	5,055.2	2021-2030
1	Level 2	OR18B	Bucharest Southern Ring Road Upgrade	Core TEN-T link	100.0	**14.5%**	175.7	5,230.9	2014-2020
2		OR7A	Bacau-Suceava Expressway	Core TEN-T link	86.3	**12.6%**	645.4	5,876.3	2021-2030
3		OR13C	Buzau-Focsani Expressway	Core TEN-T link	81.6	**12.0%**	282.0	6,158.3	2021-2030
4		OR7B	Suceava-Siret Expressway	Core TEN-T link	79.1	**11.7%**	186.1	6,344.4	2021-2030
5		OR10	Lugoj- Craiova Expressway	Core TEN-T link	66.6	**10.0%**	1,810.9	8,155.3	2021-2030
6		OR9B	Turda-Halmeu Expressway	Other links	63.0	**13.5%**	975.4	9,130.7	2021-2030
7		OR15	Sibiu-Pitesti Expressway	Core TEN-T link	61.4	**9.3%**	1,976.9	11,107.6	2021-2030
8		OR17	Gaesti-Ploiesti-Buzau-Braila Expressway	Comprehensive TEN-T link	60.0	**11.9%**	1,279.6	12,387.2	2021-2030
9		OR13	Targu Mures-Pascani Expressway	Core TEN-T link	55.0	**8.4%**	3,550.0	15,937.2	2021-2030
10		OR6B	Bacau-Focsani-Braila-Galati Expressway	Comprehensive TEN-T link	54.4	**11.2%**	1,024.2	16,961.4	After 2030
11		OR19	Bucuresti-Alexandria-Craiova Expressway	Core TEN-T link	52.8	**8.1%**	951.8	17,913.2	After 2030
12		OR13D	Pascani-Iasi-Ungheni Expressway	Core TEN-T link	47.7	**7.4%**	550.0	18,463.2	After 2030
13		OR8	Bacau-Piatra Neamt Expressway	Other links	41.2	**10.6%**	335.1	18,798.3	After 2030
14		OR12	Gilau-Bors Expressway	Comprehensive TEN-T link	39.9	**9.2%**	1,533.6	20,331.9	After 2030
15		OR14	Brasov-Pitesti Expressway	Comprehensive TEN-T link	39.0	**9.1%**	1,842.6	22,174.6	After 2030
16		OR7C	Suceava-Botosani Expressway	Other links	28.4	**8.9%**	345.8	22,520.3	After 2030
17		OR11	Constanta-Tulcea-Braila Expressway (including Braila Bridge)	Comprehensive TEN-T link	11.9	**5.4%**	1,369.3	23,889.7	After 2030
1	Bypasses	BP12	Adjud	Core TEN-T link	85.4	**19.0%**	46.2	46.2	2014-2020
2		BP10	Targoviste	Comprehensive TEN-T link	79.0	**22.7%**	78.0	124.2	2014-2020
3		BP4	Roman	Core TEN-T link	73.2	**15.9%**	62.0	186.1	2021-2030
4		BP11	Filiasi	Core TEN-T link	71.8	**15.6%**	27.7	213.8	2021-2030
5		BP15	Falticeni	Core TEN-T link	62.4	**13.2%**	41.3	255.1	2021-2030
6		BP5	Focsani	Core TEN-T link	62.1	**13.1%**	76.1	331.2	2021-2030
7		BP3	Sighisoara	Comprehensive TEN-T link	51.8	**15.8%**	47.7	378.9	2021-2030
8		BP7	Buzau	Core TEN-T link	39.7	**7.5%**	104.8	483.7	2021-2030
9		BP6	Ramnicu Sarat	Core TEN-T link	37.1	**6.8%**	37.0	520.7	2021-2030
10		BP9	Ramnicu Valcea	Core TEN-T link	34.8	**6.2%**	195.4	716.1	2021-2030
11		BP14	Ludus	Comprehensive TEN-T link	33.5	**11.2%**	102.5	818.6	2021-2030
12		BP16	Caransebes	Core TEN-T link	32.6	**5.7%**	80.8	899.4	2021-2030
13		BP17	Beclean	Comprehensive TEN-T link	22.6	**8.4%**	42.2	941.6	2021-2030

Source: AECOM GTMP Project Prioritisation

Table 10.2 List of road investments – EES Scenario

		Code	Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
		H0	Safety Interventions	n/a	n/a	**18.5%**	150.0	150.0	2014-2020
1	Selected Level 1	H7	Sibiu-Brasov Motorway	Comprehensive TEN-T link	57.6	**17.3%**	689.8	689.8	2014-2020
2		H8	Ploiesti-Comarnic Motorway	Comprehensive TEN-T link	39.4	**12.5%**	310.4	1,000.3	2014-2020
3		H6	Craiova-Pitesti Motorway	Comprehensive TEN-T link	34.4	**12.2%**	870.3	1,870.6	2014-2020
4		H1	Comarnic-Brasov Motorway	Comprehensive TEN-T link	15.5	**8.8%**	1,117.0	2,987.5	2014-2020
5		H12	Brasov-Bacau Motorway	Comprehensive TEN-T link	14.9	**7.1%**	2,067.6	5,055.2	2021-2030
1	Level 2	OR18B	Bucharest Southern Ring Road Upgrade	Core TEN-T link	71.0	**14.5%**	175.7	5,230.9	2014-2020
2		OR7A	Bacau-Suceava Expressway	Core TEN-T link	70.2	**12.6%**	645.4	5,876.3	2021-2030
3		OR7B	Suceava-Siret Expressway	Core TEN-T link	65.1	**11.7%**	186.1	6,062.4	2021-2030
4		OR13C	Buzau-Focsani Expressway	Core TEN-T link	60.8	**12.0%**	282.0	6,344.4	2021-2030
5		OR6B	Bacau-Focsani-Braila-Galati Expressway	Comprehensive TEN-T link	46.5	**11.2%**	1,024.2	7,368.6	2021-2030
6		OR9B	Turda-Halmeu Expressway	Other links	44.0	**13.5%**	975.4	8,344.0	2021-2030
7		OR17	Gaesti-Ploiesti-Buzau-Braila Expressway	Comprehensive TEN-T link	43.4	**11.9%**	1,279.6	9,623.6	2021-2030
8		OR10	Lugoj- Craiova Expressway	Core TEN-T link	40.1	**10.0%**	1,810.9	11,434.5	2021-2030
9		OR19	Bucuresti-Alexandria-Craiova Expressway	Core TEN-T link	37.3	**8.1%**	951.8	12,386.3	2021-2030
10		OR15	Sibiu-Pitesti Expressway	Core TEN-T link	36.4	**9.3%**	1,976.9	14,363.2	2021-2030
11		OR12	Gilau-Bors Expressway	Comprehensive TEN-T link	36.1	**9.2%**	1,533.6	15,896.8	2021-2030
12		OR13D	Pascani-Iasi-Ungheni Expressway	Core TEN-T link	33.6	**7.4%**	550.0	16,446.8	2021-2030
13		OR7C	Suceava-Botosani Expressway	Secondary connectivity with TEN-T	32.3	**8.9%**	345.8	16,792.6	After 2030
14		OR13	Targu Mures-Pascani Expressway	Core TEN-T link	31.9	**8.4%**	3,550.0	20,342.6	After 2030
15		OR14	Brasov-Pitesti Expressway	Comprehensive TEN-T link	25.4	**9.1%**	1,842.6	22,185.2	After 2030
16		OR8	Bacau-Piatra Neamt Expressway	Other links	19.4	**10.6%**	335.1	22,520.3	After 2030
17		OR11	Constanta-Tulcea-Braila Expressway (including Braila Bridge)	Comprehensive TEN-T link	17.1	**5.4%**	1,369.3	23,889.7	After 2030
1	Bypasses	BP10	Targoviste	Comprehensive TEN-T link	57.0	**22.7%**	78.0	78.0	2014-2020
2		BP12	Adjud	Core TEN-T link	56.6	**19.0%**	46.2	124.2	2014-2020
3		BP4	Roman	Core TEN-T link	47.9	**15.9%**	62.0	186.1	2021-2030
4		BP11	Filiasi	Core TEN-T link	46.9	**15.6%**	27.7	213.8	2021-2030
5		BP15	Falticeni	Core TEN-T link	40.1	**13.2%**	41.3	255.1	2021-2030
6		BP5	Focsani	Core TEN-T link	39.9	**13.1%**	76.1	331.2	2021-2030
7		BP3	Sighisoara	Comprehensive TEN-T link	37.6	**15.8%**	47.7	378.9	2021-2030
8		BP14	Ludus	Comprehensive TEN-T link	24.5	**11.2%**	102.5	481.3	2021-2030
9		BP7	Buzau	Core TEN-T link	23.9	**7.5%**	104.8	586.2	2021-2030
10		BP6	Ramnicu Sarat	Core TEN-T link	22.0	**6.8%**	37.0	623.2	2021-2030
11		BP9	Ramnicu Valcea	Core TEN-T link	20.5	**6.2%**	195.4	818.6	2021-2030
12		BP17	Beclean	Comprehensive TEN-T link	19.7	**8.4%**	42.2	860.8	2021-2030
13		BP16	Caransebes	Core TEN-T link	18.9	**5.7%**	80.8	941.6	2021-2030

Source: AECOM GTMP Project Prioritisation

Table 10.3 List of road investments – Core TEN-T Scenario

		Code	Project Description	TEN-T	Score	Lungime	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
		H0	Safety Interventions	n/a	n/a	n/a	**18.5%**	150.0	150.0	2014-2020
1	Completion of TEN-T Core	OR18B	Bucharest Southern Ring Road Upgrade	Core TEN-T link	100.0	35.0	**14.5%**	175.7	175.7	2014-2020
2		H2	Sibiu-Pitesti Motorway	Core TEN-T link	74.7	119.7	**12.1%**	2,471.2	2,646.9	2014-2020
2a		H11a	Ploiesti-Bacau Motorway	Core TEN-T link	63.6	200.0	**11.0%**	1,700.0	4,346.9	2014-2020
3		H11	Bacau-Suceava-Siret Motorway	Core TEN-T link	63.6	224.7	**11.0%**	1,781.3	6,128.1	2021-2030
4		H15	Targu Mures-Iasi-Ungheni Motorway	Core TEN-T link	39.4	285.0	**8.7%**	5,056.3	11,184.4	2021-2030
5		H28	Lugoj - Craiova Motorway	Core TEN-T link	28.5	246.3	**7.7%**	2,399.2	13,583.6	2021-2030
6		H9	Bucharest-Alexandria-Craiova Motorway	Core TEN-T link	23.0	195.0	**7.2%**	1,189.8	14,773.4	2021-2030
7		H10	Craiova-Calafat Motorway	Core TEN-T link	2.3	70.0	**5.2%**	419.2	15,192.6	2021-2030
8		H29	Drobeta - Calafat Motorway (including H28)	Core TEN-T link	0.0	76.9	4.5%	482.0	15,674.6	2021-2030
9		H27	Timisoara - Moravita Motorway	Core TEN-T link	0.0	76.9	3.7%	470.4	16,145.1	After 2030

Source: AECOM GTMP Project Prioritisation

10.2.2 The review of the prioritisation process led to some minor changes to the road projects. These were:

o The direct link from Bacau to Iasi (part of the Brasov – Bacau – Iasi scheme) was replaced by the route via Pascani, and extended to the Moldovan border. This was done because of very difficult ground conditions on the direct route, and because Pascani – Iasi is a well-used route with a significant economic need as demonstrated by the "lost time" analysis (see chapter 5).

o The Buzau-Focsani link added as it formed a "missing link" on the route between Ploiesti and Focsani, and forecasts showed it was carrying high traffic volumes.

o The Campia Turzii-Targu Mures motorway had recently obtained funding under the 2007 – 2013 Operational Programme, and it was therefore added to schemes to be completed by 2020.

o Following the analysis of EES Scenario results (recommended), expressway Bucharest-Alexandria-Craiova has been identified as a priority. This was tested as a Level 2 project and was integrated in the prioritization procedure.

o Considering the advanced degree of maturity of Gilau-Bors project, the standard was modified from expressway to motorway, having in view the fact that he acquisition procedures for the execution works are in an advanced stage. The project has been re-evaluated from this perspective and the Strategy Report will define its period of implementation.

10.2.3 Some identified bypasses are part of larger Level 1 or Level 2 projects. The decision to advance these proposals as separate projects will be determined within the Implementation Strategy which will examine the funding opportunities and the maturity of each project. If the more significant project appears as feasible early in the implementation plan, then a separate bypass will not be needed. A value for money analysis based ont he lifetime forecast for the bypass as an individual entity will determine the adequate solution..

10.2.4 In each of these three scenarios there will be included the interventions on rehabilitation and modernisation of national roads. The available budgets for 2020 and 2030 were considered for the prioritisation of these interventions, as shown in Table 10.4.

Table 10.4 List of road investments – rehabilitation of national roads

Nr.	Denumire proiect	Lungime (km)	Cost estimat (preturi 2014, mil EUR, fara TVA)	Stare tehnica	Indicator Deservire a populatiei	Indicator Mobilitate Urbana	Scor MCA	Cost cumulat	Perioada de implementare
1	Galati - Giurgiulesti (MD si UA)	6	3.5	5.00	90388	0.90	5.00	3.5	2014-2020
2	A1 - Timisoara - Moravita (SRB)	59	29.5	3.90	8577	0.67	4.05	33.0	2014-2020
3	Braila - Slobozia - Dranjna (A2) - Calarasi - Chiciu (BG)	142	71.0	2.33	7289	0.71	3.46	104.0	2014-2020
4	Brasov - Sighisoara - Tg Mures (DE 3)	161	102.1	2.64	7353	0.65	3.42	206.1	2014-2020
5	A5 - Sf. Gheorghe - B. Tusnad - Miercurea Ciuc - Ditrau (DE 3)	147	79.1	3.32	5928	0.65	3.16	285.2	2014-2020
6	Bucuresti - Alexandria - Rosiori - Caracal – Craiova	206	103.0	2.89	8698	0.46	3.15	388.2	2021-2030
7	Iasi - Vaslui - Bacau - Piatra Neamt - Tg. Neamt - DE 3	251	158.9	3.38	6702	0.49	3.09	547.1	2021-2030
8	Braila - Focsani - A5 - Tg. Secuiesc	205	125.8	2.37	6287	0.60	2.99	672.9	2021-2030
9	A3 (Oradea) - Carei - Satu Mare - DE 4	137	68.5	2.88	5881	0.54	2.74	741.4	Dupa 2030
10	Bucuresti - Giurgiu (BG)	55	41.3	2.02	11041	0.35	2.71	782.7	Dupa 2030
11	Corabia - Caracal - Dragasani - Rm. Valcea - DE 1	199	112.4	2.61	5234	0.37	2.41	895.1	Dupa 2030
12	Craiova - Calafat (BG)	83	41.5	1.00	7977	0.56	2.40	936.6	Dupa 2030
13	A1 - Arad - Salonta - Oradea	122	60.5	1.15	6081	0.63	2.37	997.1	Dupa 2030
14	Saratel - Reghin - Tg Mures	78	44.0	1.00	9154	0.49	2.20	1,041.1	Dupa 2030
15	Drobeta Tr. Severin - Calafat (BG)	96	50.8	2.22	4308	0.41	1.91	1,091.9	Dupa 2030
16	Botosani - Suceava - Vatra Dornei - Bistrita - Saratel -Dej	285	178.4	2.03	4387	0.40	1.82	1,270.3	Dupa 2030
17	Iacobeni - Borsa - S.Marmatiei - Negresti Oas - DE 4	235	159.1	2.03	3359	0.53	1.71	1,429.4	Dupa 2030
18	Caransebes - Resita - Bocsa - Voiteg	104	62.6	1.83	3231	0.52	1.62	1,492.0	Dupa 2030
19	Filiasi - Tg. Jiu - Petrosani - Hateg - Deva - A1	226	136.5	1.08	4518	0.57	1.54	1,628.5	Dupa 2030
20	A1 (Deva) - Brad - Stei - Oradea - A3	197	124.3	1.00	4197	0.57	1.50	1,752.8	Dupa 2030

10.3 Rail Sector, 2020 and 2030

10.3.1 The development of the rail strategy is described in detail in Chapter 5. The 2020 and 2030 proposals are shown on Table 10.5, for both ES and EES scenarios, which are identical.

Table 10.5 List of rail investments – ES and EES Scenarios

	Code		Project Description	TEN-T	Score	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1		DS10B	Bucharest to Giurgiu via Gradistea. Rehabilitation to design speed and electrification.	Core TEN-T link	80.0	**12.0%**	225.5	225.5	2014-2020
2		DS02A	Bucharest to Constanta. Rehabilitation to design speed.	Core TEN-T link	74.0	**68.4%**	21.8	247.3	2014-2020
3		DS05B	Bucharest to Sibiu via Pitesti and Ramnicu Valcea. New link, rehabilitation to design speed and	Comprehensive TEN-T link	33.0	**8.2%**	1,245.3	1,492.6	2014-2020
4		DS04A	Bucharest to Iasi via Bacau + Buzau to Galati + Pascani to Ukraine. Rehabilitation to design speed.	Core TEN-T link	32.6	**6.2%**	3,335.6	4,828.2	2021-2030
5		DS11A	Craiova to Calafat. Rehabilitation to design speed.	Core TEN-T link	30.0	4.5%	183.4	5,011.6	2021-2030
6	Rail	DS03A	Bucharest to Arad via Craiova and Timisoara. Rehabilitation to design speed.	Core TEN-T link	26.6	**5.4%**	2,423.1	7,434.7	2021-2030
7		DS01A	Bucharest to Hungary via Brasov + Teius to Cluj. Rehabilitation to design speed.	Core TEN-T link	26.3	**5.3%**	1,740.4	9,175.2	2021-2030
8		DS06A	Cluj-Napoca to Iasi. Rehabilitation to design speed.	Core TEN-T link	24.0	0.3%	2,791.1	11,966.3	2021-2030
9		DS07C	Cluj-Napoca to Oradea, electrification.	Comprehensive TEN-T link	20.0	4.8%	211.1	12,177.4	2021-2030
10		DS07A	Cluj-Napoca to Oradea. Rehabilitation to design speed.	Comprehensive TEN-T link	20.0	-0.2%	653.4	12,830.8	2021-2030
11		DS08B	Oradea to Timisoara, Rehabilitation to design speed. Timisoara to Serbian border, rehabilitation to design	Comprehensive TEN-T link	14.0	1.1%	518.6	13,349.4	2021-2030

Source: AECOM GTMP Project Prioritisation

10.3.2 In the case of the rail projects, prioritisation led to some more fundamental changes. Taking into account the maturity of projects, the preparatory work undertaken, and the current progress with feasibility and design studies, the following adjustments were made:

o The project to complete the improvements to the Bucharest – Arad – Hungary, and Bucharest – Cluj corridor (Project DS01A) was added as a priority in 2020. The sections remaining to be completed are Predeal – Brasov, and Brasov – Sighisoara. The Masterplan recommendations include the introduction of a regular interval timetable as well as rehabilitation.

o There are €1.36bn of cost already committed to current upgrading of the lines west of Sighisoara, which together with other savings in the budget provides sufficient funds for the Bucharest - Iasi corridor upgrade to be completed as far as Sabaoani. The available budget for this project (Reference DS04A) in the 2014 - 2020 is 2.479 bn, and its total cost is €3.267bn.

o Three schemes performed very poorly in economic terms, having an EIRR of less than 3%; considering the available budget for rail investments, these were kept in the long list of projects.

10.4 Ports and Waterways, 2020 and 2030

10.4.1 The recommendations for Ports and Waterways are fully described in Chapter 6. The 2020 and 2030 proposals are shown on Table 10.6, for both ES and EES scenarios, which are identical.

Table 10.6 List of ports and waterways investments – ES and EES Scenarios

		Code	Project Description	TEN-T	Score	Length	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1	Ports, Waterways	P-GL-S	Galati Port	Core TEN-T link	74.0		**39.9%**	17.6	17.6	2014-2020
2		P-GR-S	Giurgiu Port	Core TEN-T link	51.7		**24.3%**	4.3	22.0	2014-2020
3		P-OT-S	Oltenita Port	Comprehensive TEN-T link	50.0		**30.1%**	5.6	27.5	2014-2020
4		P-DB-S	Drobeta Turnu Severin Port	Core TEN-T link	49.4		**22.8%**	17.3	44.9	2014-2020
5		P-CV-S	Cernavoda Port	Core TEN-T link	48.9		**22.4%**	6.9	51.8	2014-2020
6		P-OV-S	Olrsova Port	Comprehensive TEN-T link	42.4		**24.8%**	7.8	59.6	2014-2020
7		P-CB-S	Corabia Port	Other links	32.8		**25.1%**	4.5	64.1	2014-2020
8		W1	Dredging of the joint Romanian-Bulgarian sector of the Danube	Core TEN-T link	30.9		**19.6%**	103.3	167.4	2014-2020
9		P-CO-S	Constanta Port	Core TEN-T link	29.5		**8.9%**	351.1	518.5	2021-2030
10		P-MV-S	Moldova Veche Port	Comprehensive TEN-T link	17.2		**7.2%**	3.7	522.2	2021-2030
11		W36	Bucharest to Danube Canal Connection	Core TEN-T link	10.0		4.7%	1,500.8	2,023.0	After 2030

Source: AECOM GTMP Project Prioritisation

10.4.2 The Bucharest – Danube Channel could have commenced construction in the period 2020 – 2030. However, we are reluctant to recommend this project at this time, for several reasons:

o Bucharest is already well-connected to the east and west by rail and road, and one of the primary objectives of the Master Plan is to re-invigorate the railway. Testing with the National Model showed that the channel would have a significant, adverse impact on the Constanta – Bucharest – Craiova – Hungary rail corridor.

o The proposals for improvements to the Ports at Giurgiu and Oltenita gave very good economic value, with EIRR of 24% and 30% respectively, for modest investments of €4.3m and €5.6m respectively. If the Bucharest – Danube Channel were to be implemented, it would jeopardise these investments.

o The Channel is expensive and barely economically viable. It has an estimated cost of €1.5bn, and an EIRR of only 4.7%.

10.4.3 For these reasons we recommend that the viability of the Channel is re-examined in the mid 2020s when the impact of the Port improvements, and rail improvements, would become clearer.

10.5 Aviation, 2020 and 2030

10.5.1 Text.The proposals for the Aviation sector are described in Chapter 7. The 2020 and 2030 proposals are shown on Table 10.7, for both ES and EES scenarios, which are identical.

Table 10.7 List of aviation investments – ES and EES Scenarios

		Code	Project Description	TEN-T	Score	Length	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1	Aviation	A8	Oradea	Comprehensive TEN-T link	50.0		**48.0%**	1.2	1.2	2014-2020
2		A10	Sibiu	Comprehensive TEN-T link	34.8		**34.9%**	51.0	52.2	2014-2020
3		A11	Suceava	Comprehensive TEN-T link	31.2		**31.8%**	3.2	55.5	2014-2020
4		A3	Bucharest	Core TEN-T link	18.1		**12.0%**	247.3	302.7	2021-2030
5		A7	Iasi	Comprehensive TEN-T link	14.4		**17.4%**	10.8	313.5	2021-2030
6		A6	Craiova	Comprehensive TEN-T link	12.4		**15.7%**	46.6	360.1	2021-2030
7		A13	Timisoara	Core TEN-T link	10.9		**5.7%**	78.3	438.4	2021-2030
8		A16	Tulcea	Comprehensive TEN-T link	10.3		**13.8%**	17.0	455.4	2021-2030
9		A1	Bacau	Comprehensive TEN-T link	6.8		**10.9%**	86.6	542.0	After 2030
10		A2	Baia Mare	Comprehensive TEN-T link	6.3		**10.4%**	2.3	544.3	After 2030
11		A5	Constanta	Comprehensive TEN-T link	5.8		**10.0%**	1.6	545.9	After 2030
12		A4	Cluj	Comprehensive TEN-T link	3.6		**8.1%**	38.1	584.0	After 2030
13		A12	Targu Mures	Other links	1.1		**14.5%**	4.2	588.2	After 2030

Source: AECOM GTMP Project Prioritisation

10.5.2 As we describe in Section 7.1.3, the air passenger forecasts, and CBA, were made with a bespoke forecasting model. This is because passenger numbers at smaller airports are very volatile, as they are correlated closely with service provision, especially low-cost airlines. Thus, as we make clear in Chapter 9, the recommended interventions at the smaller airports should only proceed if there is certainty regarding increased flights.

10.6 Intermodal Transport, 2020 and 2030

10.6.1 The recommendations for Inter-Modal Terminals are fully described in Chapter 8. The 2020 and 2030 proposals are shown on Tables 10.8-9, for the ES, and EES scenarios respectively.

Table 10.8 List of intermodal investments – ES Scenarios

		Code	Project Description	TEN-T	Score	Length	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1	Intermodal	I-TM-S	Timisoara IMT	Core TEN-T link	100.0		**24.4%**	1.5	1.5	2014-2020
2		I-CJ-S	Cluj-Napoca IMT	Core TEN-T link	64.2		**14.5%**	5.3	6.8	2014-2020
3		I-BC-S	Bacau IMT	Core TEN-T link	63.9		**14.4%**	5.3	12.0	2014-2020
4		I-SU-S	Suceava IMT	Core TEN-T link	63.6		**14.3%**	5.3	17.3	2014-2020
5		I-BU-S	Bucharest IMT	Core TEN-T link	61.8		**13.8%**	18.0	35.3	2014-2020
6		I-IS-S	Iasi IMT	Core TEN-T link	55.4		**12.0%**	4.0	39.3	2014-2020
7		I-TU-S	Turda IMT	Core TEN-T link	35.8		**6.6%**	5.3	44.5	2014-2020
8		I-CR-S	Craiova IMT	Core TEN-T link	35.8		**6.6%**	18.0	62.5	2014-2020
9		I-DB-S	Drobeta Turnu Severin IMT	Core TEN-T link	32.2		**5.6%**	8.0	70.5	2021-2030
10		I-GL-S	Galati IMT	Core TEN-T link	30.0		4.7%	23.0	93.5	2021-2030
11		I-OR-S	Oradea IMT	Comprehensive TEN-T link	29.3		**10.6%**	5.3	98.8	2021-2030

Source: AECOM GTMP Project Prioritisation

Table 10.9 List of intermodal investments – EES Scenarios

		Code	Project Description	TEN-T	Score	Length	EIRR	Cost (2014 prices)	Cumulated Cost	Implementation period
1	Intermodal	I-TM-S	Timisoara IMT	Core TEN-T link	80.0		**24.4%**	1.5	1.5	2014-2020
2		I-CJ-S	Cluj-Napoca IMT	Core TEN-T link	54.5		**14.5%**	5.3	6.8	2014-2020
3		I-BC-S	Bacau IMT	Core TEN-T link	54.2		**14.4%**	5.3	12.0	2014-2020
4		I-SU-S	Suceava IMT	Core TEN-T link	54.0		**14.3%**	5.3	17.3	2014-2020
5		I-BU-S	Bucharest IMT	Core TEN-T link	52.7		**13.8%**	18.0	35.3	2014-2020
6		I-IS-S	Iasi IMT	Core TEN-T link	48.1		**12.0%**	4.0	39.3	2014-2020
7		I-OR-S	Oradea IMT	Comprehensive TEN-T link	34.5		**10.6%**	5.3	44.5	2014-2020
8		I-TU-S	Turda IMT	Core TEN-T link	34.1		**6.6%**	5.3	49.8	2014-2020
9		I-CR-S	Craiova IMT	Core TEN-T link	34.1		**6.6%**	18.0	67.8	2021-2030
10		I-DB-S	Drobeta Turnu Severin IMT	Core TEN-T link	31.6		**5.6%**	8.0	75.8	2021-2030
11		I-GL-S	Galati IMT	Core TEN-T link	30.0		4.7%	23.0	98.8	2021-2030

Source: AECOM GTMP Project Prioritisation

10.6.2 After analysing the potential demand at each location, we have examined in detail each of the selected sites to determine whether existing sites could be refurbished, or whether an entirely new facility should be provided. The assessment took into account not only the existing facilities, but also the location of each site and the quality of access.

10.6.3 The improvements to the inter-modal terminals consist either of refurbishment of particular facilities within each site, or an entirely new terminal. This accounts for the large variation in cost. More detailed feasibility studies may reach different conclusions about the viability of refurbishment as opposed to new build.

10.6.4 With regard to operation, our recommendation is that these should be operated by the private sector, and the existing terminals transferred to the private sector under a lease or concession.

10.7 Selection of the Recommended Scenario

10.7.1 According to the methodology described in section 2.6, the final stage within project prioritization is the selection of the recommended scenario.

10.7.2 Projects have been prioritized in three potential development scenarios, as follows:

- o An Economic Sustainability Scenario (ES);
- o An Economic and Environmental Sustainability Scenario (EES);
- o A scenario for the finalization of the Core TEN-T Network (CTT), which includes prioritization of projects on new roads (motorways), situated on the TEN-T Core, based exclusively on economic criteria, while the remaining interventions for the other modes of transport are similar to EES Scenario

10.7.3 The last scenario (CTT) has been developed for the purpose of testing the alternative in which the main objective is the finalization of TEN-T Core by 2030.

10.7.4 Prioritized projects for each mode of transport have been combined in the three scenarios. Scenarios were tested with the National Transport Model, in view of identifying the ones which generate the best economic efficiency results..

Economic Indicators

10.7.5 Tables 10.10-10.12 include the key economic performance indicators for the three scenarios which were analysed.

Table 10.10 Key Performance Indicators, ES Scenario

Economic Impact	Incremental Cost or Benefit (Million EUR) Discounted	Share in Total Costs / Benefits
Cost to Infrastructure Manager		
CAPEX	14,489	74%
OPEX	5,156	26%
Cost to Operator		
CAPEX	0	0%
OPEX	631	3%
Benefit To Users		
Value of Time	24,548	61.24%
Vehicle Operating Costs	1,046	2.61%
External Impacts		
Accidents (Safety)	10,511	26.22%
Noise	298	0.74%
Air Pollution	4,953	12.36%
Climate Change	-641	-1.60%
Present Value of Costs	**19,646**	
Present Value of Benefits	**40,085**	
Net Present Value (NPV)	**20,439**	
EIRR	**11.1%**	
Benefit Cost Ratio	**2.04**	

Source: National Transport Model, CBA tool, AECOM

Table 10.11 Key Performance Indicators, EES Scenario

Economic Impact	Incremental Cost or Benefit (Million EUR) Discounted	Share in Total Costs / Benefits
Cost to Infrastructure Manager		
CAPEX	15,155	74%
OPEX	5,193	26%
Cost to Operator		
CAPEX	0	0%
OPEX	903	4%
Benefit To Users		
Value of Time	26,423	61.26%
Vehicle Operating Costs	381	0.88%
External Impacts		
Accidents (Safety)	12,262	28.43%
Noise	341	0.79%
Air Pollution	5,503	12.76%
Climate Change	-871	-2.02%
Present Value of Costs	**20,348**	
Present Value of Benefits	**43,136**	
Net Present Value (NPV)	**22,787**	
EIRR	**11.4%**	
Benefit Cost Ratio	**2.12**	

Source: National Transport Model, CBA tool, AECOM

Table 10.12 Key Performance Indicators, CTT Scenario

Economic Impact	Incremental Cost or Benefit (Million EUR) Discounted	Share in Total Costs / Benefits
Cost to Infrastructure Manager		
CAPEX	14,923	74%
OPEX	5,132	26%
Cost to Operator		
CAPEX	0	0%
OPEX	817	4%
Benefit To Users		
Value of Time	23,167	66.01%
Vehicle Operating Costs	324	0.92%
External Impacts		
Accidents (Safety)	8,593	24.48%
Noise	222	0.63%
Air Pollution	4,453	12.69%
Climate Change	-845	-2.41%
Present Value of Costs	**20,055**	
Present Value of Benefits	**35,097**	
Net Present Value (NPV)	**15,042**	
EIRR	**9.63%**	
Benefit Cost Ratio	**1.75**	

Source: National Transport Model, CBA tool, AECOM

10.7.6 Table 10.13 includes a summary of the CBA results for the three scenarios.

Table 10.13 Headline CBA Results for the three Scenarios

Indicatori	ES	EES	CTT
Investment Costs(undiscounted, mill EUR 2010 prices)	**42.198**	**44.549**	**43.482**
Net Present Value (NPV, mill EUR, 2010 prices)	**20.439**	**22.787**	**15.042**
Economic Internal Rate of Return (EIRR)	**11.1%**	**11.4%**	**9.63%**
Benefit Cost Ratio (BCR)	**2.04**	**2.12**	**1.75**

Source: National Transport Model, CBA tool, AECOM

Note: the discount year is 2010, so all costs and benefits are expressed in 2010 terms, except where stated otherwise.

10.7.7 For a similar total investment cost of approximately 44 billion EURO for 2020 and 2030 horizon projects, the EES scenario provides the best economic performance, with the highest cost-benefit ratio out of the three tested scenarios. Consequently, the EES scenario is recommended and will ground the definition of the project implementation plan. .

10.7.8 It is important to note that the alternative of finalizing the Core TEN-T Network offers lower economic benefits to the ES and EES, which also illustrates that the methodology applied for the road infrastructure project selection and identification was a correct and robust one.

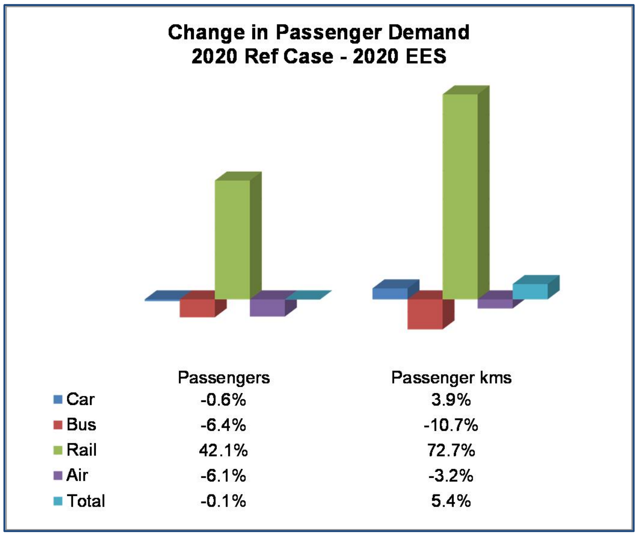
10.7.9 The underlying purpose of the Master Plan is to contribute to Romania's economic growth. The undiscounted benefits from the Master Plan total some €170bn, which equates to approximately 2% of Romania's GDP in the period 2020 – 2050.

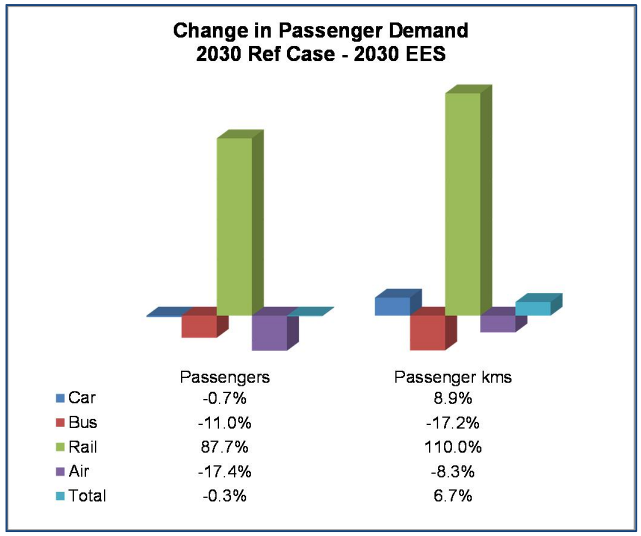
Operational Performance Indicators

10.7.10 The NTM produces a large volume of data which demonstrate how the transport network is performing. The EES is compared with the Reference Scenario, which represents the situation that would exist without the Master Plan, that is with financially committed projects only.

Passenger Transport

Figure 10.2 Evolution of Passenger Transport in 2020 and 2030 EES vs. Ref Case

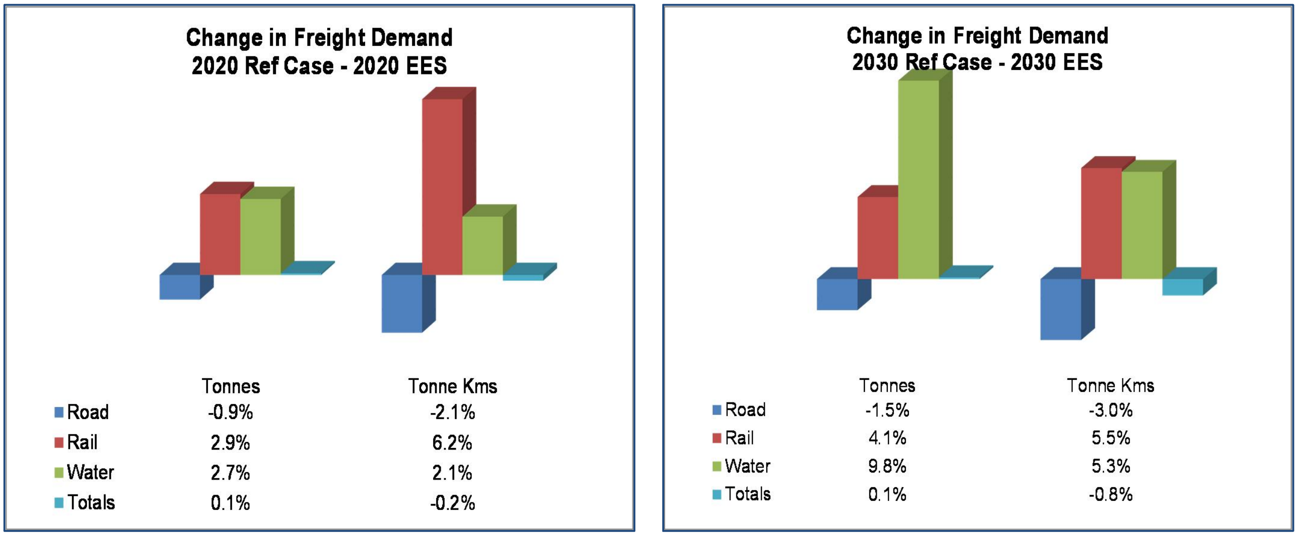




Source: AECOM, National Transport Model and CBA Tool

10.7.11 The results show that, with the investments in improved maintenance, and in line speeds and service improvements, substantial increases in passenger traffic could be achieved. One feature of the forecast impacts is the increase in average journey lengths – passenger kms grow to a much larger extent than passenger numbers, and this is to be expected given the shorter journey times, and more convenient services that the Master Plan interventions will provide.

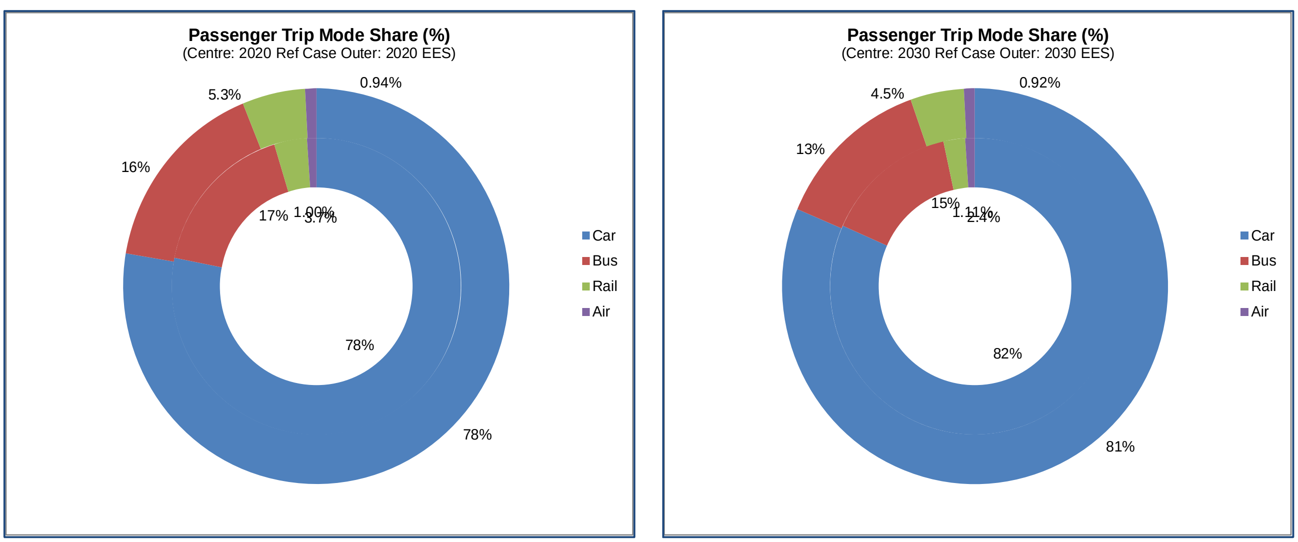
Figure 10.3 Evolution of Freight Transport in 2020 and 2030 EES vs. Ref Case



Source: AECOM, National Transport Model and CBA Tool

10.7.12 The same pattern for freight traffic is evident, although the impact is less, for two reasons. First, the relative improvement in freight train speeds is less than for passenger services, and secondly, the transit time is only one element of the cost of moving freight. Freight tonne kms grow at roughly twice the rate of tonnes lifted.

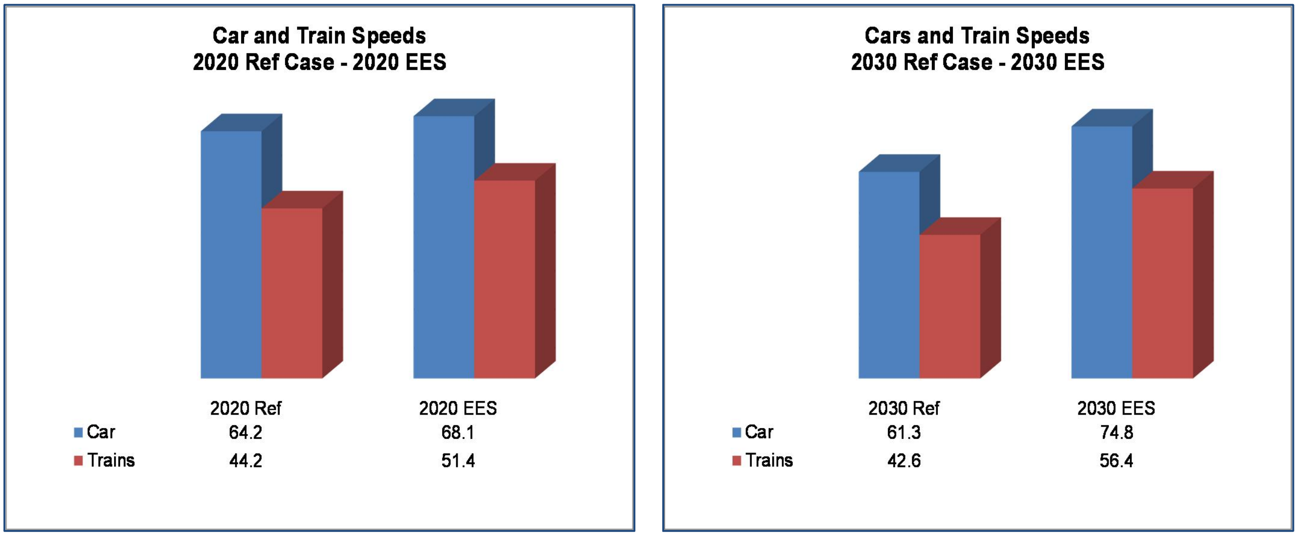
Figure 10.4 Changes in the Overall Mode Choice



Source: AECOM, National Transport Model and CBA Tool

10.7.13 Here, the performance of rail should be assessed against a historical backdrop of decreasing mode share. The forecasts from the National Model show that rail mode share can be maintained with investment, improved maintenance and better services, even in an expanding travel market and with increasing car ownership, and with significant improvements to the road network.

Figure 10.5 Changes in the Cars and Trains Average Speeds



Source: AECOM, National Transport Model and CBA Tool

10.7.14 The historical trend in Romania has been for a decrease in train speeds. However, the combined effects of improved maintenance and renewals, and restoration of design speeds on the improved corridors, has resulted in a marked improvement in train speeds of 16% in 2020, and 32% by 2030. These are network-wide improvements, and demonstrate the scale of improvements that are possible with an integrated approach to rail maintenance and investment.

10.7.15 The improvements to car speeds is due to the provision of 2,747 kms of additional motorways and expressways, but the relatively modest increases must be seen in the light of the increases in vehicle kms from the Base Year. Nevertheless, improvements of 6% and 22% over the whole network demonstrate the effectiveness of the roads strategy.

Accessibility

10.7.16 A additional analysis was done on the relative accessibility of the main urban areas, considering the number of employees.

10.7.17 The formula for the effectity density is given below:

$$U = \sum_{j}^{i \neq j} \left(A_j / (d_{ij})^{\alpha} \right) + A_j / d_i$$

where:

U = Effective Density in a specific zone i
Aj = Measure of economic activity in other zones – we have used number of employees for the analysis
dij = Generalised cost of travel between zone i and other zones (composite GC matrix)
Ai = Measure of economic activity in the specific zone i – we have used number of employees
di = typical generalised cost of travel for an internal trip (assumed 30 mins for all zones within Romania)
α = 1.0

10.7.18 The effective density numbers have units of employees per minute. The absolute effective density number for a zone does not have an own meaning; what is important is the % difference in values, either between different regions in the same year or between the same regions in different scenarios or years.

10.7.19 Effective density for a zone is calculated by looking at each of the other zones in the model and calculating the number of employees in the zones divided by the generalised cost (in minutes) of getting from the original zone to the other zones. This gives a value for each of the other zones. The values for all other zones are added together and this is the effective density for the original zone. This process is then repeated for each zone in the model. we then take weighted average across zones within each county and across all zones in Romania. The effective density calculations are done with a series of matrix calculations within the model as it requires cost of travel between all origin-destination pairs.

10.7.20 The effective density of a zone is therefore bigger for a zone where you can travel to a large number of employees in other zones in a short time; and low if you can only travel to a smaller numbers of employees in longer times.

10.7.21 Because of the way it is calculated the effective density has units of employees per minute; however, it is not a measure of the number of employees that can be accessed in 1 minute, rather it is an indicator of how easy it is to access other employees from a zone relative to other zones. This is why % changes in effective density are used to assess impacts rather than at absolute values.

10.7.22 The Base Year, and 2030 Accessibility plots, for domestic travel are shown on Figures 10.6-10.7 below.

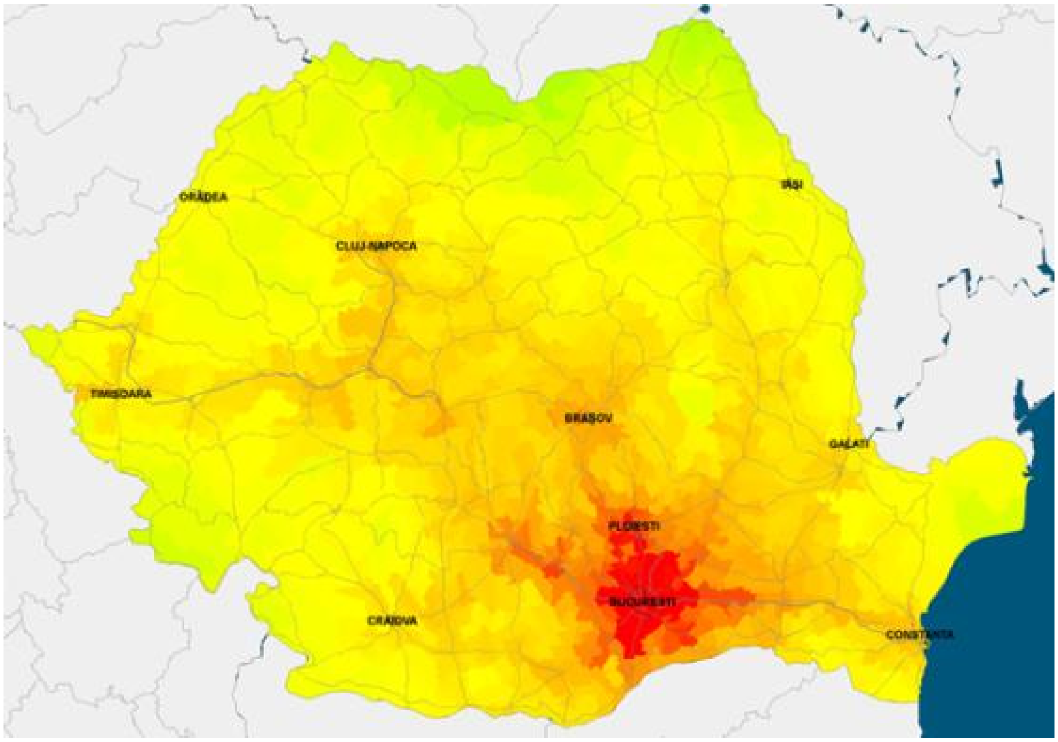


Figure 10.6 Base Year Accessibility, Domestic Travel.

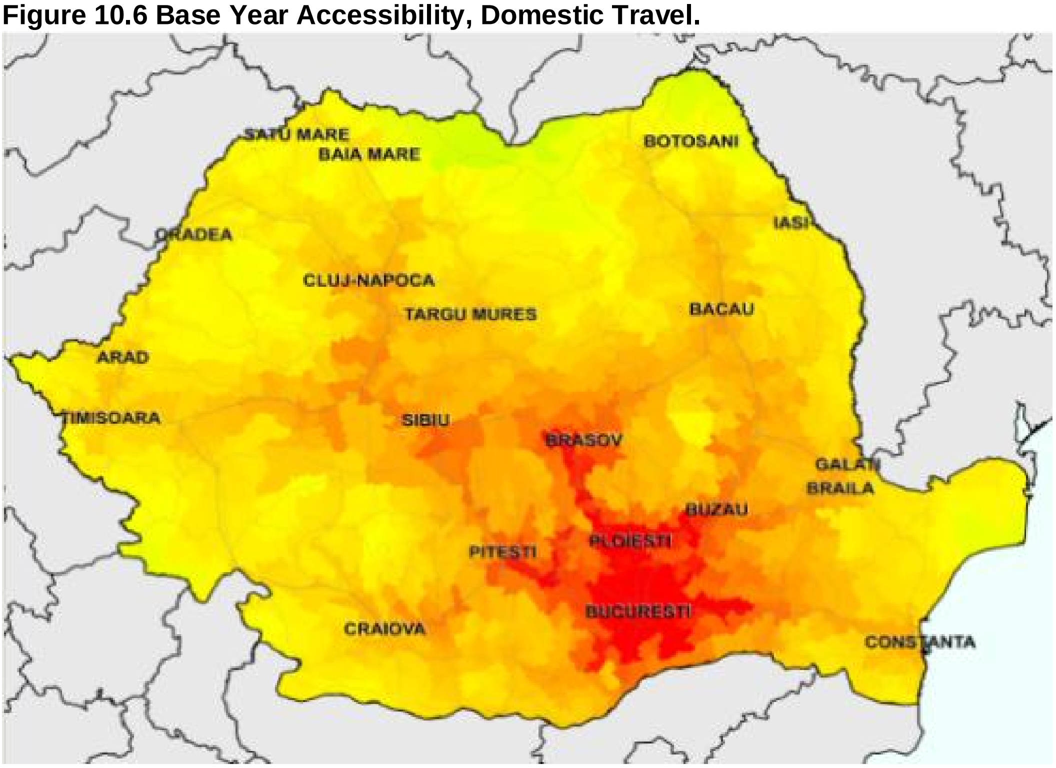


Figure 10.7 2030 Accessibility, Domestic Travel.

10.7.23 A comparison between the two plots shows that accessibility to the peripheral parts of Romania, such as the north-eastern areas of the country in the Buzau – Iasi corridor has increased, and also to the north-west in the Cluj/Targu Mures area, and to the west around Timisoara.

10.7.24 Figures 10.8 and 10.9 show the accessibility of Romania to neighbouring countries, for the Base Year and the 2030 EES scenario.

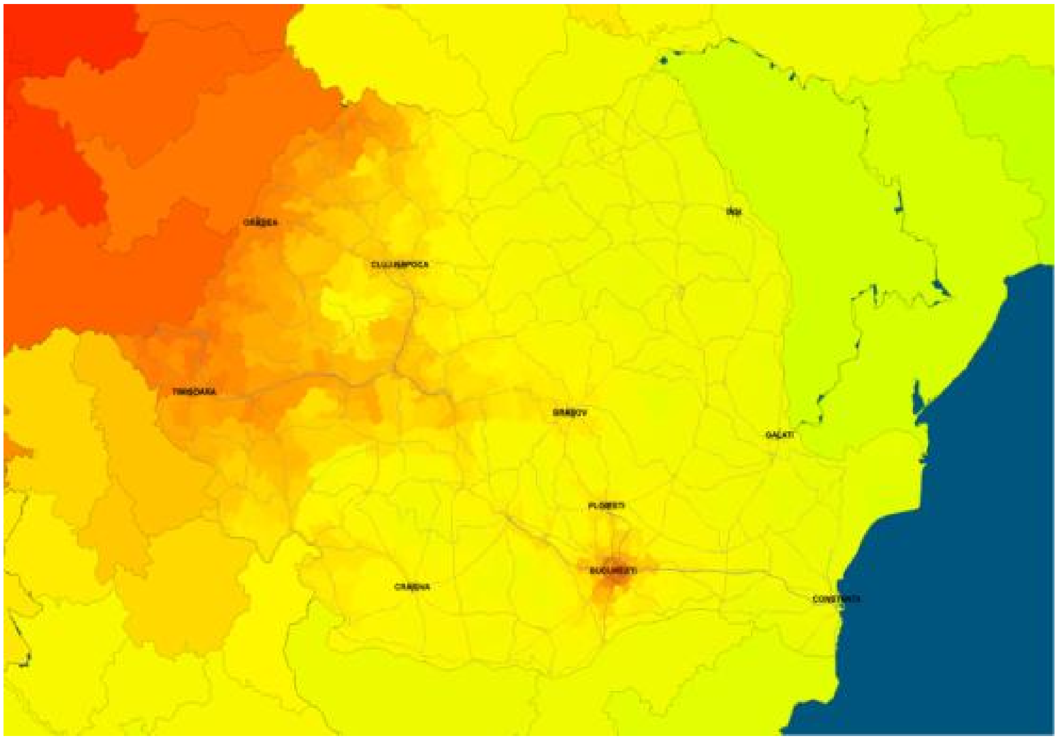


Figure 10.8 Base Year Accessibility, International Travel.

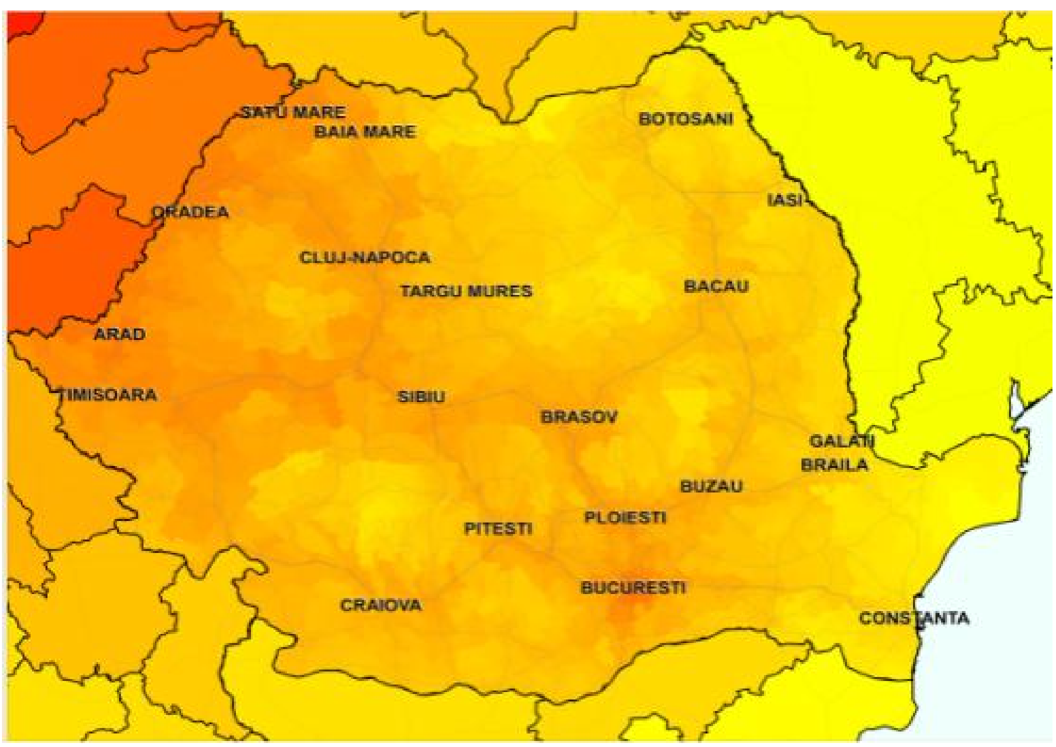


Figure 10.9 2030 Accessibility, International Travel.

10.7.25 The contrast between the base year and 2030 is marked. Most of the Western and Central areas of Romania will experience a significant increase in accessibility to external employment and markets, demonstrating the success that the Master Plan will have in helping Romania to improve its competitiveness in the wider, global market place.

Appendices

11 Appendices

11.1 Appendix A. GTMP Financial Plan

Financial Plan Transport Sector

Key assumptions/committments to confirm :
Budget allocation of **2%** of GDP for transport sector financing, this includes EU Contribution
In practice this requireds a substantial increase from the historic average of **1.15%** over the period 2007-2013.

The 2% allocation actually covers:
Infrastructure maintenance and renewal costs for all sectors.
Infrastructure rehabilitation and new infrastructure investments.

The 2% allocation does not cover:
Loan service repayments
Availability payments for e.g. motorway concessions
Subsidies/compensations for e.g. rail public service contracts with passengers operators
These items require an **additional 0.57% of GDP** 2014 - 2020

EU Funds available for 2014-2020 (mill)

CF	3,404
CEF	1,200
ERDF	1,728

Overcommittment	30%	% of GDP allocated to Transport	2.00%
Include rail rehab backlog? (Y/N)	N	Include RUC revenues? (Y/N)	N

Source/Comments

- GDP assumption as per CNP forecast for 2014-2017. For the 2018-2030 period the NTM forecasts were used.
- Source: AECOM analysis of spend required to cover maintenance and repairs on rail network which retains 55% of entire current network including lines within stations and sidings and 99% of passenger/freight tonne kms Rail network. It includes a gradually increase to the target ammount.
- AECOM estimate of Maintenance and Renewal Costs based on World Bank Cost Recovery Model. It includes a gradually increase to the target ammount.
- Estimated cost with dredging and other maintenance operations on Danube
- Potential RUC revenues following HGV taxation to improve road cost coverage; does not include recovery of external environmental costs
- Rail rehabilitation costs are being priortised and determined as part of the Master Plan and will therefore being funded out of the remaining available budget
- AECOM estimate of Rehabilitation Costs (Lifecycle) using World Bank Cost Recovery Financial Model, with current status of pavement based on information provided by CNANDR. It assumed that rehabilitation/removal of backlog will be completed in 2020, with road lifecycle costs post 2020 coming under standard renewals
- Additional National Contribution to support the mandatory allocations + EU funded projects
- Includes allowance for over commitment, as defined above

Figures are in mill EUR, fixed prices

	2014	2015	2016	2017	2018	2019	2020	TOTAL 2014-2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total 2021 - 2030
	147,178	150,857	155,383	160,511	166,128	171,943	177,961	1,129,961	184,190	190,636	197,308	204,214	211,362	218,759	226,416	234,341	242,543	251,031	2,160,800
	2,944	3,017	3,108	3,210	3,323	3,439	3,559	22,599	3,684	3,813	3,946	4,084	4,227	4,375	4,528	4,687	4,851	5,021	43,216
	486	486	486	486	486	486	486	3,404	486	486	486	486	486	486	486	486	486	486	4,863
	171	171	171	171	171	171	171	1,200	171	171	171	171	171	171	171	171	171	171	1,714
	247	247	247	247	247	247	247	1,728	247	247	247	247	247	247	247	247	247	247	2,469
Romanian National Budget Contribution (2% GDP less EU Contribution)	2,039	2,113	2,203	2,306	2,418	2,534	2,655	16,267	2,779	2,908	3,042	3,180	3,323	3,471	3,624	3,782	3,946	4,116	34,170
Maintenance and lifecycle costs	540	772	1,004	1,236	1,236	1,236	1,236	7,260	2,065	2,065	2,065	2,065	2,065	2,065	2,065	2,065	2,065	2,065	20,650
Railways	324	393	463	532	532	532	532	3,308	532	532	532	532	532	532	532	532	532	532	5,320
Roads	191	354	516	679	679	679	679	3,777	1,508	1,508	1,508	1,508	1,508	1,508	1,508	1,508	1,508	1,508	15,080
Air	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterways	25	25	25	25	25	25	25	175	25	25	25	25	25	25	25	25	25	25	250
Additional revenues from HGV taxation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rehabilitation works for the viable road network	327	436	545	654	763	872	981	4,578	0	0	0	0	0	0	0	0	0	0	0
Railways	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roads	327	436	545	654	763	872	981	4,578											0
Air																			
Waterways																			
Available Public Funds for construction and maintenance of new projects, including EU and National Contribution	2,077	1,809	1,559	1,320	1,324	1,331	1,342	10,761	1,619	1,748	1,881	2,019	2,162	2,310	2,463	2,622	2,786	2,956	22,566
Out of which EU funds								6,332											9,046
Cohesion Fund	486	486	486	486	486	486	486	3,404	486	486	486	486	486	486	486	486	486	486	4,863
Connecting Europe Facility	171	171	171	171	171	171	171	1,200	171	171	171	171	171	171	171	171	171	171	1,714
ERDF	247	247	247	247	247	247	247	1,728	247	247	247	247	247	247	247	247	247	247	2,469
Required National Contribution/Co-financing	302	302	302	302	302	302	302	2,111	302	302	302	302	302	302	302	302	302	302	3,015
Other required national funds / Deficit	870	603	353	114	117	125	136	2,319	413	542	675	813	956	1,104	1,257	1,416	1,580	1,750	10,505
Earmarked for phased projects								2,489											3,000
Earmarked for Bucharest Metro								727											1,000
Available for GTMP projects (total inc. EU + national)	1,617	1,350	1,099	861	864	871	883	7,545	1,219	1,348	1,481	1,619	1,762	1,910	2,063	2,222	2,386	2,556	18,566
+Overcommitment	2,102	1,755	1,429	1,119	1,123	1,133	1,148	9,809	1,584	1,752	1,926	2,105	2,291	2,483	2,682	2,888	3,102	3,322	24,136
New ROADS infrastructure																			
Motorways																			
Expressways																			
By-passes																			
Safety schemes																			
Parking & weighting infra																			
Border crossing infra																			
RAIL investments																			
Line rehabilitations																			
Rolling stock																			
Intermodals																			
Reform advisory services																			
AIRPORTS																			
IWT and Maritime Transport																			
Danube fairway																			
Danube ports																			
Constanta port																			

Allocation of available funds to be determined as part of Master Plan Process

11.2 Appendix B. TEN-T Maps for Romania

Figure B.1 Core and comprehensive TEN-T road, ports, rail terminals and airports networks

Source: http://ec.europa.eu/transport/themes/infrastructure/revision-t_en.htm

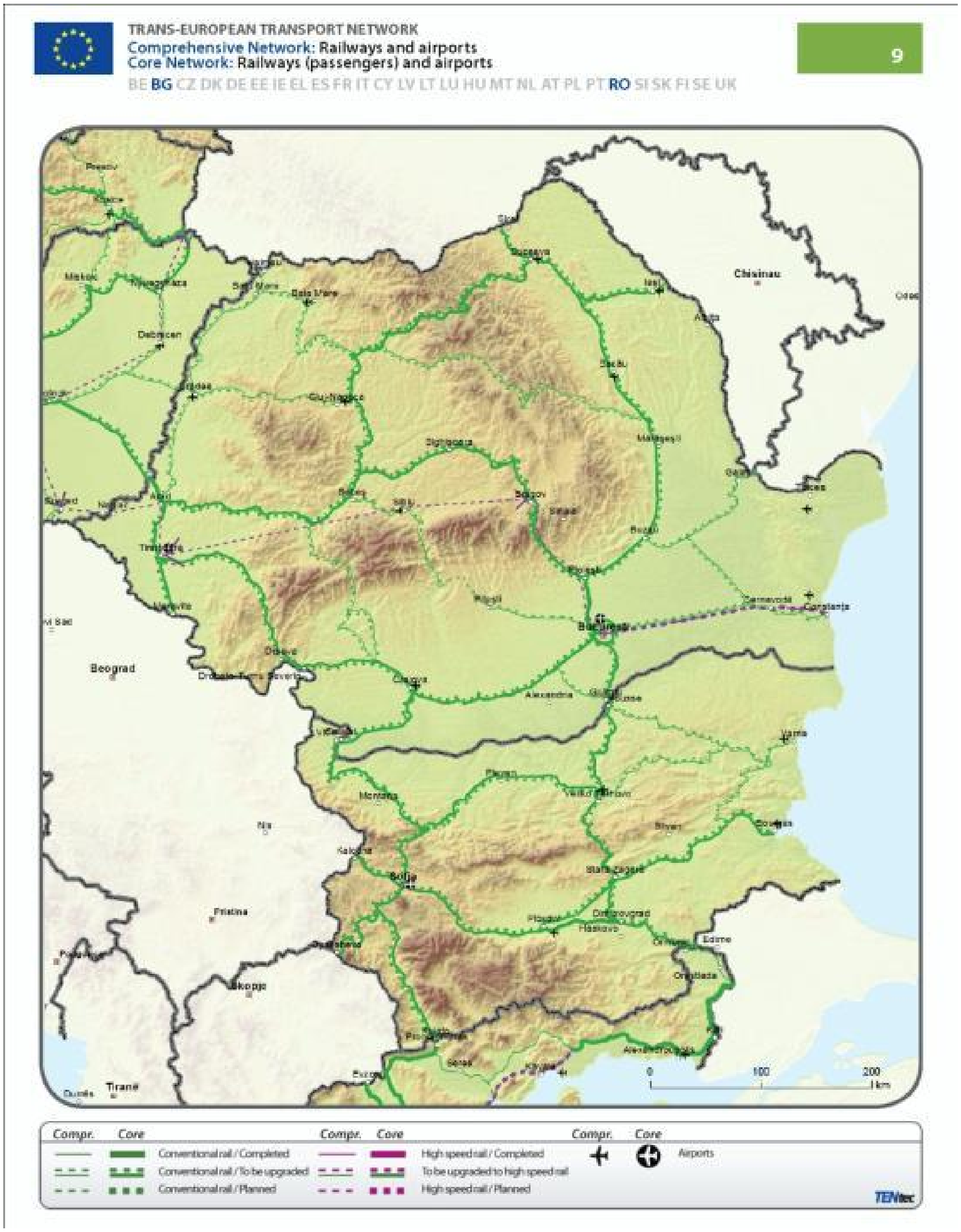


Figure B.2 Core TEN-T passengers rail lines, airports and comprehensive railways and airports network

Source: http://ec.europa.eu/transport/themes/infrastructure/revision-t_en.htm

11.3 Appendix C. Detailed Rail Test Results

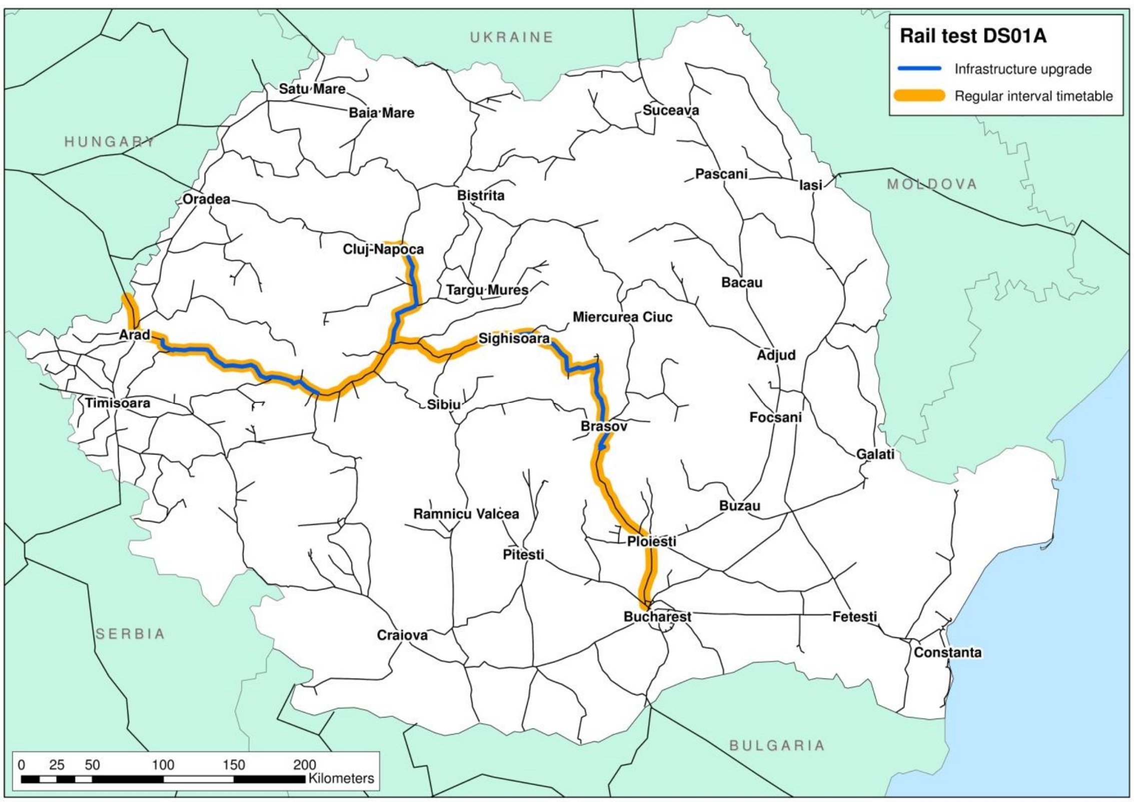
Core TEN-T corridor IV-N and link to Cluj-Napoca to design speed (Test DS01A)

Proposal description

Upgrade programme for Core TEN-T corridor IV-N between Bucharest Nord and Arad /Hungarian border; and line 300 between Cluj-Napoca and Core TEN-T corridor IV-N. The sections Bucharest to Predeal, Sighisoara to Deva and Hungarian border to km 614 (Northwest of Lipova) are either already rehabilitated or under upgrade.

This project includes:

- Rehabilitation to design speed of corridors: 300 Bucharest Nord to Cluj-Napoca, 200A, 200 Hungarian border to Alba Iulia (some sections have been already rehabilitated).
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communications systems, ERTMS will be implemented on Core TEN-T corridor IV-N.
- Improved station facilities at Bucharest, Ploiesti, Campina, Predeal, Brasov, Sigishoara, Medias, Blaj, Aiud, Campia Turzii, Cluj-Napoca, Alba Iulia, Simeria, Deva, Ilia, Radna and Arad.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Cluj-Napoca (0.5 tph), Bucharest to Arad (0.5 tph), Bucharest to Brasov (1 tph), Deva to Cluj-Napoca (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains between Bucharest and Cluj-Napoca, Bucharest and Arad and towards Hungary.

- Delays due to poor infrastructure condition, commercial speeds below design parameters between Predeal and Arad and Teius and Cluj-Napoca. Maximum speeds as low as 45% the design parameters (section Augustin – Racos).
- Low rail market share on the Bucharest – Ploiesti – Brasov section, rail is not competitive versus road on the corridor.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems. Infrastructure between Bucharest and Brasov may not be able to cope with the forecast rail traffic after rehabilitation; a pilot ERTMS test planned on this line would increase capacity and safety drastically.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network and infrastructure rehabilitation of corridors either previously restored or under upgrade.

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	3,054	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signaling equipment New rolling stock Improved station facilities
OPEX	1,813	Additional train operating costs
Total	4,867	CAPEX + OPEX

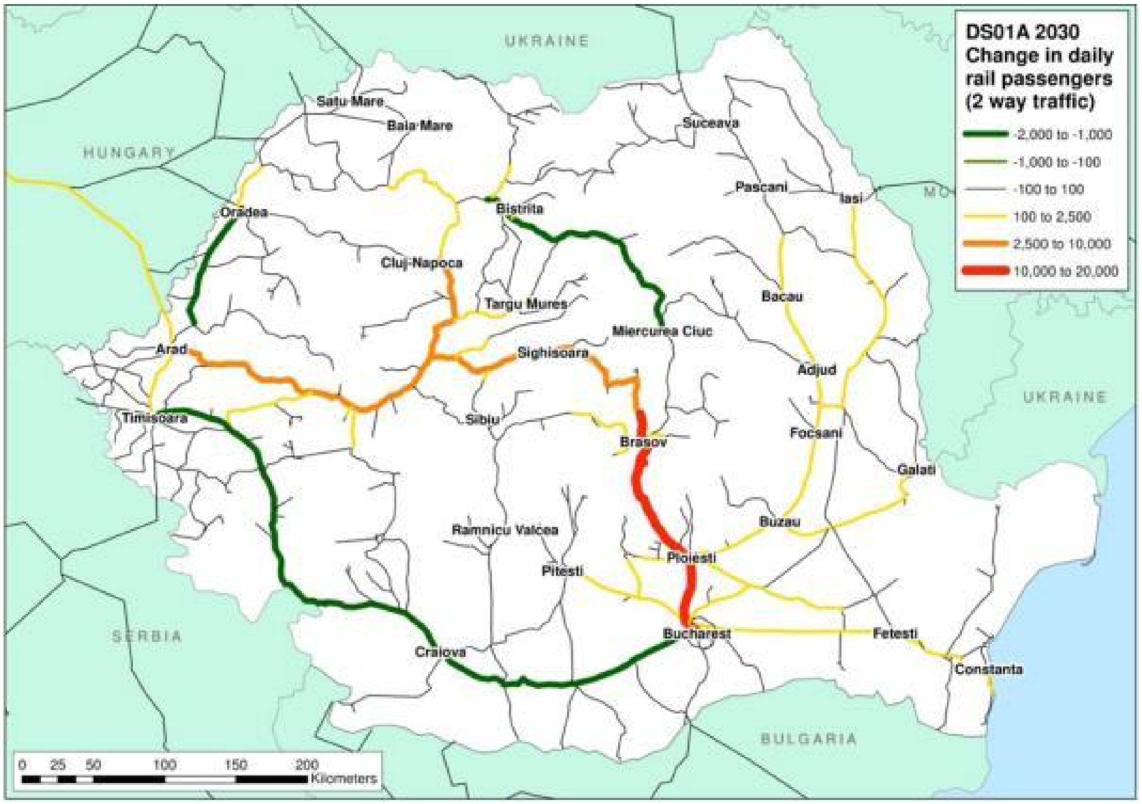
Outcomes

This intervention returns good value for money (BCR = 1.11), and a significant overall increase in rail passenger and freight traffic, of +27% and +9% respectively over the whole system, see table below:

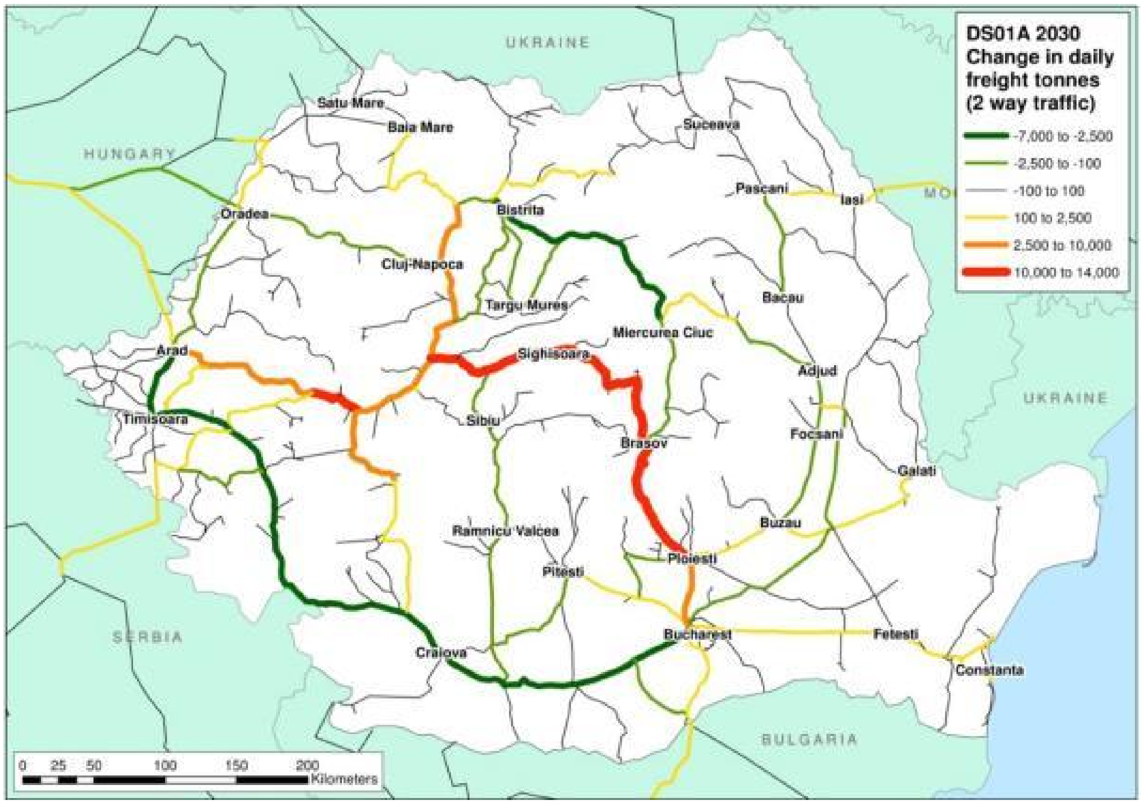
Test code	**DS01A**
Overall inc. in Pass-km (1000's 2030)	+5,814 (+27%)
Overall inc. in Pass-km share (2030)	+1.7%
Overall inc. in Tonne-km (1000,s 2030)	+4,175 (+9%)
Overall inc. Tonne-km share (2030)	+1.2%
NPV € Mill (2014 Prices)	**221**
BCR	**1.11**
EIRR	**5.56%**
Upgraded main line infrastructure (track-	795

Test code	DS01A
km)	
Required rolling stock units	25

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



As the image above demonstrates this project leads to an increase in passenger demand on the Bucharest – Ploiesti – Brasov – Arad line. Patronage between Ploiesti and Brasov is expected to grow by +115%, and by up to +155% between Deva and Arad. There is a significant element of demand attraction from the line Bucharest – Craiova – Timisoara – Arad as a result of the improved passenger services. Demand between Craiova and Drobeta - Turnu Severin has been forecast to drop by -40%.



Freight traffic is also expected to grow overall, with an increase in the number of tonnes transported of about +60% between Brasov and Sighisoara. Similarly to the forecast trend in the passenger market, some freight traffic is expected to transfer from the line Bucharest – Craiova – Timisoara – Arad to the upgraded corridor. The number of transported tonnes has been estimated to fall by -50%.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

- Section Bucharest – Predeal completed.
- Sighisoara to Deva and Hungarian border to km 614 between 2014 and 2020.
- Other corridors on this test estimated 2020

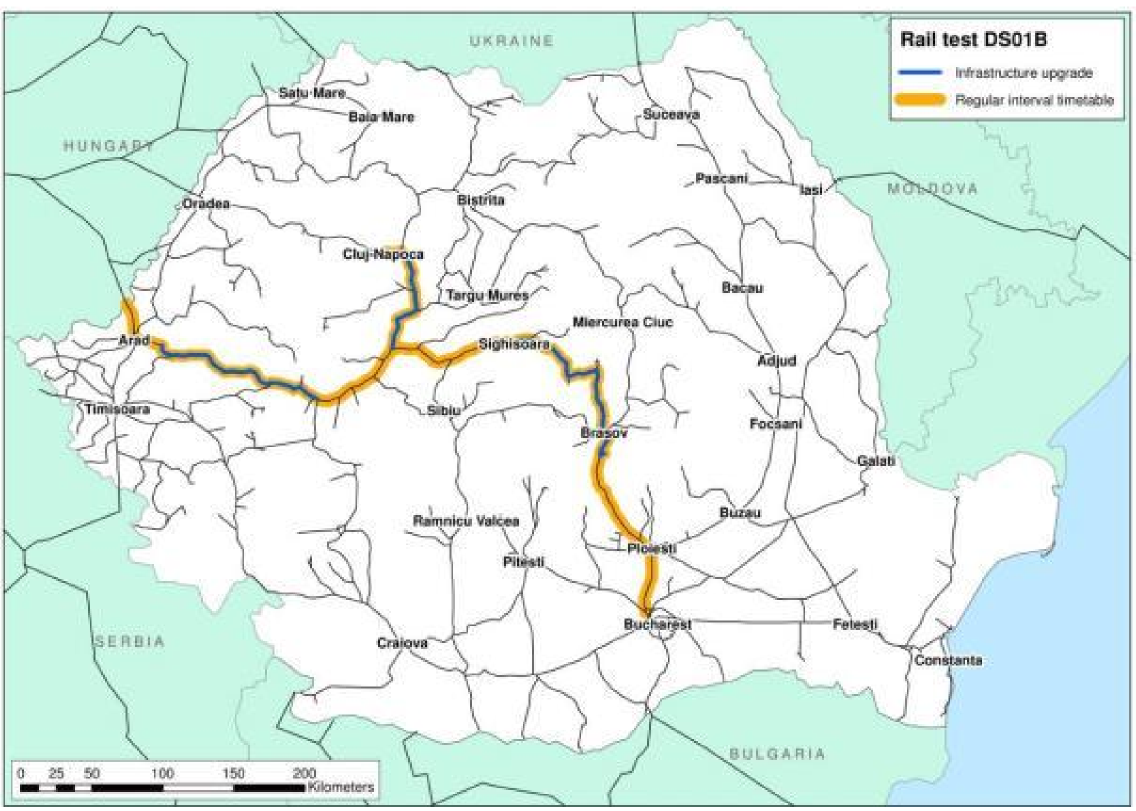
Core TEN-T corridor IV-N and link to Cluj-Napoca to enhanced speed (Test DS01B)

Proposal description

Upgrade programme for Core TEN-T corridor IV-N between Bucharest Nord and Arad /Hungarian border; and line 300 between Cluj-Napoca and Core TEN-T corridor IV-N. Lines with design speed below 100 km/h upgraded to enhanced speed. The sections Bucharest to Predeal, Sighisoara to Deva and Hungarian border to km 614 (Northwest of Lipova) are either already rehabilitated or under upgrade.

This project includes:

- Rehabilitation to design speed of corridors: 300 Bucharest Nord to Cluj-Napoca, 200A, 200 Hungarian border to Alba Iulia (some sections have been already rehabilitated).
- Rehabilitation to enhanced speed of sections with design speed below 100 km/h on the following corridors: 300 Bucharest Nord to Cluj-Napoca, 200A, 200 Hungarian border to Alba Iulia (Some sections have been already rehabilitated).
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communications systems, ERTMS will be implemented on Core TEN-T corridor IV-N.
- Improved station facilities at Bucharest, Ploiesti, Campina, Predeal, Brasov, Sigishoara, Medias, Blaj, Aiud, Campia Turzii, Cluj-Napoca, Alba Iulia, Simeria, Deva, Ilia, Radna and Arad.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Cluj-Napoca (0.5 tph), Bucharest to Arad (0.5 tph), Bucharest to Brasov (1 tph), Deva to Cluj-Napoca (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains between Bucharest and Cluj-Napoca, Bucharest and Arad and towards Hungary.
- Delays due to poor infrastructure condition, commercial speeds below design parameters between Predeal and Arad and Teius and Cluj-Napoca. Maximum speeds as low as 45% the design parameters (section Augustin – Racos).
- Low rail market share on the Bucharest – Ploiesti – Brasov section, rail is not competitive versus road on the corridor.
- Low design speeds of the sections Predeal to Brasov and Razboieni to Apahida.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems. Infrastructure between Bucharest and Brasov may not be able to cope with the forecast rail traffic after rehabilitation; a pilot ERTMS test planned on this line would increase capacity and safety drastically.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network and infrastructure rehabilitation of corridors either previously restored or under upgrade.

Item	**Undiscounted costs (Million €, 2014 prices)**	**Description of improvements included**
CAPEX	2,830	Rehabilitation of track to provide current or enhanced design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	1,446	Additional train operating costs
Total	4,276	CAPEX + OPEX

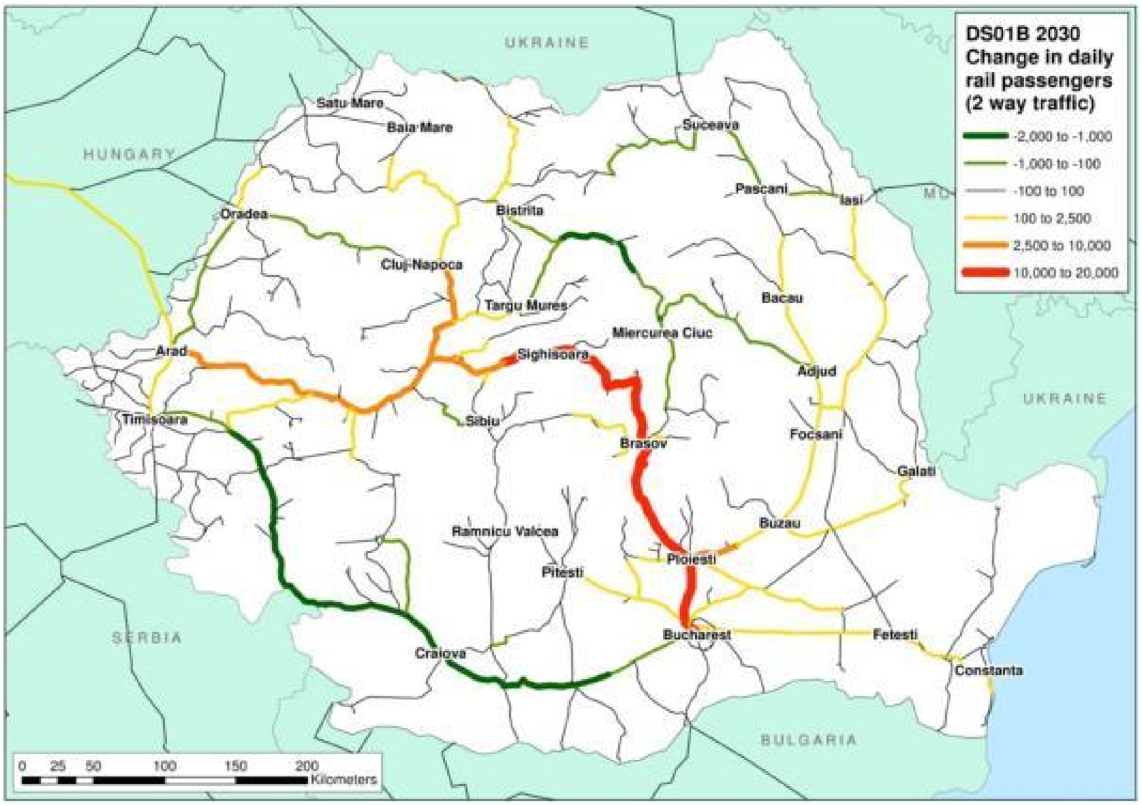
Outcomes

This intervention returns low value for money (BCR = 1), and a significant overall increase in rail passenger and freight traffic, +30% and +9% respectively over the whole system, see table below:

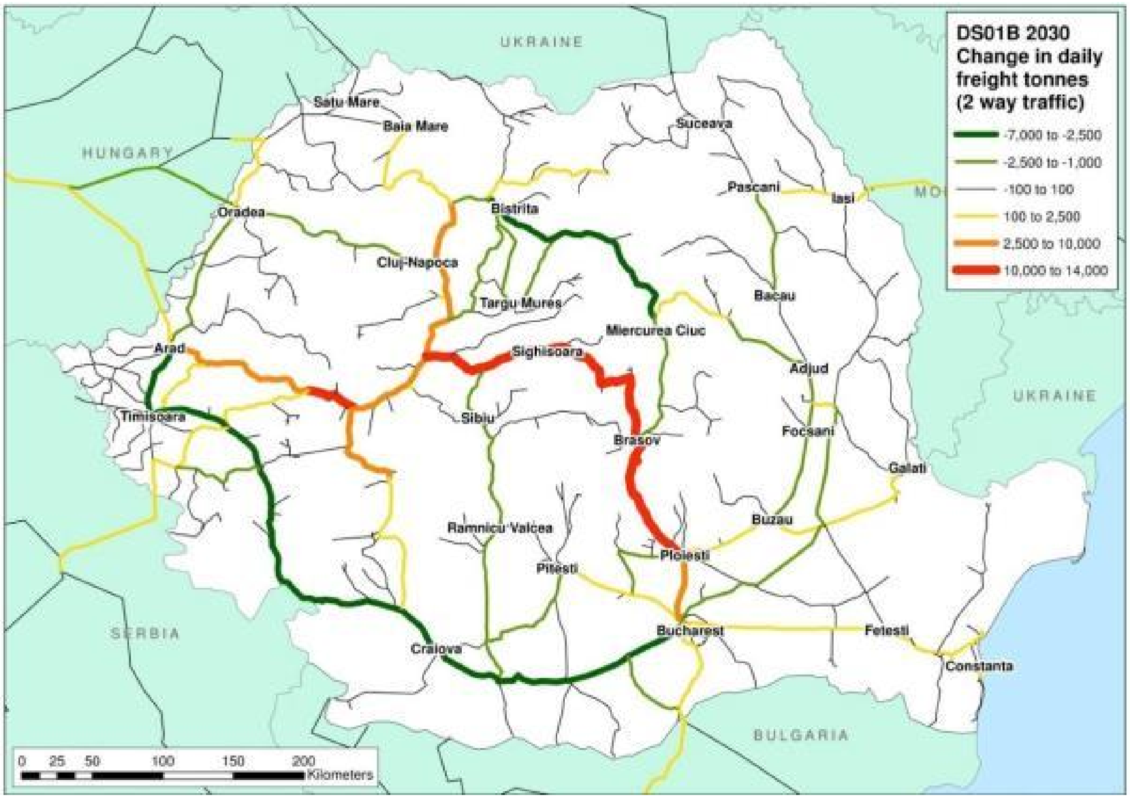
Test code	**DS01B**
Overall inc. in Pass-km (1000's 2030)	+6,374 (+30%)
Overall inc. in Pass-km share (2030)	1.9%
Overall inc. in Tonne-km (1000,s 2030)	+4,189 (+9%)
Overall inc. Tonne-km share (2030)	1.2%
NPV € Mill (2014 Prices)	**1**

Test code	**DS01B**
BCR	**1.00**
EIRR	**5.00%**
Upgraded main line infrastructure (track-km)	795
Required rolling stock units	25

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



As the image above demonstrates this project leads to an increase in passenger demand on the Bucharest – Ploiesti – Brasov – Arad line, slightly higher than for Test DS01A. Patronage between Ploiesti and Brasov is expected to grow by +130%, and by up to +155% between Deva and Arad. There is a significant element of demand attraction from the line Bucharest – Craiova – Timisoara – Arad as a result of the improved passenger services. Demand between Craiova and Drobeta – Turnu Severin has been forecast to plumb by -45%.



Freight traffic is also expected to grow overall, with an increase in the number of tonnes transported of about +60% between Brasov and Sighisoara. Similarly to the forecast trend in the passenger market, some freight traffic is expected to transfer from the line Bucharest – Craiova – Timisoara – Arad to the upgraded corridor. The number of transported tonnes has been estimated to fall by -50%.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

- Section Bucharest – Predeal completed.
- Sighisoara to Deva and Hungarian border to km 614 between 2014 and 2020.
- Other corridors on this test estimated 2020

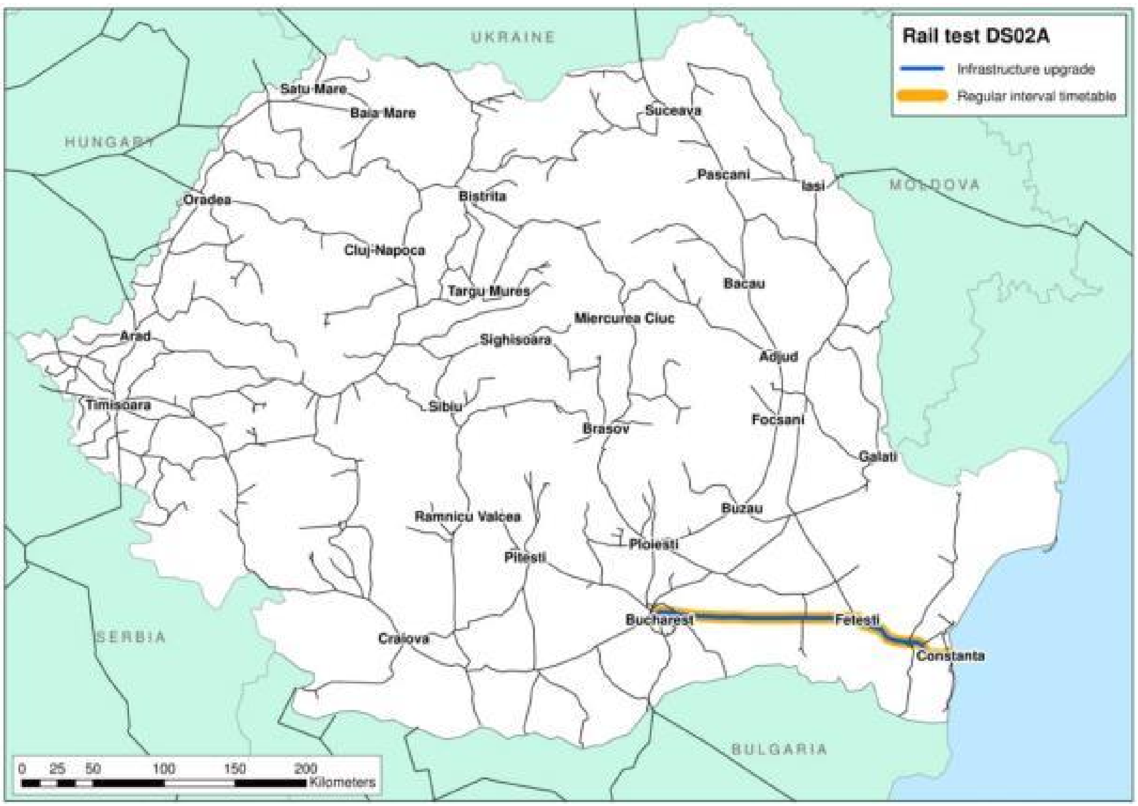
Line Bucharest to Constanta to design speed (Test DS02A)

Proposal description

Upgrade programme for the line Bucharest to Constanta. Although this line has been upgraded in the last decade, existing speed restrictions slow journey times significantly below design parameters.

This project includes:

- Rehabilitation to design speed and removal of speed restrictions.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communications systems.
- Improved station facilities at Bucharest, Lehliu, Ciulnita, Fetesti, Cernavoda, Medgidia and Constanta, some improvement works already carried out on this corridor.
- InterRegio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Constanta (1 tph), with a fast and a stopping service every two hours.



Problems addressed

This intervention addresses the following issues:

- Existing speed restrictions leading to slower running speeds than projected following recent line upgrade. Although some sections on the corridor have been designed for a maximum speed of up to 200 km/h, passenger trains currently are limited to 140 km/h.
- Low rail market share, rail is not competitive versus road on the corridor. In principle the existing infrastructure enables faster rail than car journeys between Bucharest and Constanta.
- Poor rolling stock and station facilities condition, country wide issue.

- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Operational gaps for maintenance tasks, this work should be carried out at night.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Low frequency between Bucharest and Constanta.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	218	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	117	Additional train operating costs
Total	335	CAPEX + OPEX

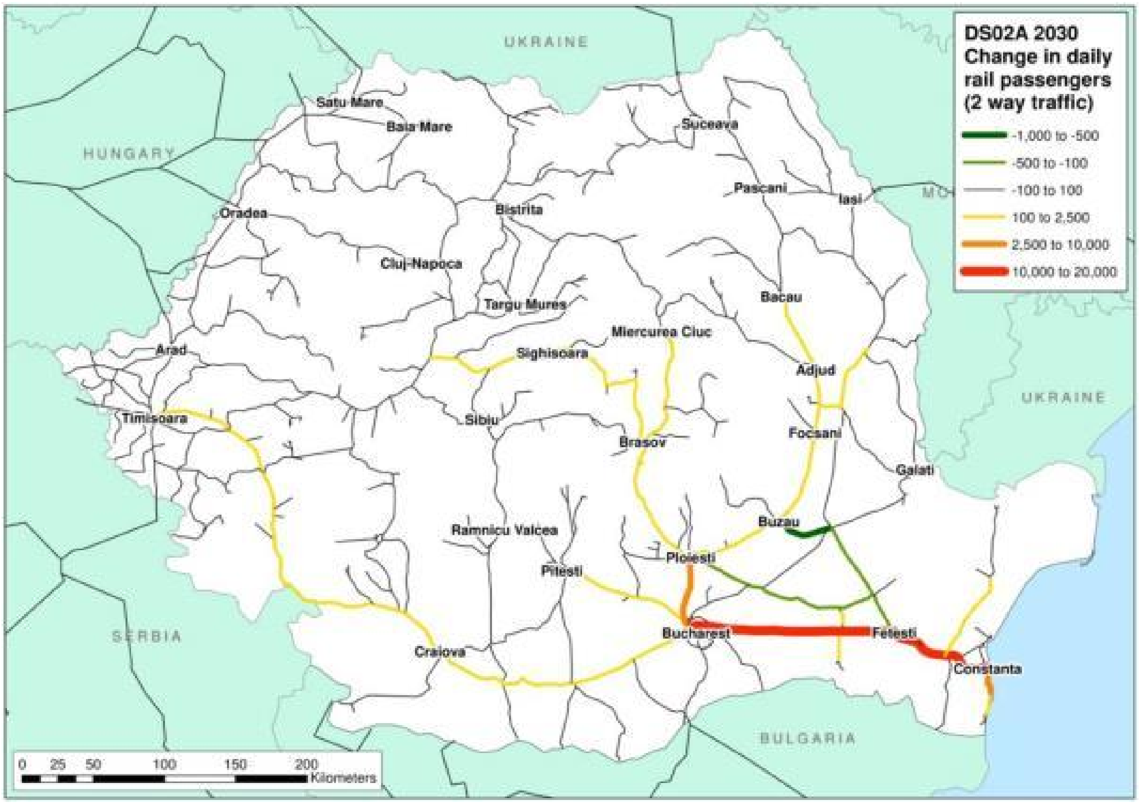
Outcomes

This intervention returns good value for money (BCR = 1.85), and a sensible overall increase in rail passenger traffic (+7%) over the whole system, see table below:

Test code	**DS02A**
Overall inc. in Pass-km (1000's 2030)	+1,422 (+7%)
Overall inc. in Pass-km share (2030)	0.4%
Overall inc. in Tonne-km (1000,s 2030)	-14 (+0%)
Overall inc. Tonne-km share (2030)	0.0%
NPV € Mill (2014 Prices)	**100**
BCR	**1.85**
EIRR	**8.31%**
Upgraded main line infrastructure (track-km)	225[1]
Required rolling stock units	5

[1]Remove speed restrictions existing on the 225 track-km line

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



Passenger demand on the rehabilitated corridor grows significantly compared to the reference case, the forecast traffic increase on the Lehilu to Ciulnita section is +115%, this figure decreases to +80% on the Fetesti to Cernavoda section.

It has been assumed that the current condition of the infrastructure does not condition freight travel times and therefore no significant freight travel time savings will be achieved.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

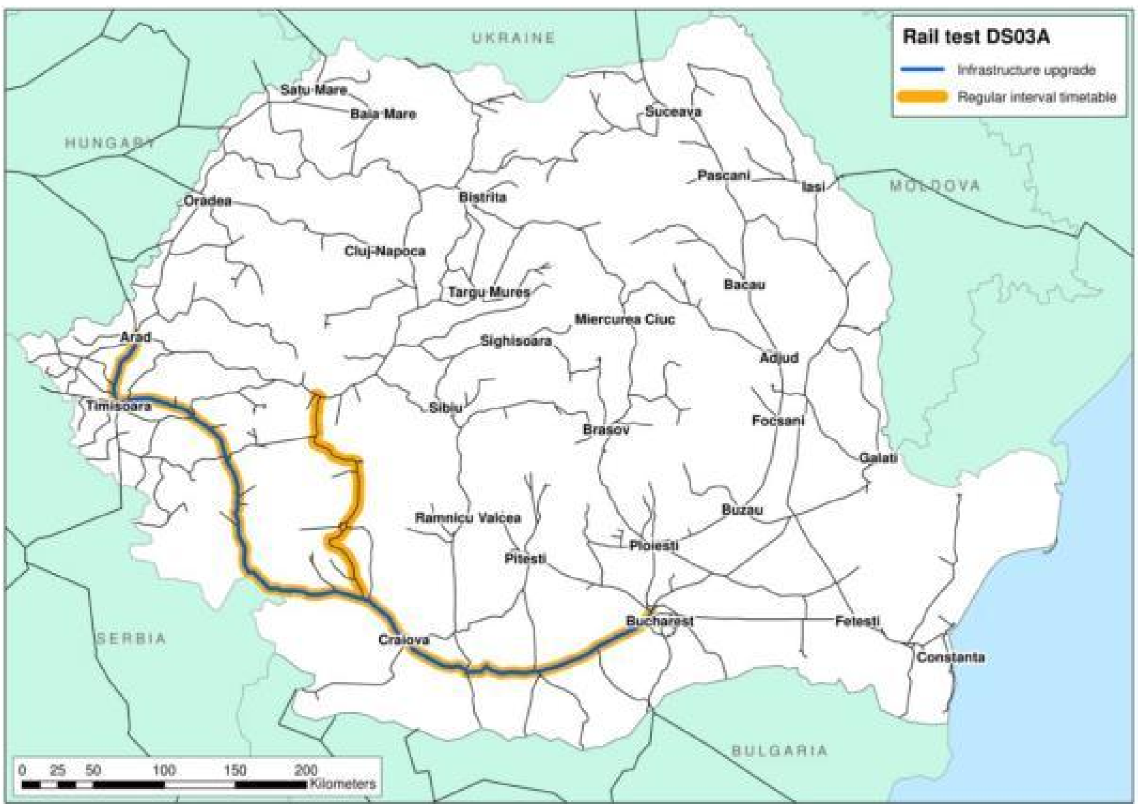
It has been estimated that the project could be implemented by 2020 if funding is secured.

Bucharest to Arad via Craiova to design speed (Test DS03A)

Proposal description

Upgrade programme for Core TEN-T corridor IV-S between Arad and Craiova and line 900 between Craiova and Bucharest; this test also contemplates a regular interval connection to Core TEN-T corridor IV-N via line 202. This project includes:

- Rehabilitation to design speed of corridor 900 between Bucharest and Timisoara and the section Timisoara to Arad.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Bucharest, Videle, Rosiori de Vede, Caracal, Craiova, Filiasi, Drobeta – Turnu Severin, Caransebes, Lugoj, Timisoara and Arad.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Arad via Timisoara (0.5 tph), Bucharest to Craiova (1 tph), Bucharest to Deva via Craiova (0.5 tph). Services to Deva could be extended to Cluj-Napoca if rail patronage increases.



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains on Core TEN-T corridor IV-S.

- Delays due to poor infrastructure condition and speed restrictions. Commercial speeds are below design parameters on many sections of the line (Bucharest to Videle, Olteni to Rosiori de Vede Nord ...)
- Low rail market share on the Bucharest – Craiova section. There is a considerable degree of suppressed demand between these cities due to the poor passenger service.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems in many stations along the corridor.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

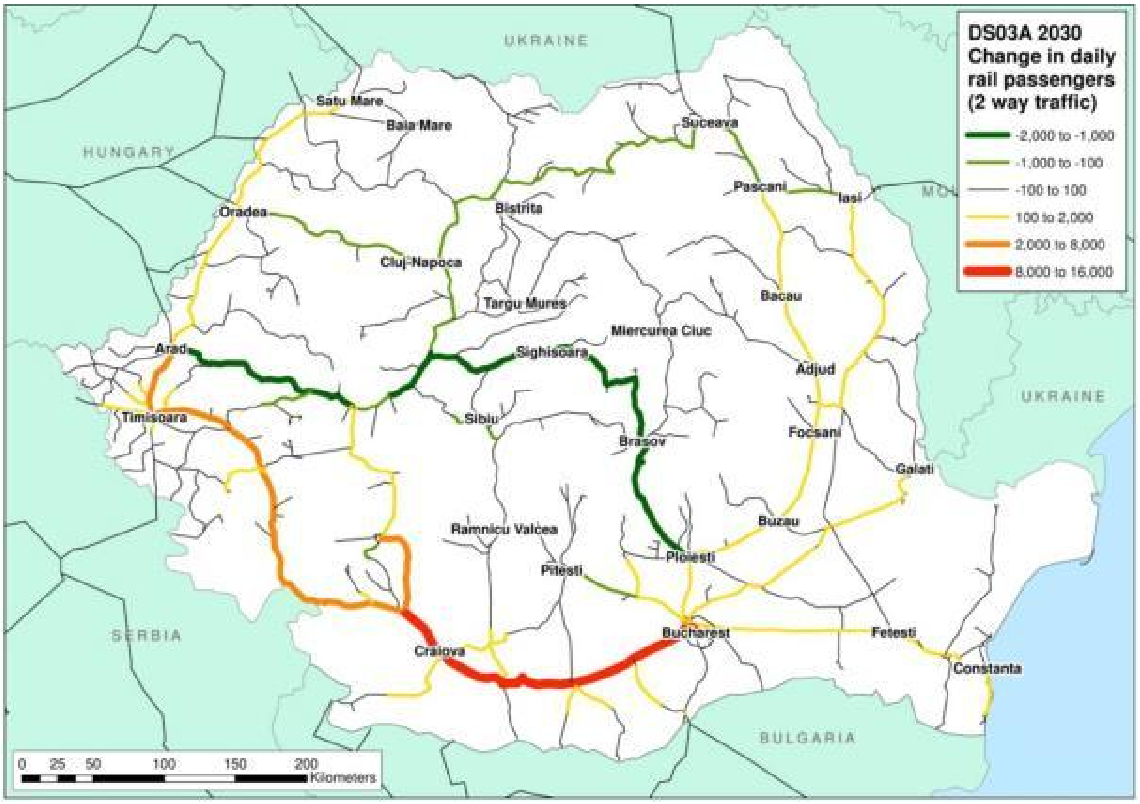
Item	**Undiscounted costs (Million €, 2014 prices)**	**Description of improvements included**
CAPEX	1,874	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	1,898	Additional train operating costs
Total	3,772	CAPEX + OPEX

Outcomes

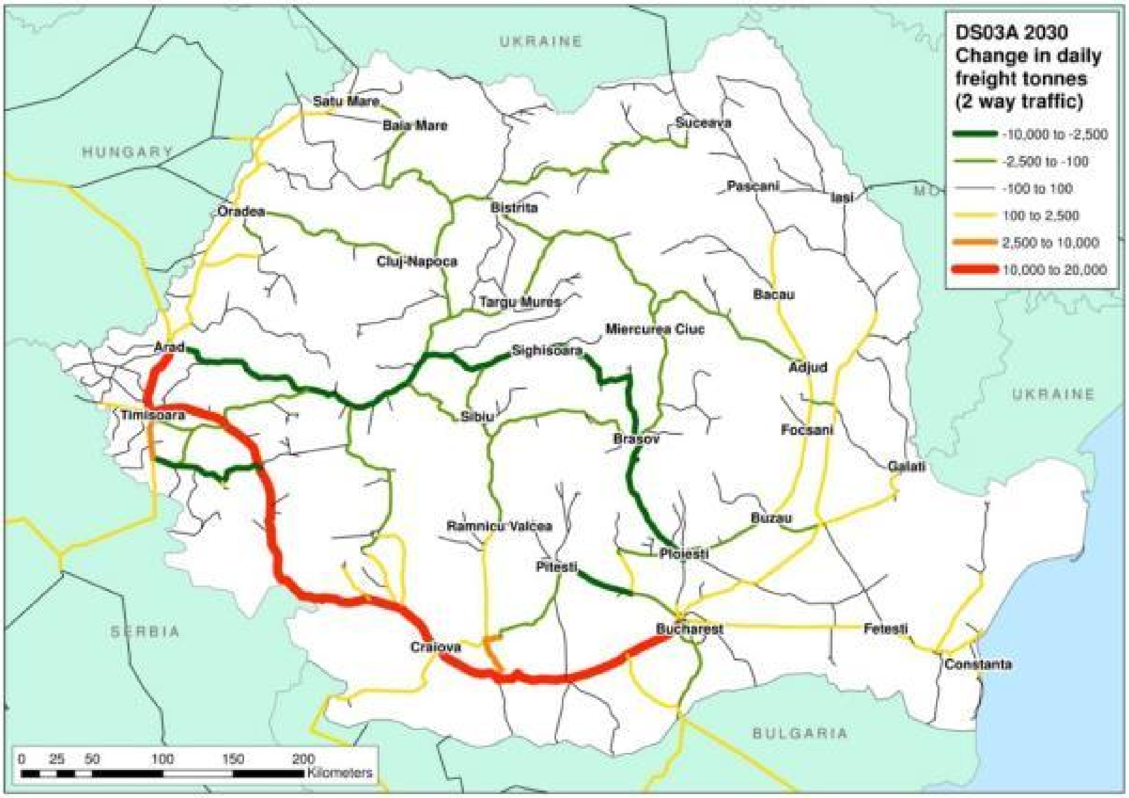
This intervention returns good value for money (BCR = 1.11), and a significant increase in rail passenger and freight traffic, of +23% and +9% respectively over the whole system, see table below:

Test code	**DS03A**
Overall inc. in Pass-km (1000's 2030)	+4,946 (+23%)
Overall inc. in Pass-km share (2030)	1.5%
Overall inc. in Tonne-km (1000,s 2030)	+4,101 (+9%)
Overall inc. Tonne-km share (2030)	1.2%
NPV € Mill (2014 Prices)	**111**
BCR	**1.09**
EIRR	**5.44%**
Upgraded main line infrastructure (track-km)	875
Required rolling stock units	21

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



As the image above demonstrates this project leads to an increase in passenger demand on the Bucharest – Craiova – Timisoara – Arad line. Patronage between Rosiori de Vede and Caracal is expected to grow by +125%, and by up to +180% between Craiova and Drobeta - Turnu Severin. There is a significant element of demand attraction from the line Bucharest – Brasov - Arad as a result of the improved passenger services. Demand between Brasov and Sighisoara has been forecast to fall by -30%.



Freight traffic is also expected to grow overall, with an increase in the number of tonnes transported of about +80% between Craiova and Filiasi. Similarly to the forecast trend for the passenger market, some freight traffic will transfer from the line Bucharest – Brasov – Arad to the upgraded corridor, freight traffic on that corridor has been estimated to fall by -40%.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

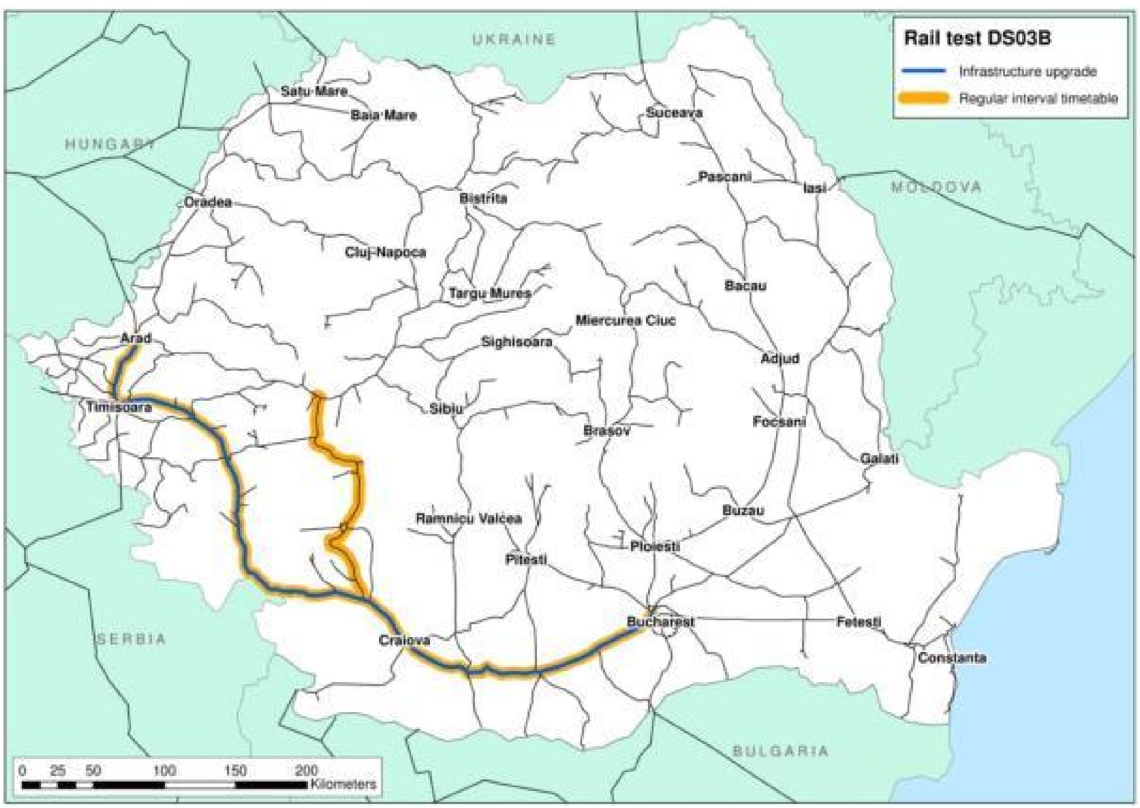
It has been estimated that the project could be implemented between 2020 and 2030 if funding is secured.

Bucharest to Arad via Craiova to enhanced speed (Test DS03B)

Proposal description

Upgrade programme for Core TEN-T corridor IV-S between Arad and Craiova and line 900 between Craiova and Bucharest; this test also contemplates a regular interval connection to Core TEN-T corridor IV-N via line 202. This project includes:

- Rehabilitation to design speed of corridor 900 between Bucharest and Timisoara and the section Timisoara to Arad.
- Rehabilitation to enhanced speed of sections with design speed below 100 km/h on the Bucharest to Arad via Timisoara corridor.
- Steady state maintenance of the core network (baseline assumption for Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Bucharest, Videle, Rosiori de Vede, Caracal, Craiova, Filiasi, Drobeta – Turnu Severin, Caransebes, Lugoj, Timisoara and Arad.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Arad via Timisoara (0.5 tph), Bucharest to Craiova (1 tph), Bucharest to Deva via Craiova (0.5 tph). The service to Deva could be extended to Cluj-Napoca if rail patronage increases.



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains on Core TEN-T corridor IV-S.

- Low design speeds of some sections on the stretch Drobeta-Turnu Severin to Caransebes.
- Delays due to poor infrastructure condition and speed restrictions. Commercial speeds are below design parameters on many sections of the line (Bucharest to Videle, Olteni to Rosiori de Vede Nord ...)
- Low rail market share on the Bucharest – Craiova section. There is a considerable degree of suppressed demand between these cities due to the poor passenger service.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems in many stations along the corridor.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	2,259	Rehabilitation of track to provide current or enhanced design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	1,893	Additional train operating costs
Total	4,152	CAPEX + OPEX

Outcomes

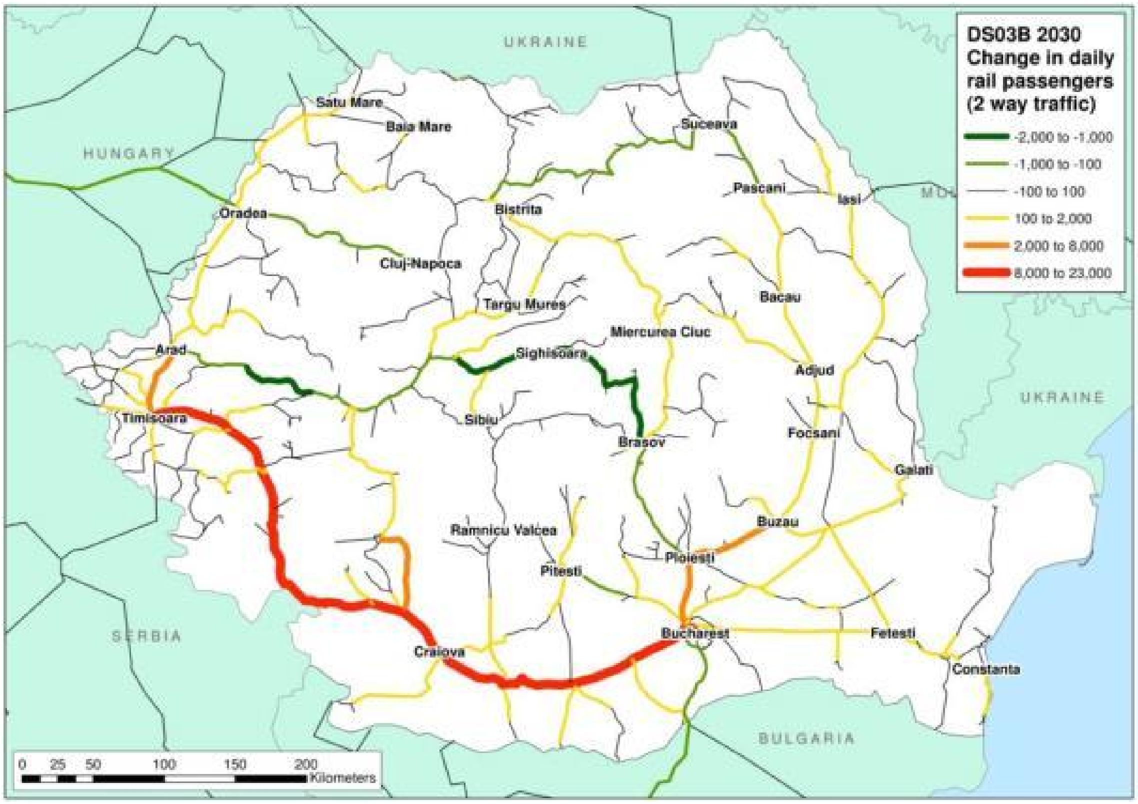
This intervention returns lower value for money than alternative DS03A (BCR =1.02), and a greater increase in rail passenger and freight traffic than DS03A, +27% and +9% respectively over the whole system, see table below:

Test code	**DS03B**
Overall inc. in Pass-km (1000's 2030)	+5,721 (+27%)
Overall inc. in Pass-km share (2030)	1.7%
Overall inc. in Tonne-km (1000,s 2030)	+4,083 (+9%)
Overall inc. Tonne-km share (2030)	1.2%
NPV € Mill (2014 Prices)	**32**
BCR	**1.02**
EIRR	**5.11%**
Upgraded main line infrastructure (track-km)	875

Test code **DS03B**

Required rolling stock units 21

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



As the image above demonstrates this project leads to an increase in passenger demand on the Bucharest – Craiova – Timisoara – Arad line. Patronage between Rosiori de Vede and Caracal is expected to grow by +125%, and by up to +180% between Craiova and Drobeta - Turnu Severin. There is a significant element of demand attraction from the line Bucharest – Brasov - Arad as a result of the improved passenger services. Demand between Brasov and Sighisoara has been forecast to fall by -35%.

Changes in freight flows on this test are similar to DS03A.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

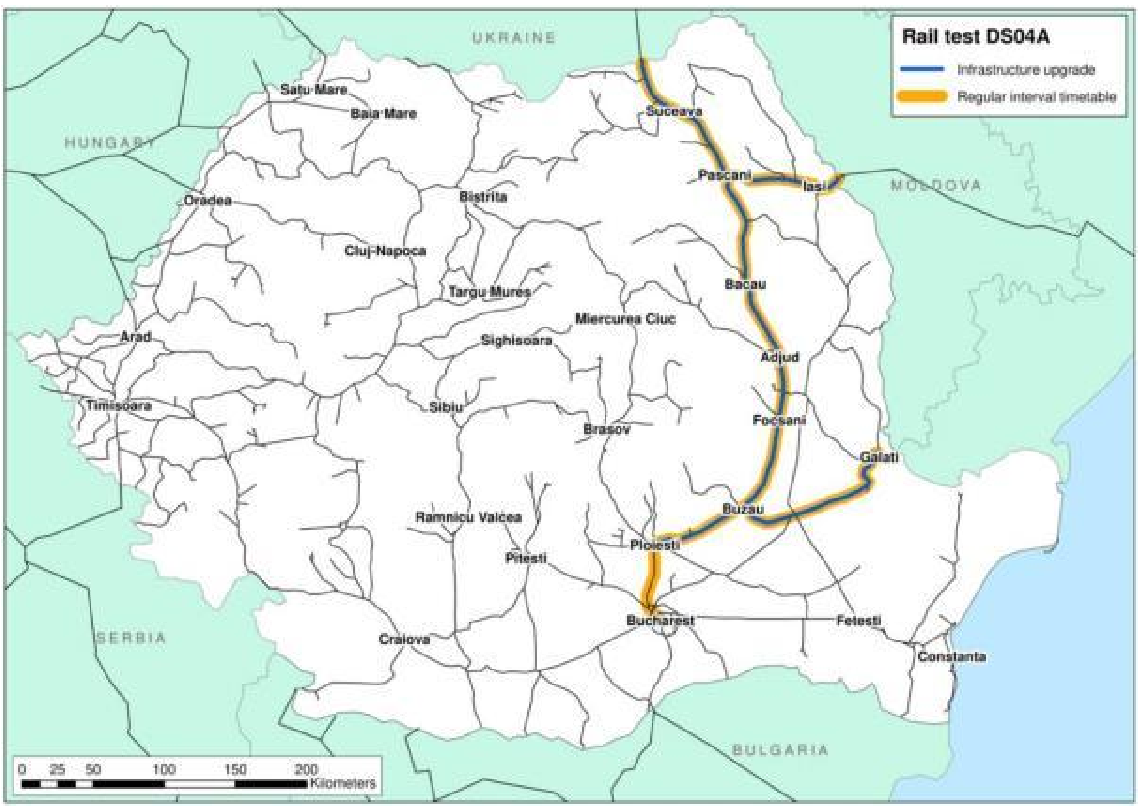
It has been estimated that the project could be implemented between 2020 and 2030 if funding is secured.

Core TEN-T corridor IX and links Buzau to Galati and Pascani to Suceava to design speed (Test DS04A)

Proposal description

Upgrade programme for Core TEN-T corridor IX between Ploiesti and Iasi, Pascani to Suceava of line 500 and Buzau to Galati of lines 702 and 700. This project includes:

- Rehabilitation to design speed of: Core TEN-T corridor IX between Ploiesti and Iasi, line 500 between Pascani and Suceava and line 700 between Buzau and Galati.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to increase safety and efficiency.
- Improved station facilities at Bucharest, Ploiesti, Buzau, Ramnicu Sarat, Focsani, Marasesti, Adjud, Bacau, Roman, Pascani, Dolhasca, Veresti, Suceava, Faurei, Braila, Galati, Targu Frumos and Iasi.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Galati (0.5 tph), Bucharest to Iasi via Bacau (0.5 tph), Bucharest to Suceava (0.5 tph), Bucharest to Focsani (0.5 tph), Suceava to Iasi (0.5 tph)



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains between Bucharest and the East / Northeast Romania.
- Delays due to poor infrastructure condition, commercial speeds below design parameters along the considered corridors. For example, the maximum speed between Ploiesti and Suceava is limited to 80 km/h, 40 km/h below design parameters.

- Low rail market between Bucharest and major cities on corridor 500, rail is not competitive versus road on the corridor.
- Passenger trains travelling between Bucharest and Iasi need to either change traction before joining corridor 600, or run as diesel units between Bucharest and Tecuci.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

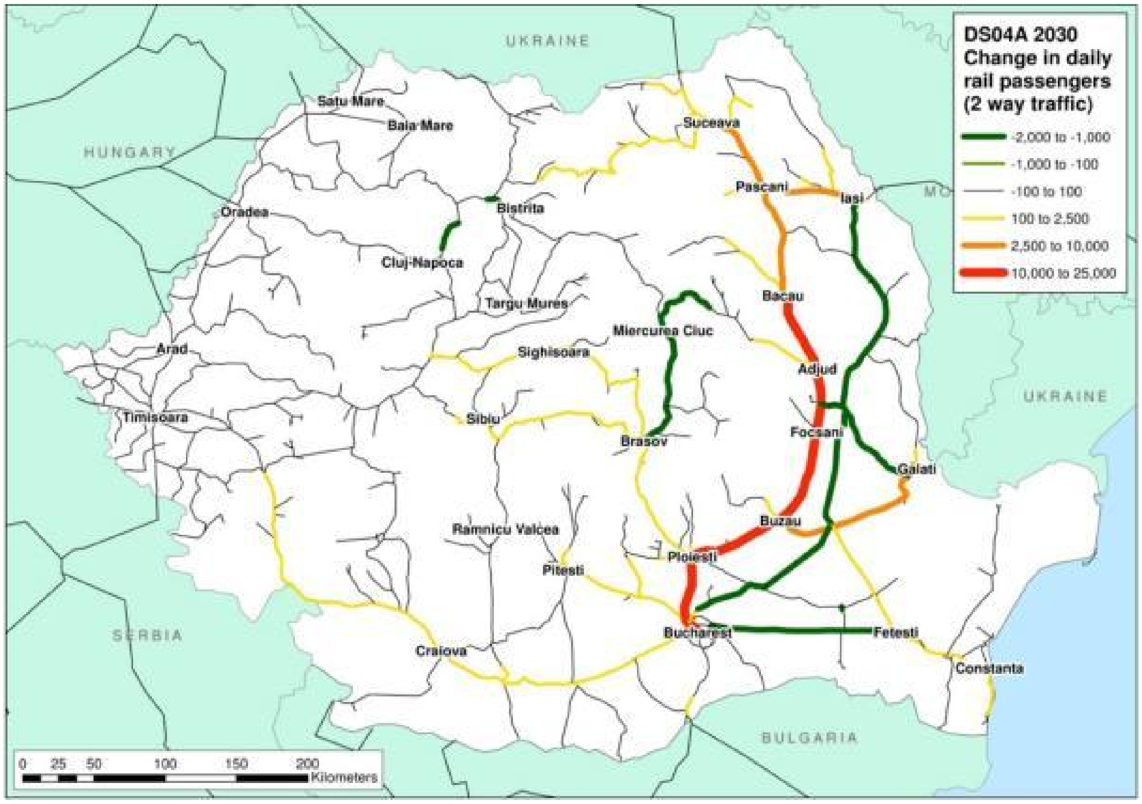
Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	2,567	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	659	Additional train operating costs
Total	3,226	CAPEX + OPEX

Outcomes

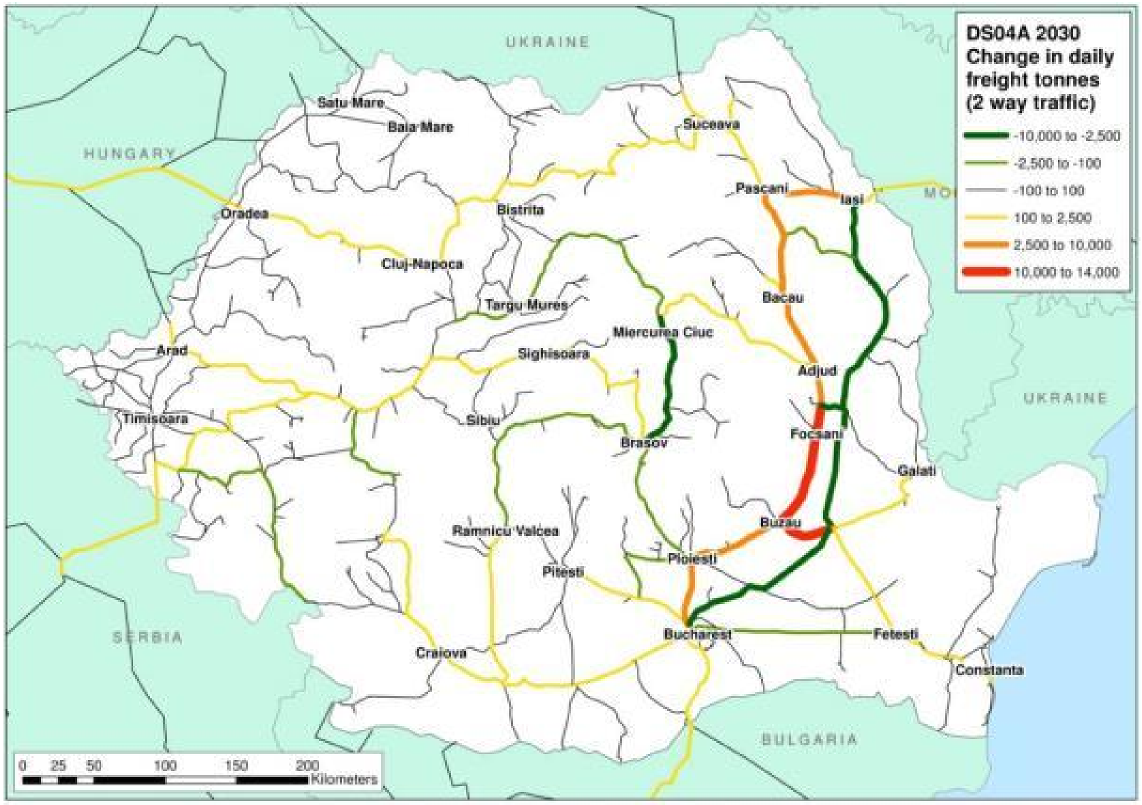
This intervention returns good value for money (BCR = 1.27), and a significant increase in rail passenger and freight traffic, of +32% and +5% respectively over the whole system, see table below:

Test code	**DS04A**
Overall inc. in Pass-km (1000's 2030)	+6,783 (+32%)
Overall inc. in Pass-km share (2030)	2.0%
Overall inc. in Tonne-km (1000,s 2030)	+2,159 (+5%)
Overall inc. Tonne-km share (2030)	0.6%
NPV € Mill (2014 Prices)	**465**
BCR	**1.27**
EIRR	**6.31%**
Upgraded main line infrastructure (track-km)	1,260
Required rolling stock units	28

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



The key consequence of this test is a significant increase in the overall passenger demand, with the upgraded corridor experiencing a marked grow in total demand: +115% between Buzau and Focsani, +180% between Faurei and Galati, +130% between Pascani and Iasi and +85% from Pascani to Suceava. Since the upgraded corridor becomes the faster route to the Northeast, line 600 loses about 45% of its passenger traffic in the reference scenario.



Core Corridor Ten-T IX also attracts significant freight demand, +175% between Buzau and Focsani and +165% from Bacau to Pascani. In contrast the number of tonnes transported between Barlad and Vaslui falls by -50%.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

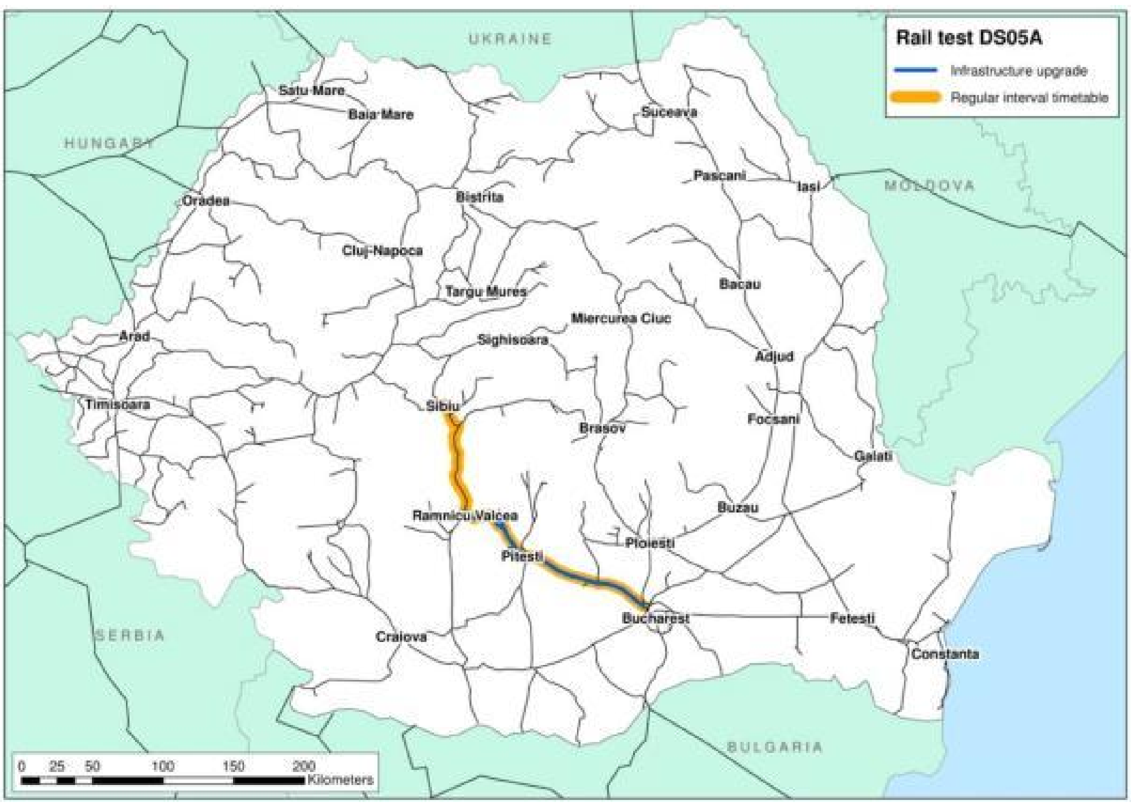
It has been estimated that the project could be implemented by 2030 if funding is secured.

Line Bucharest to Pitesti to design speed and new link Videle - Ramnicu Valcea (Test DS05A)

Proposal description

Upgrade programme for the line Bucharest to Pitesti to design speed and new rail link between Videle and Ramnicu Valcea, this project includes 4 local stations on the new link. Passenger services on this test are extended to Ramincu Valcea and Sibiu. This project includes:

- Rehabilitation to design speed of corridor 901 between Bucharest and Pitesti.
- New rail link between Valcele and Ramnicu Valcea, some infrastructure elements already exist on the line.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Bucharest Nord, Titu, Gaesti, Pitesti, Valcele, Ramnicu Valcea Nord, Talmaciu and Sibiu.
- InterRegio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Ramnicu Valcea (0.5 tph), Bucharest to Sibiu via Pitesti (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds between Bucharest and Pitesti.
- Poor rail connectivity of passenger trains between Bucharest and Ramnicu Valcea / Sibiu.
- No direct route available for freight trains travelling from Constanta towards the Northwest and central Europe.

- Delays due to poor infrastructure condition, commercial speeds below design parameters between Chitila and Ghergani.
- Low rail market share on the Bucharest to Pitesti section, rail is not competitive versus road on the corridor, there is a motorway parallel to the rail line.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

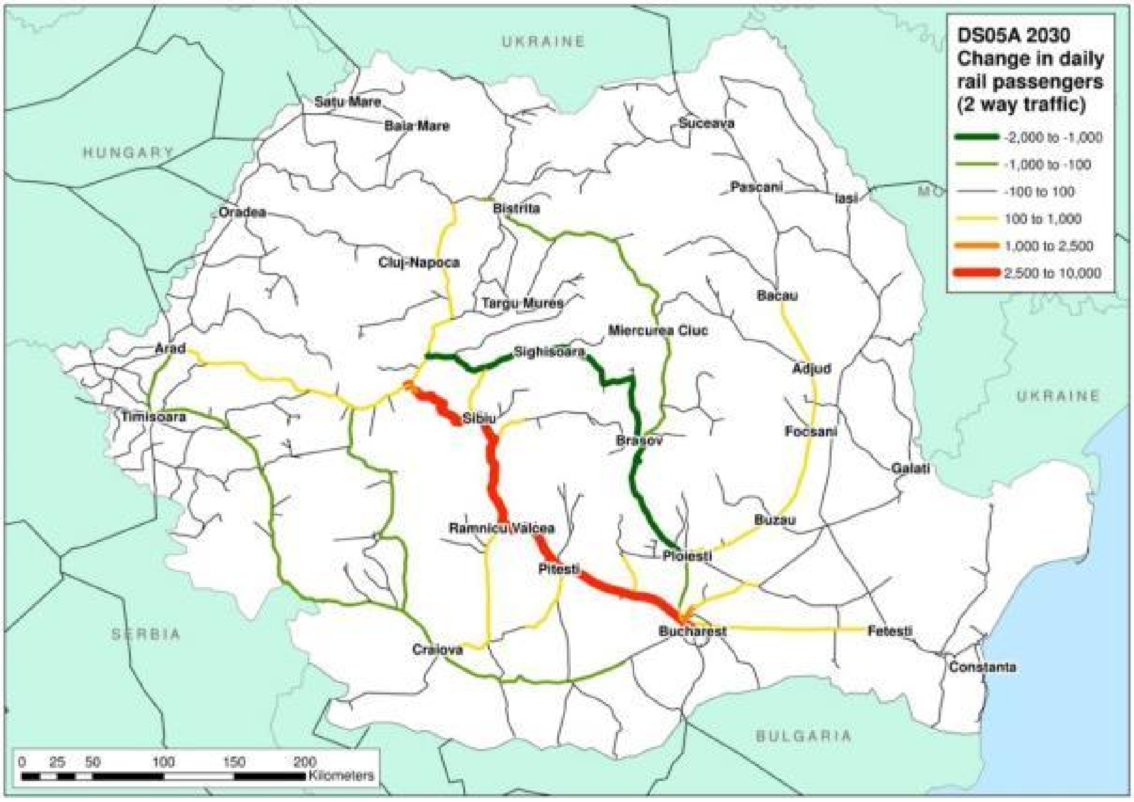
Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	628	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rail link New rolling stock Improved station facilities
OPEX	92	Additional train operating costs
Total	719	CAPEX + OPEX

Outcomes

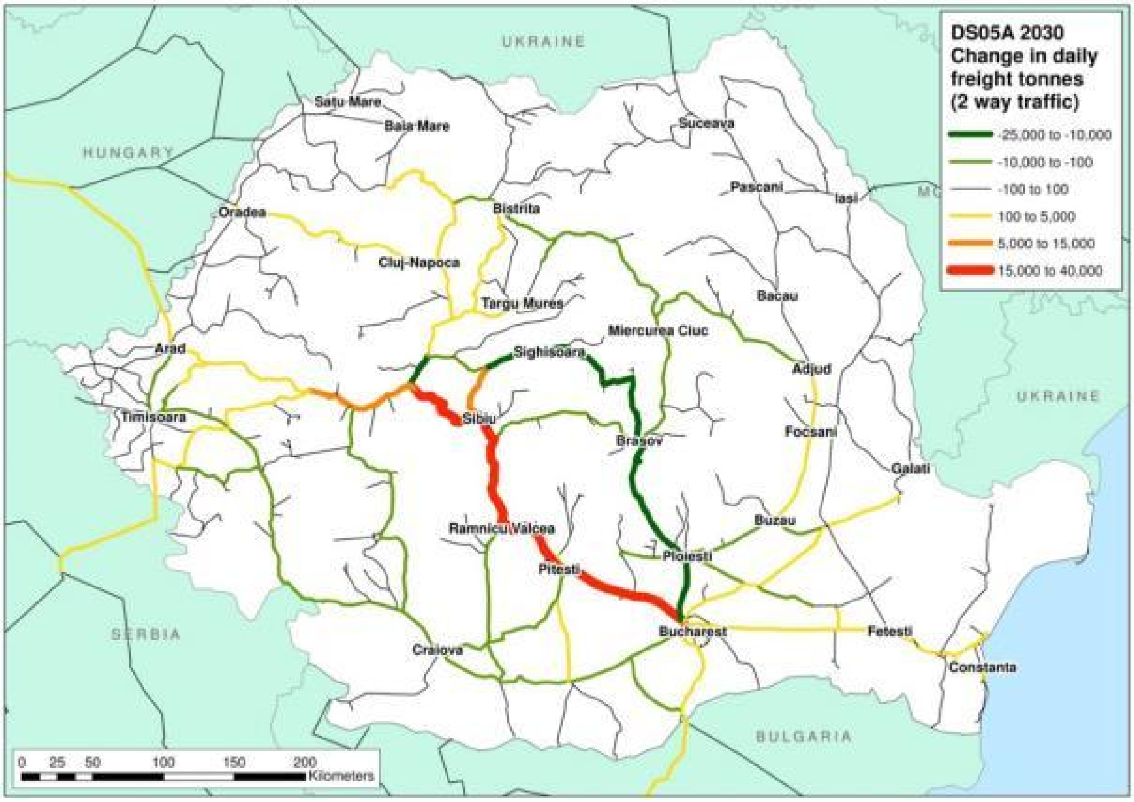
This intervention returns very low value for money (BCR = 0.01), and a sensible increase in rail passenger and freight traffic, of +6% and +3% respectively, see table below. It is to notice that the significant local pollution generated by diesel freight trains drives the poor results of this test.

Test code	**DS05A**
Overall inc. in Pass-km (1000's 2030)	+1,253 (+6%)
Overall inc. in Pass-km share (2030)	0.4%
Overall inc. in Tonne-km (1000,s 2030)	+1,435 (+3%)
Overall inc. Tonne-km share (2030)	0.5%
NPV € Mill (2014 Prices)	**- 448**
BCR	**0.01**
EIRR	**- 11.07%**
Upgraded main line infrastructure (track-km)	320
Required rolling stock units	8

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



This project leads to a marked increase in passenger traffic travelling between Bucharest and the Pitesti / Ramnicu Valcea / Sibiu area. Patronage between Bucharest and Pitesti grows by +130%, whilst traffic West of Pitesti soars with growth coefficients up to 10 to 15 times the demand forecast in the Reference scenario. Traffic on routes parallel to the upgraded corridor is expected to fall slightly as the image above demonstrates.



The new link constructed on this test attracts significant freight traffic to the studied line which becomes the more direct route between Bucharest and the Northeast. Whilst freight demand on the section Bucharest to Pitesti grows sharply by about +320%, traffic surges West of Pitesti.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

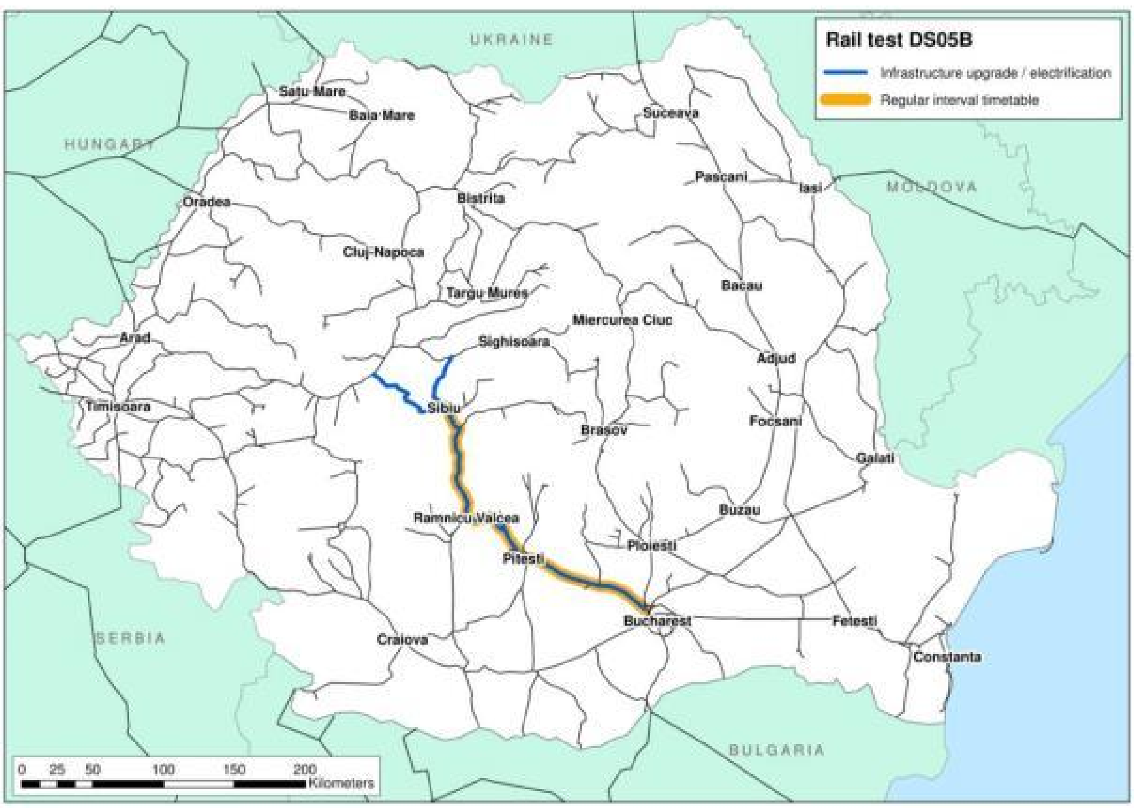
It has been estimated that the project could be implemented by 2020 if funding is secured.

Line Bucharest – Pitesti to design speed, new link Videle - Ramnicu Valcea and line electrification (Test DS05B)

Proposal description

Upgrade programme for the line Bucharest to Pitesti to design speed and new rail link between Videle and Ramnicu Valcea, this project includes 4 local stations on the new link. Passenger services on this test are extended to Ramnicu Valcea and Sibiu. This project includes:

- Rehabilitation to design speed of corridor 901 between Bucharest and Pitesti.
- New rail link between Valcele and Ramnicu Valcea, some infrastructure elements already exist on the line.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Electrification of the lines: Bucharest to Pitesti, Pitesti to Ramnicu Valcea (via the new link), Ramnicu Valcea to Sibiu, Sibiu to Core Ten-T corridor IV-N (Southwest of Alba Iulia) and corridor 208.
- Improved station facilities at Bucharest Nord, Titu, Gaesti, Pitesti, Valcele, Ramnicu Valcea Nord, Talmaciu and Sibiu.
- InterRegio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Bucharest to Ramnicu Valcea (0.5 tph), Bucharest to Sibiu via Pitesti (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds between Bucharest and Pitesti.
- Poor rail connectivity of passenger trains between Bucharest and Ramnicu Valcea / Sibiu
- No direct route available for freight trains travelling from Constanta towards the Northwest and central Europe.
- Delays due to poor infrastructure condition, commercial speeds below design parameters between Chitila and Ghergani.
- Low rail market share on the Bucharest to Pitesti section, rail is not competitive versus road on the corridor, there is a motorway parallel to the rail line.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems.
- Significant local emissions forecast in test DS05A.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	948	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rail link Line electrification New rolling stock Improved station facilities
OPEX	489	Additional train operating costs
Total	1,437	CAPEX + OPEX

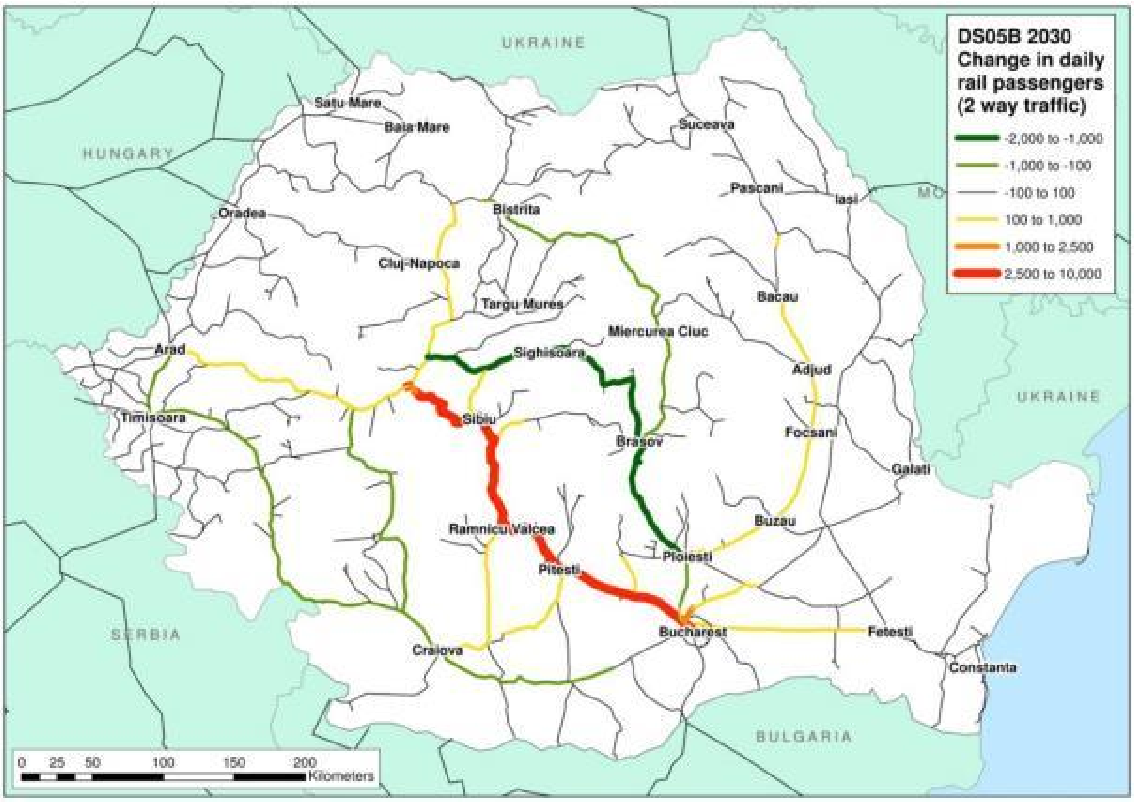
Outcomes

This intervention returns a good value for money (BCR = 1.66), and a sensible increase in rail passenger and freight traffic, of +6% and +2% respectively over the whole system, see table below:

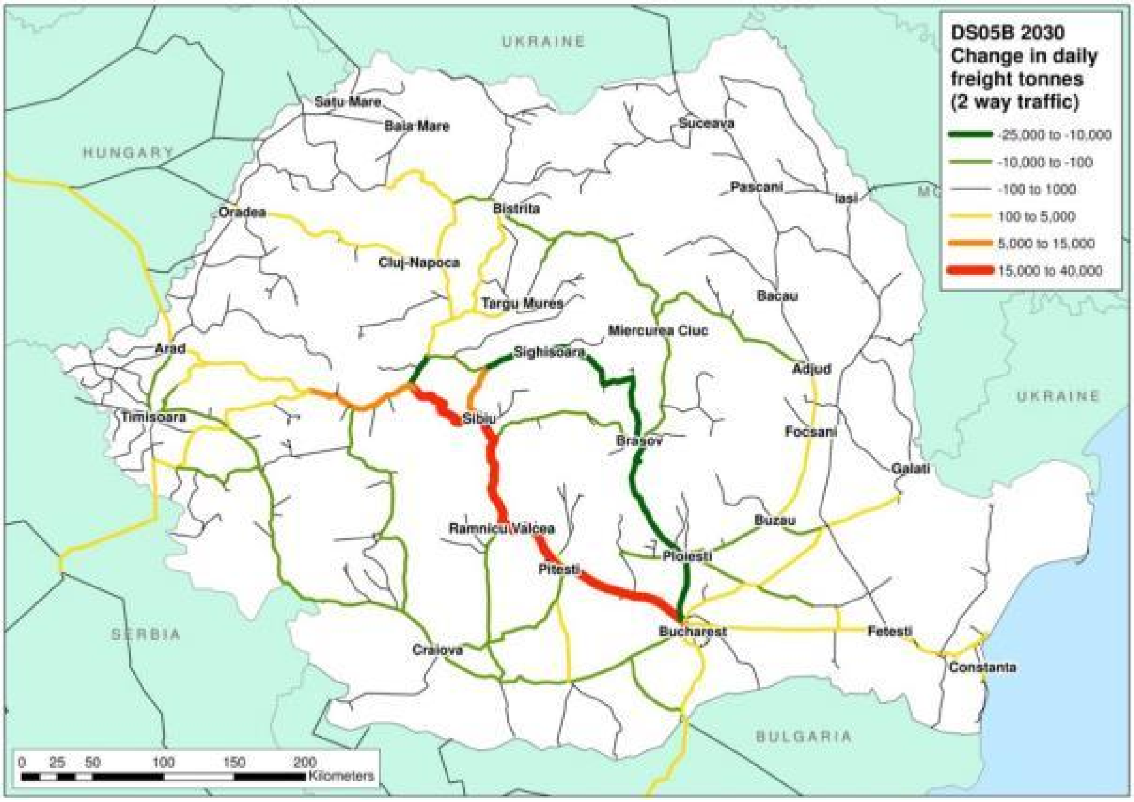
Test code	**DS05B**
Overall inc. in Pass-km (1000's 2030)	+1,238 (+6%)
Overall inc. in Pass-km share (2030)	0.4%
Overall inc. in Tonne-km (1000,s 2030)	+1,358 (+2%)
Overall inc. Tonne-km share (2030)	0.4%
NPV € Mill (2014 Prices)	**545**
BCR	**1.66**

Test code	**DS05B**
EIRR	**8.36%**
Upgraded main line infrastructure (track-km)	320 (line upgrade)
	520 (electrification)
Required rolling stock units	8

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



This project leads to a marked increase in passenger traffic travelling between Bucharest and the Pitesti / Ramnicu Valcea / Sibiu area. Patronage between Bucharest and Pitesti grows by +130%, whilst traffic West of Pitesti soars with growth coefficients up to 10 to 15 times the demand forecast in the Reference scenario. Traffic on routes parallel to the upgraded corridor is expected to fall slightly as the image above demonstrates.



The new link constructed on this test attracts significant freight traffic to the upgraded corridor which becomes the more direct link between Bucharest and the Northeast. Whilst freight demand on the section Bucharest to Pitesti grows sharply by about +320%, traffic surges West of Pitesti.

Implementing organisation
This scheme would be implemented by CFR SA and the Rail Operating Companies

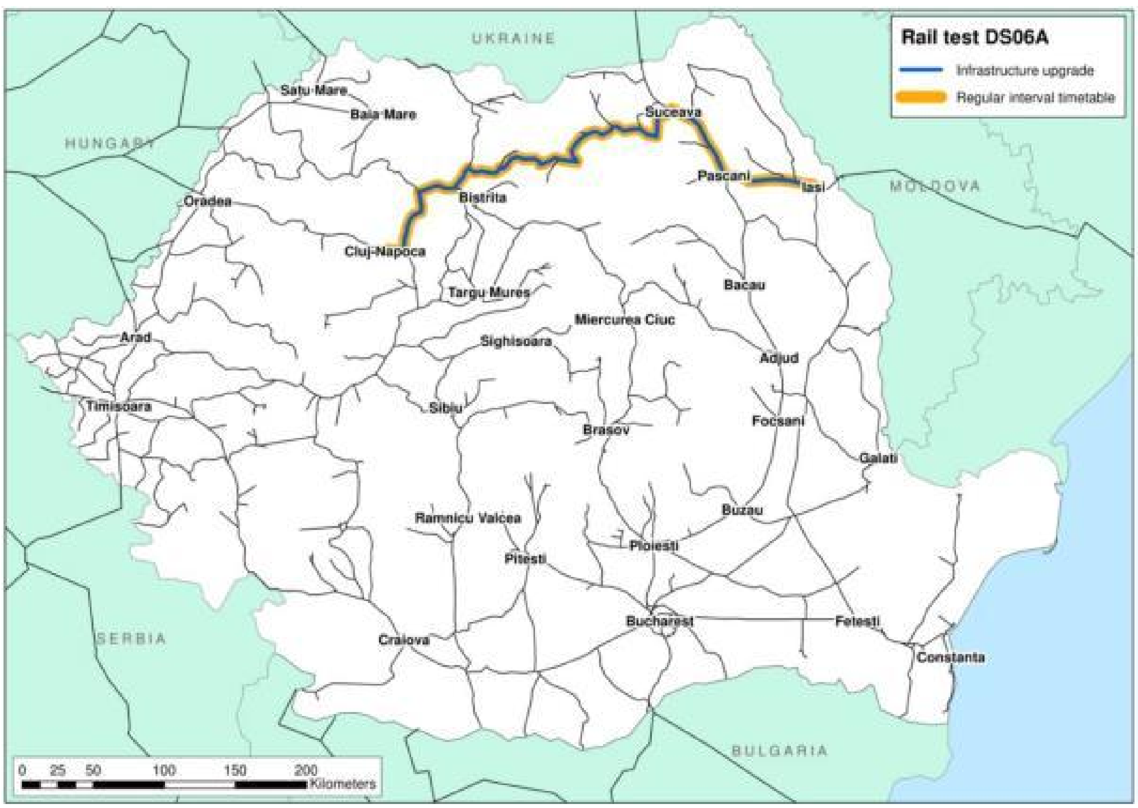
Implementation years
It has been estimated that the project could be implemented by 2020 if funding is secured.

Line Cluj-Napoca to Iasi to design speed (Test DS06A)

Proposal description

Upgrade programme for the rail line between Cluj-Napoca and Iasi, via Beclean and Suceava. This project includes:

- Rehabilitation to design speed of: line 300 between Cluj-Napoca and Apahida, line 401 between Apahida and Dej, line 400 between Dej and Beclean, line 401 between Beclean and Ilva Mica, line 502 between Ilva Mica and Suceava, line 500 between Suceava and Pascani and line 606 between Pascani and Iasi.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Cluj-Napoca, Gherla, Dej Calatori, Beclean pe Somes, Salva, Ilva Mica, Vatra Dornei, Campulung Moldovenesc, Suceava, Veresti, Dolhasca, Pascani, Targu Frumos and Iasi.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Cluj-Napoca to Iasi (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds between Cluj-Napoca and Iasi.
- Delays due to poor infrastructure condition and existing speed restrictions, commercial speeds below design parameters on several corridors, for example between Dej Calatori and Beclean.
- Poor rolling stock and station facilities condition, country wide issue.

- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

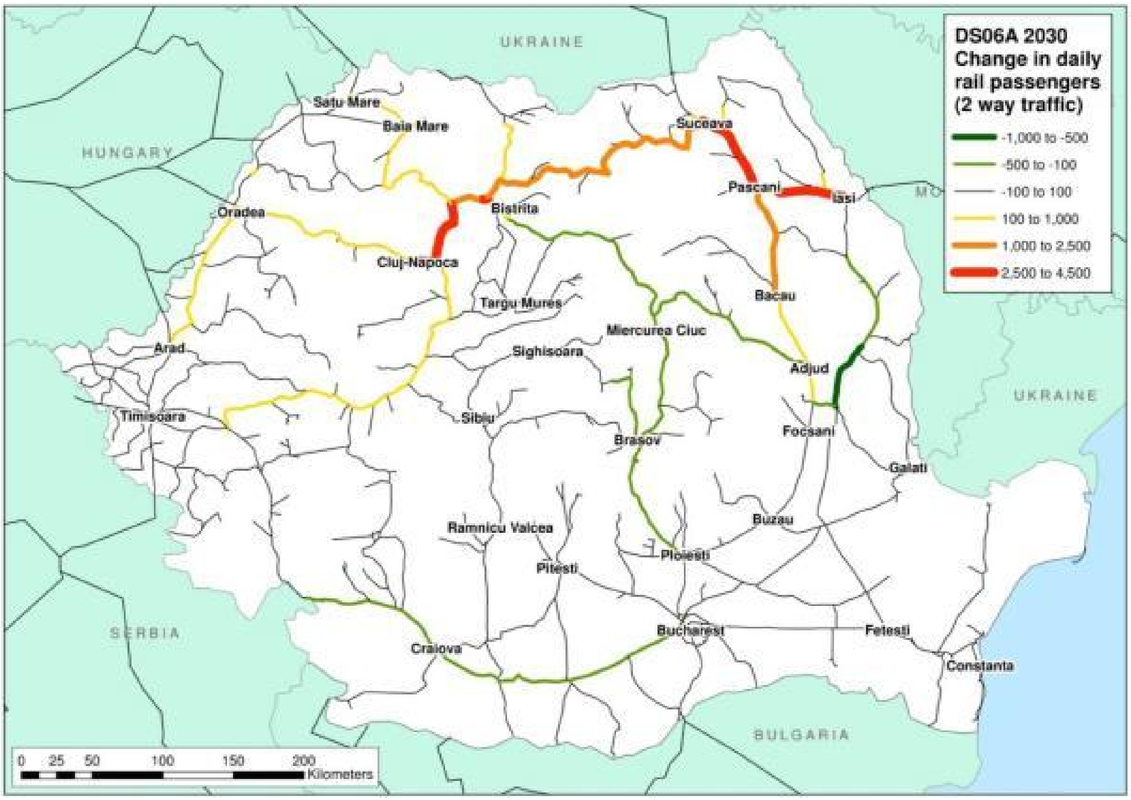
Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	2,163	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	55	Additional train operating costs
Total	2,218	CAPEX + OPEX

Outcomes

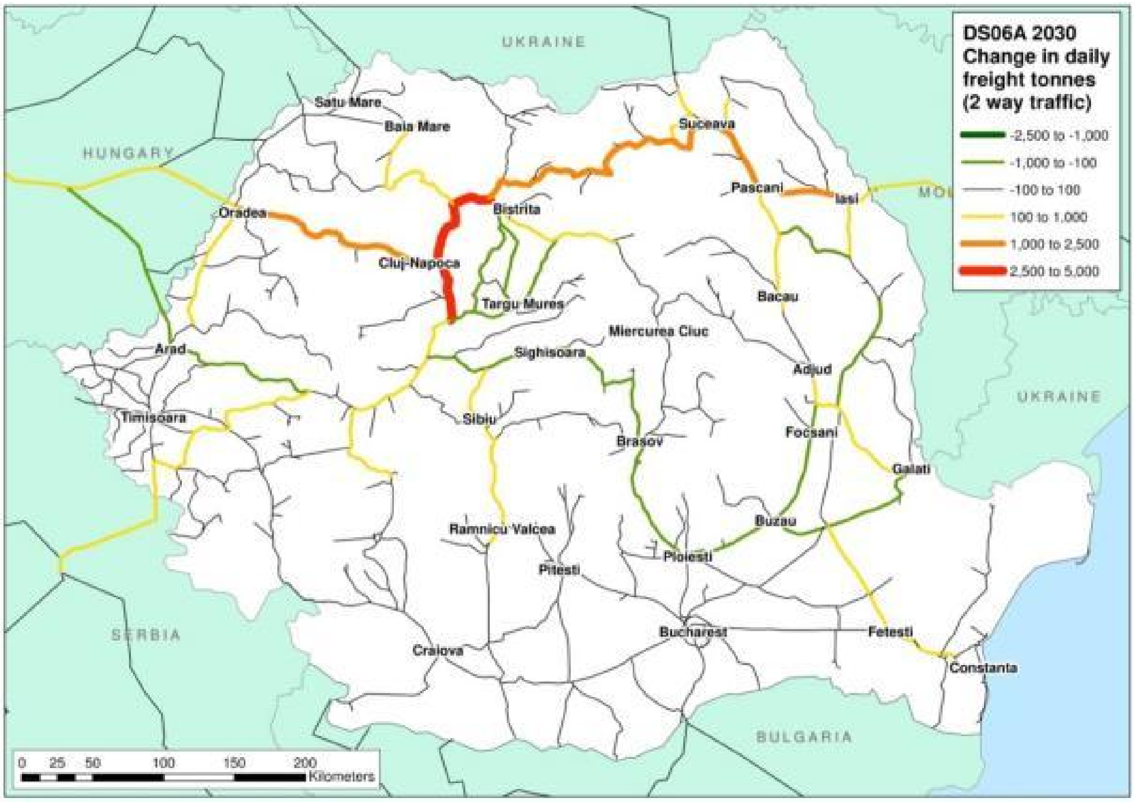
This intervention returns poor value for money (BCR = 0.40), and a small increase in rail passenger and freight traffic, of +7% and +3% respectively over the whole system, see table below:

Test code	**DS06A**
Overall inc. in Pass-km (1000's 2030)	+1,390 (+7%)
Overall inc. in Pass-km share (2030)	0.4%
Overall inc. in Tonne-km (1000,s 2030)	+1,220 (+3%)
Overall inc. Tonne-km share (2030)	0.3%
NPV € Mill (2014 Prices)	**-902**
BCR	**0.40**
EIRR	**0.39%**
Upgraded main line infrastructure (track-km)	740
Required rolling stock units	8

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



Passenger traffic on the upgraded corridor has been forecast to grow significantly, with an average demand increase between Apahida and Dej of +60%, and of +70% between Ilva Mica and Suceava. This figure drops to +50% between Suceava and Pascani. Corridors 400 and 501 will see a slight reduction in passenger traffic as the image above illustrates.



The most noticeable increase in freight demand in this scenario is expected between Apahida and Beclean, freight traffic through Gherla rises for instance by almost 5,000 tonnes per day (+115%). Freight traffic also increases sharply on the rest of the upgraded corridor, +45% between Floreni and Vatra Dornei, and +15% between Veresti and Dolhasca.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

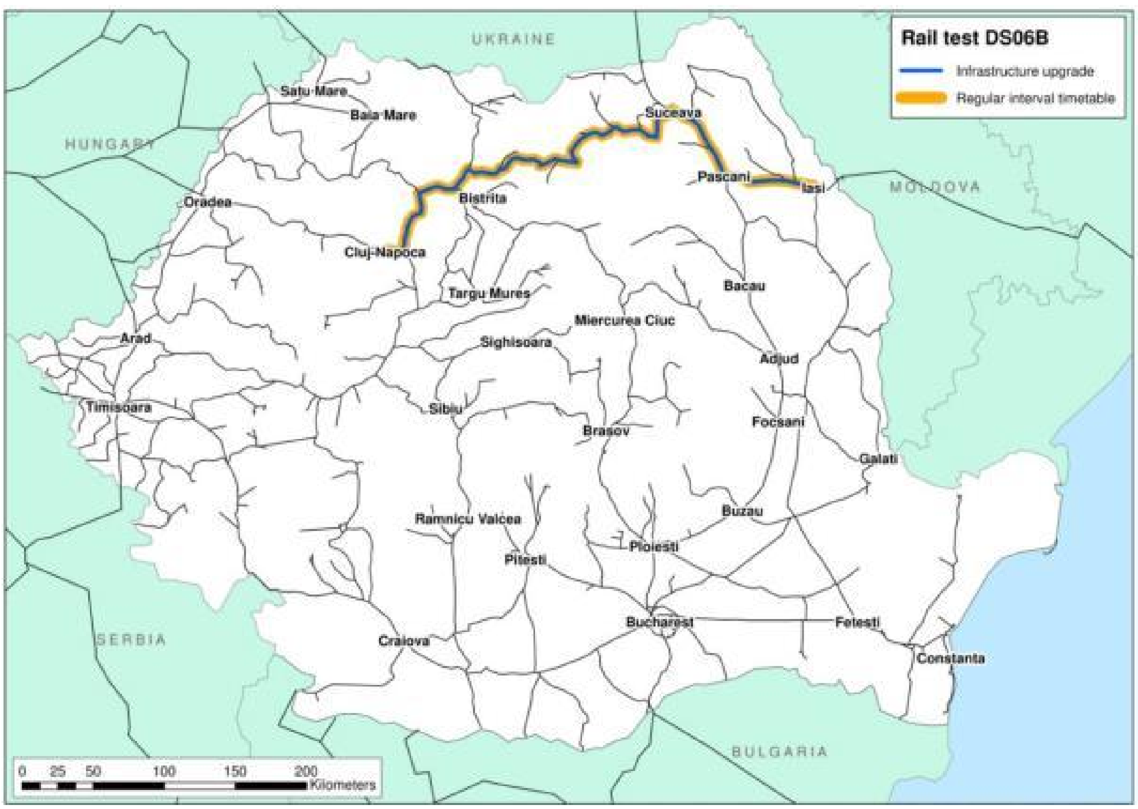
It has been estimated that the project could be implemented by 2030 if funding is secured.

Line Cluj-Napoca to Iasi to enhanced speed (Test DS06B)

Proposal description

Upgrade programme for the rail line between Cluj-Napoca and Iasi, via Beclean and Suceava. This project includes:

- Rehabilitation to design speed of: line 300 between Cluj-Napoca and Apahida, line 401 between Apahida and Dej, line 400 between Dej and Beclean, line 401 between Beclean and Ilva Mica, line 502 between Ilva Mica and Suceava, line 500 between Suceava and Pascani and line 606 between Pascani and Iasi.
- Rehabilitation to enhanced speed of sections with design speed below 100 km/h on the Cluj-Napoca to Iasi corridor.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Cluj-Napoca, Gherla, Dej Calatori, Beclean pe Somes, Salva, Ilva Mica, Vatra Dornei, Campulung Moldovenesc, Suceava, Veresti, Dolhasca, Pascani, Targu Frumos and Iasi.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Cluj-Napoca to Iasi (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds between Cluj-Napoca and Iasi.

- Delays due to poor infrastructure condition and existing speed restrictions, commercial speeds below design parameters on several corridors, for example between Dej Calatori and Beclean.
- Low design speeds of some sections on the Cluj-Napoca to Iasi corridor.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

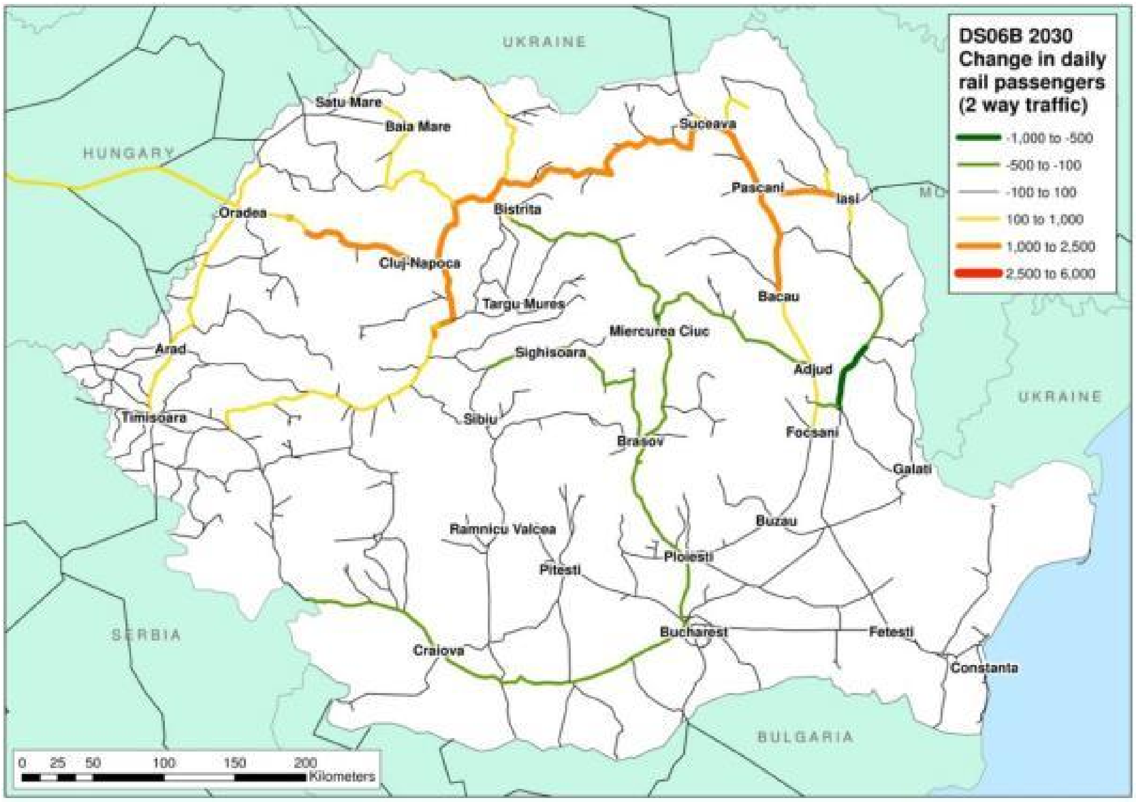
Item	**Undiscounted costs (Million €, 2014 prices)**	**Description of improvements included**
CAPEX	2,946	Rehabilitation of track to provide current or enhanced design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	61	Additional train operating costs
Total	3,007	CAPEX + OPEX

Outcomes

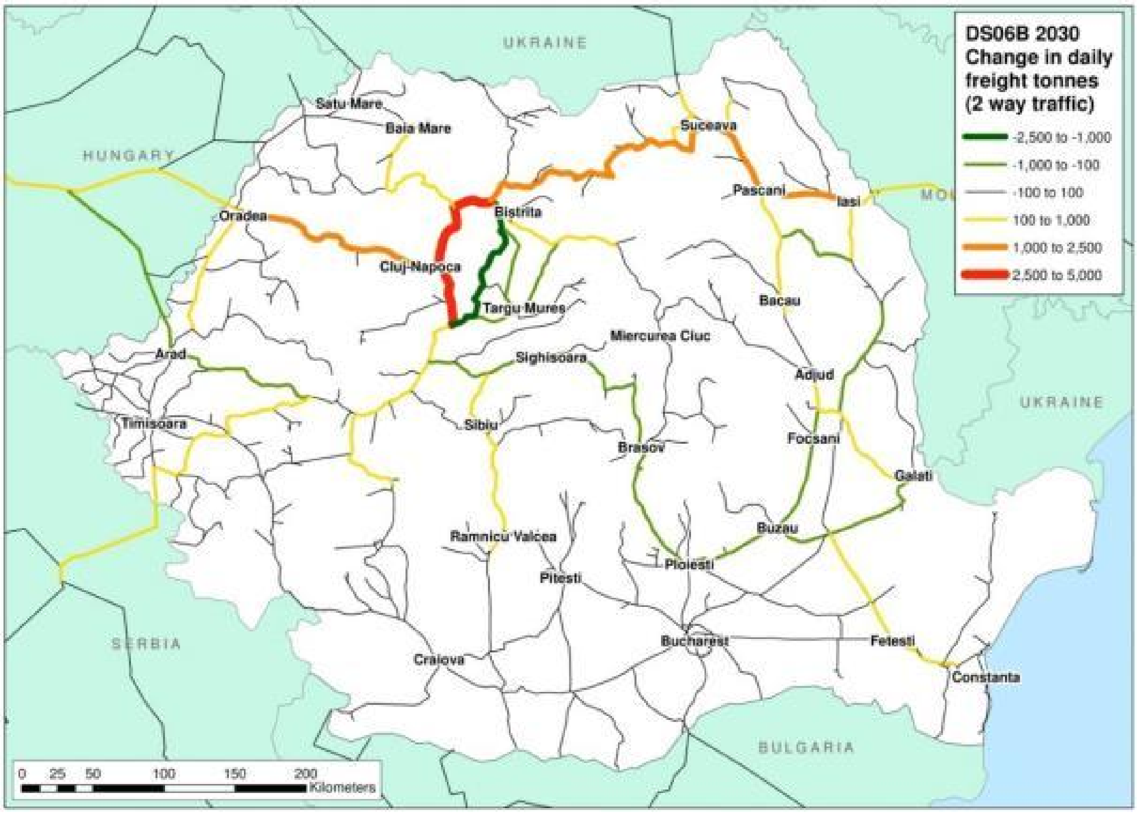
This intervention returns poor value for money (BCR = 0.36), and a small increase in rail passenger and freight traffic, of +10% and +3% respectively over the whole system, see table below:

Test code	**DS06B**
Overall inc. in Pass-km (1000's 2030)	+2,156 (+10%)
Overall inc. in Pass-km share (2030)	0.6%
Overall inc. in Tonne-km (1000,s 2030)	+1,221 (+3%)
Overall inc. Tonne-km share (2030)	0.3%
NPV € Mill (2014 Prices)	**-1,325**
BCR	**0.36**
EIRR	**-0.21%**
Upgraded main line infrastructure (track-km)	740
Required rolling stock units	8

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



Passenger traffic on the upgraded corridor has been forecast to grow significantly, with an average demand increase between Apahida and Dej of +85%, and of +135% between Ilva Mica and Suceava. This figure drops to +70% between Suceava and Pascani. Corridors 400 and 501 will see a slight reduction in passenger traffic as the image above illustrates.



The most noticeable increase in freight demand in this scenario is expected between Apahida and Beclean, freight traffic through Gherla rises for instance by almost 5,000 tonnes per day (+115%). Freight traffic also increases sharply on the rest of the upgraded corridor, +45% between Floreni and Vatra Dornei, and +15% between Veresti and Dolhasca.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

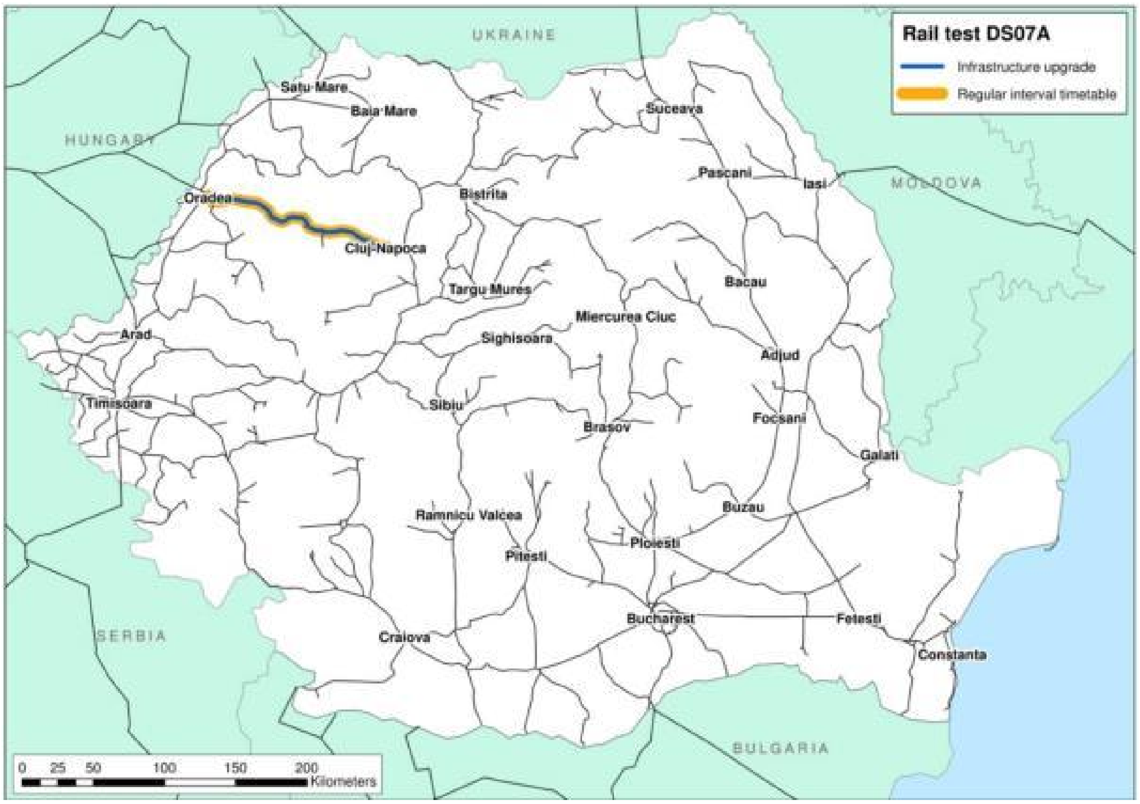
It has been estimated that the project could be implemented by 2030 if funding is secured.

Line Cluj-Napoca to Oradea to design speed (Test DS07A)

Proposal description

Upgrade programme for corridor 300 between Cluj-Napoca and Oradea. This project includes:

- Rehabilitation to design speed of corridor 300 between Cluj-Napoca and Oradea.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Oradea, Alesd, Huedin and Cluj-Napoca.
- InterRegio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Cluj-Napoca to Oradea (1 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains between Cluj-Napoca and Oradea.
- Delays due to poor infrastructure condition and speed restrictions. Commercial speeds below design parameters between Vadu Crisului and Oradea.
- Low rail market share on the Cluj-Napoca and Oradea section, potential to increase rail patronage on the corridor significantly.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.

- Limited capacity and obsolete signalling systems, single track sections between Cluj-Napoca and Oradea limit the network's capacity.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

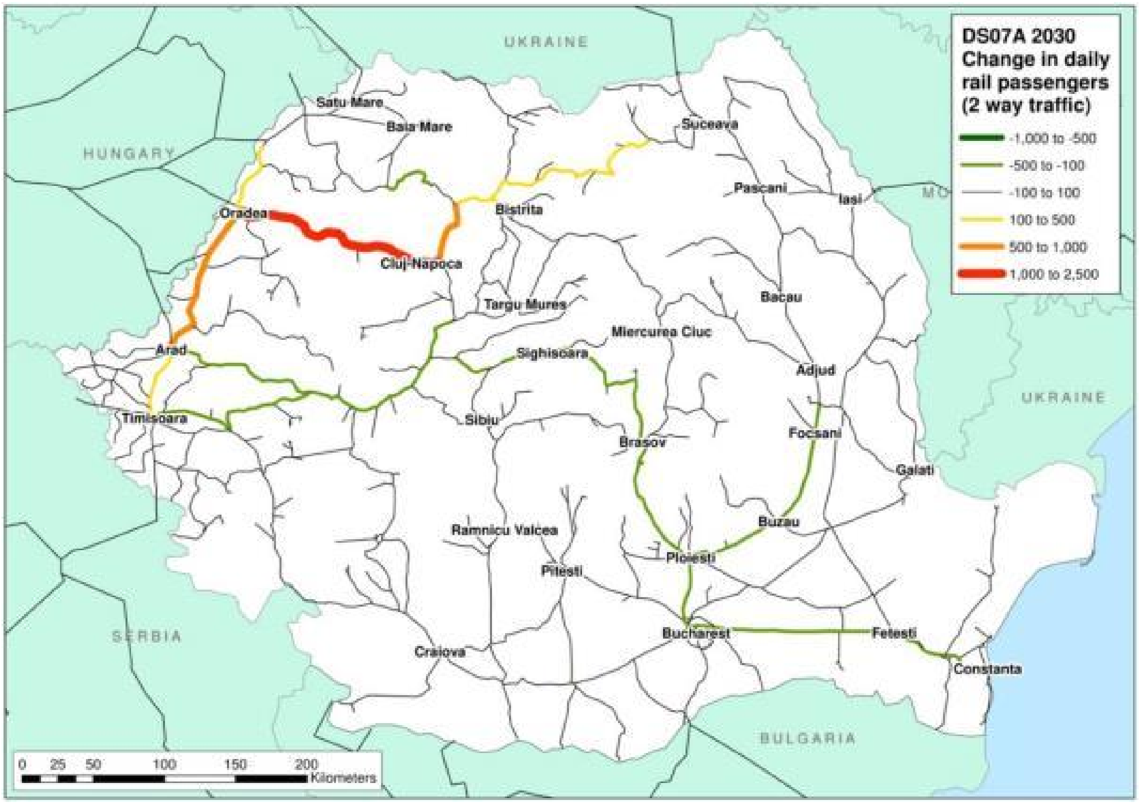
Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	505	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signaling equipment New rolling stock Improved station facilities
OPEX	173	Additional train operating costs
Total	677	CAPEX + OPEX

Outcomes

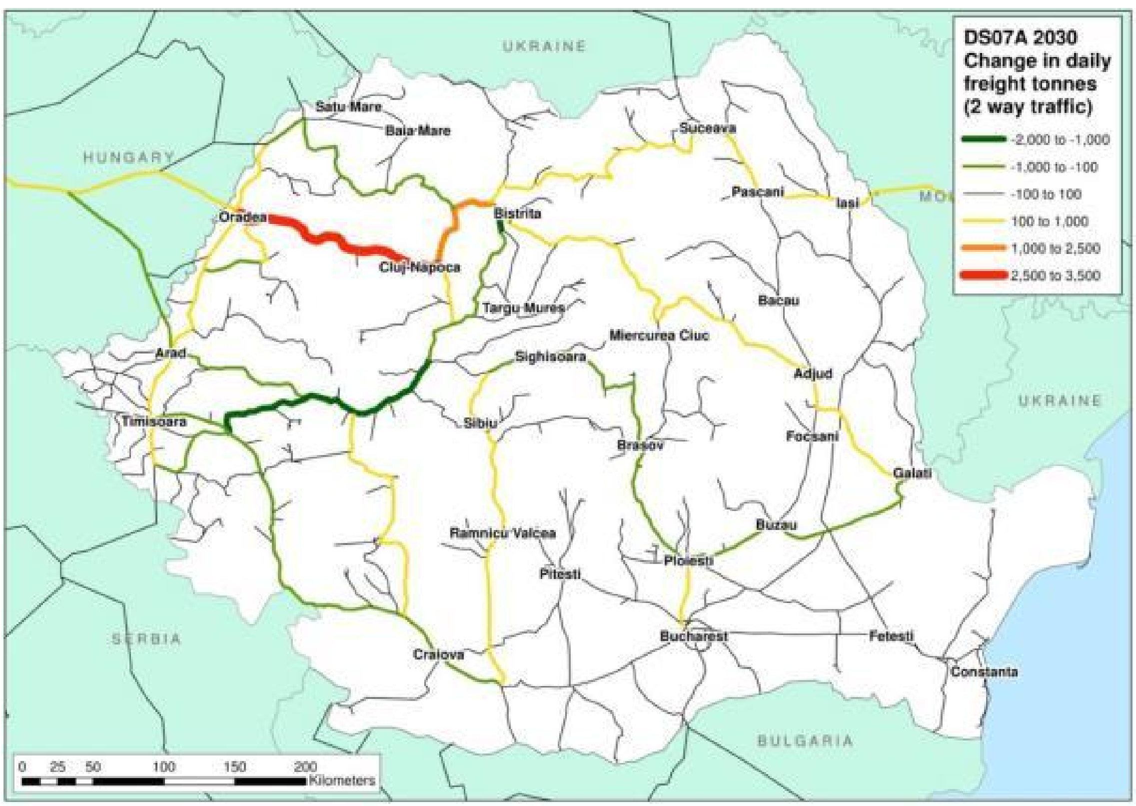
This intervention returns poor value for money (BCR = 0.31), and a minimal increase in rail passenger and freight traffic, of +1% and +1% respectively over the whole system, see table below:

Test code	**DS07A**
Overall inc. in Pass-km (1000's 2030)	+180 (+1%)
Overall inc. in Pass-km share (2030)	0.1%
Overall inc. in Tonne-km (1000,s 2030)	+456 (+1%)
Overall inc. Tonne-km share (2030)	0.1%
NPV € Mill (2014 Prices)	**-241**
BCR	**0.31**
EIRR	**-0.11%**
Upgraded main line infrastructure (track-km)	270
Required rolling stock units	5

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



Passenger traffic on the Oradea to Cluj-Napoca corridor increases in this scenario by about +60%, passengers from the Arad / Timisoara area switch to the upgraded corridor to travel towards Cluj-Napoca and the Northeast.



Freight traffic between Cluj-Napoca and Oradea has been forecast to increase by about 50% which is to some extent attracted demand from lines 200 and 413. The number of freight tonnes transported through Orastie falls by -10%, whilst traffic on corridor 413 falls by -5%.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

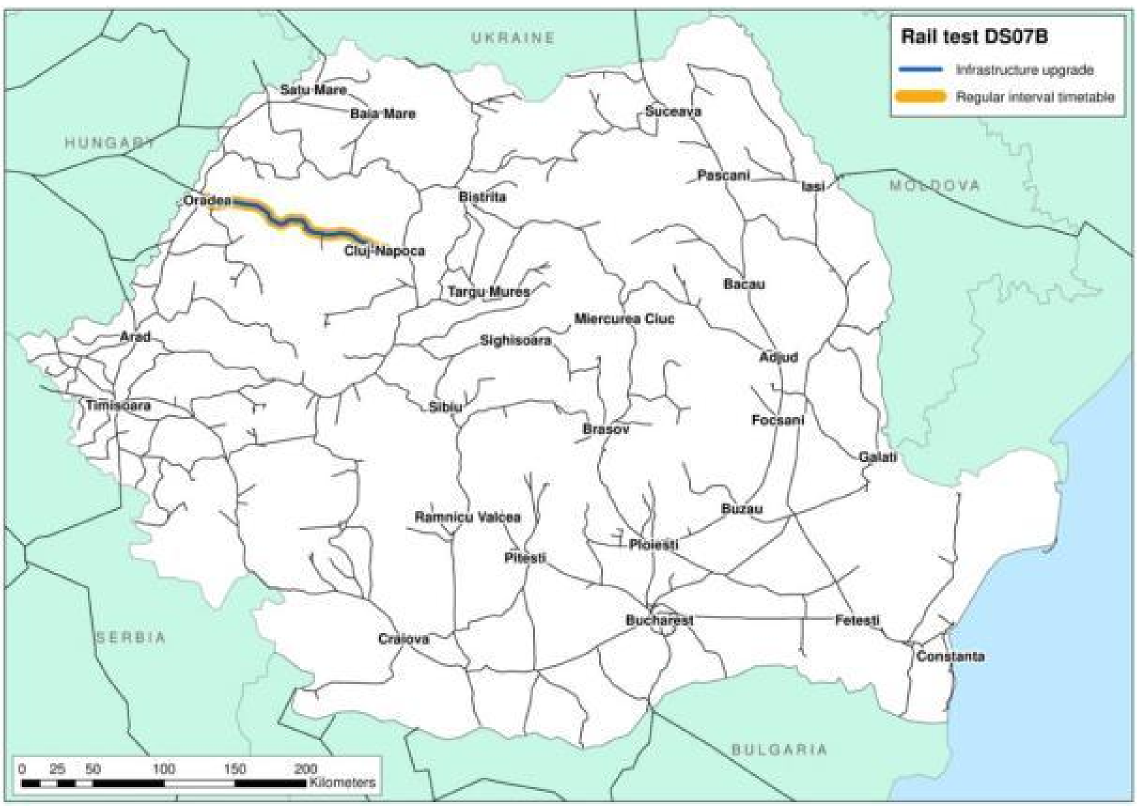
It has been estimated that the project could be implemented by 2030 if funding is secured.

Line Cluj-Napoca to Oradea to design speed plus electrification and line doubling (Test DS07B)

Proposal description

Upgrade programme for corridor 300 between Cluj-Napoca and Oradea. This project includes:

- Rehabilitation to design speed of corridor 300 between Cluj-Napoca and Oradea.
- Rehabilitation to enhanced speed of sections with design speed below 100 km/h on line 300 between Cluj-Napoca and Oradea.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Line doubling of single track sections.
- Corridor electrification.
- Improved station facilities at Oradea, Alesd, Huedin and Cluj-Napoca.
- Interregio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Cluj-Napoca to Oradea (1 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains between Cluj-Napoca and Oradea.
- Delays due to poor infrastructure condition and speed restrictions. Commercial speeds below design parameters between Vadu Crisului and Oradea.
- Low design speeds of some sections of the Cluj-Napoca to Oradea line.

- Low rail market share on the Cluj-Napoca and Oradea section, potential to increase rail patronage on the corridor significantly.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems, single track sections between Cluj-Napoca and Oradea limit to be upgraded to double track.
- Line electrification to increase interoperability and reduce delays caused by traction changes.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

Item	**Undiscounted costs (Million €, 2014 prices)**	**Description of improvements included**
CAPEX	1,241	Rehabilitation of track to provide current or enhanced design speeds Line doubling and electrification Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	309	Additional train operating costs
Total	1,550	CAPEX + OPEX

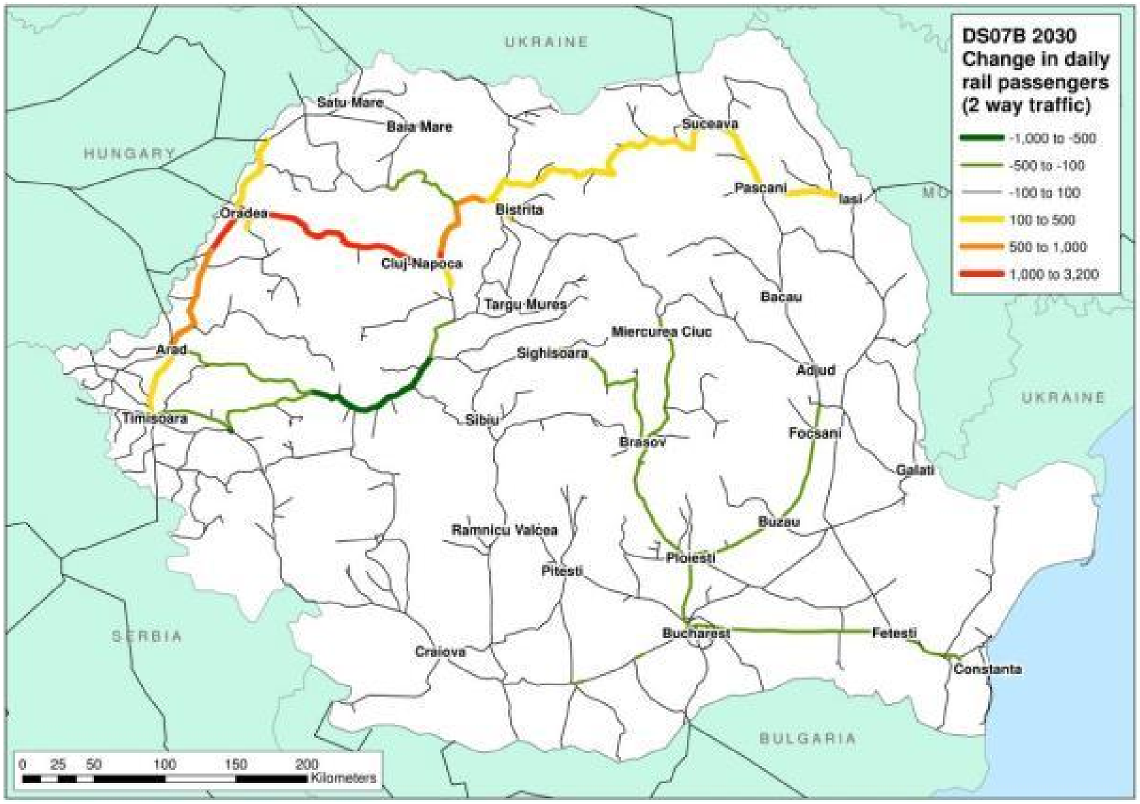
Outcomes

This intervention returns poor value for money (BCR = 0.40), and a minimal increase in rail passenger and freight traffic, of +2% and +1% respectively over the whole system, see table below:

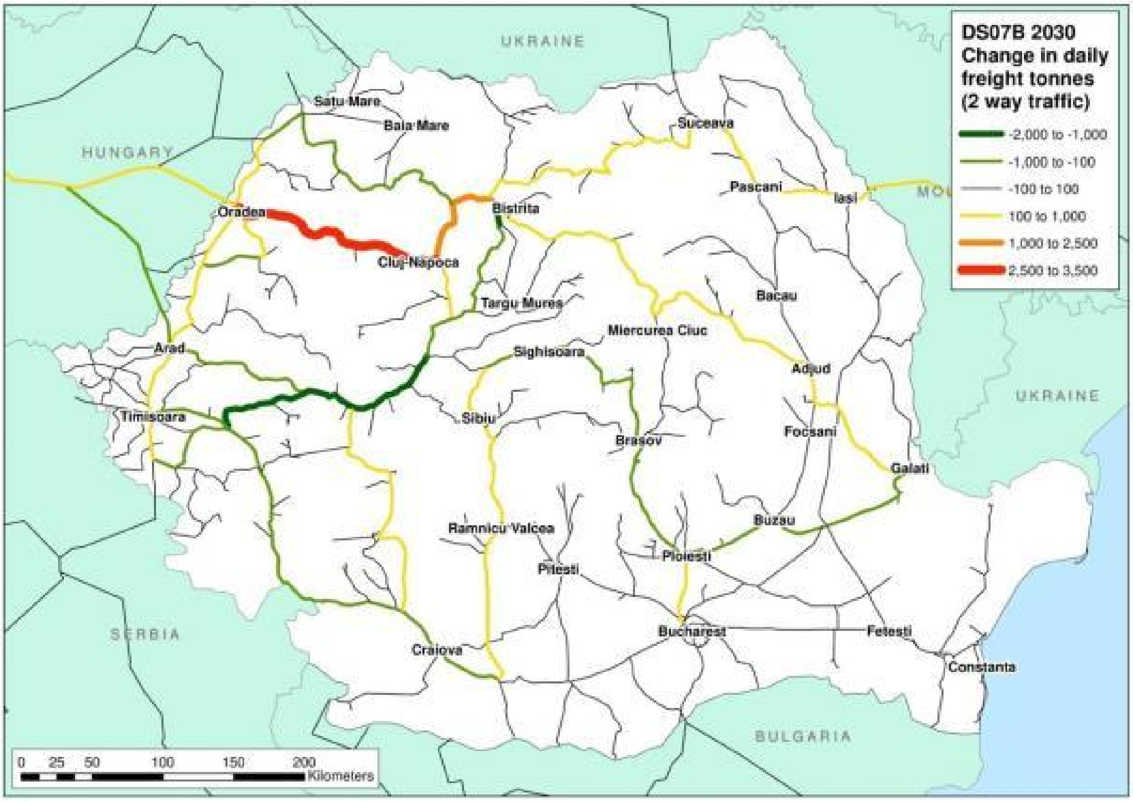
Test code	**DS07B**
Overall inc. in Pass-km (1000's 2030)	+389 (+2%)
Overall inc. in Pass-km share (2030)	0.1%
Overall inc. in Tonne-km (1000,s 2030)	+456 (+1%)
Overall inc. Tonne-km share (2030)	0.1%
NPV € Mill (2014 Prices)	**-570**
BCR	**0.40**
EIRR	**-0.05%**
Upgraded main line infrastructure (track-km)	330[1]
Required rolling stock units	5

[1] Including line doubling and electrification

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



Passenger traffic travelling on the Oradea to Cluj-Napoca corridor increases in this scenario by about +90%, passengers from the Arad / Timisoara area switch to the upgraded corridor to travel to Cluj-Napoca and the Northeast.



Freight traffic between Cluj-Napoca and Oradea has been forecast to increase by about 50% which is to some extent attracted from lines 200 and 413. The number of freight tonnes transported through Orastie falls by -10%, whilst traffic on corridor 413 falls by 5%.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

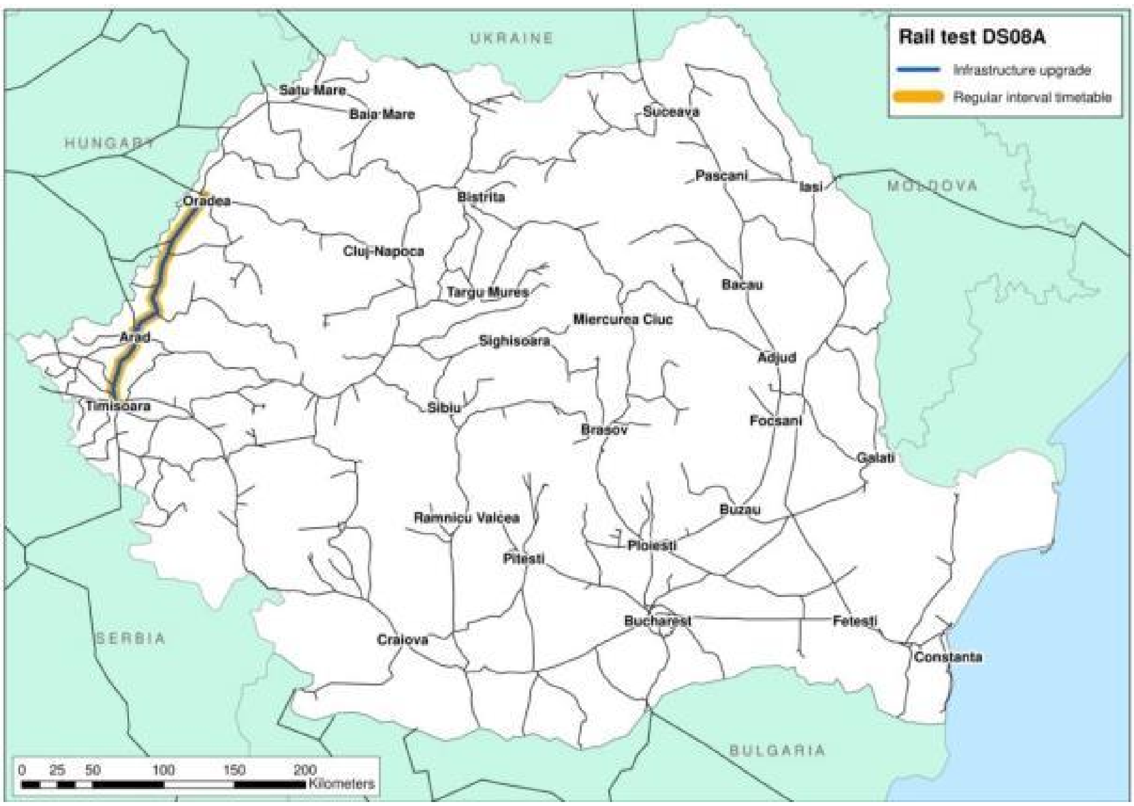
It has been estimated that the project could be implemented by 2030 if funding is secured.

Line Timisoara – Oradea to design speed (Test DS08A)

Proposal description

Upgrade programme for Core TEN-T corridor IV-S between Timisoara and Arad and line 310 from Arad to Timisoara. This project includes:

- Rehabilitation to design speed of corridors: 310 between Oradea and Arad and the section Arad to Timisoara of Core TEN-T corridor IV-S.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Timisoara, Arad, Chisineu-Cris, Salonta and Oradea.
- InterRegio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Timisoara to Oradea (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition and speed restrictions due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains between Timisoara and Oradea.
- Delays due to poor infrastructure condition. Commercial speeds below design parameters over the whole length of the corridor (between Timisoara and Arad and Oradea and Arad). Significant time savings could be achieved.
- Low rail market share of rail trips between Arad and Timisoara, potential to increase rail patronage on this section significantly.
- Poor rolling stock and station facilities condition, country wide issue.

- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems.

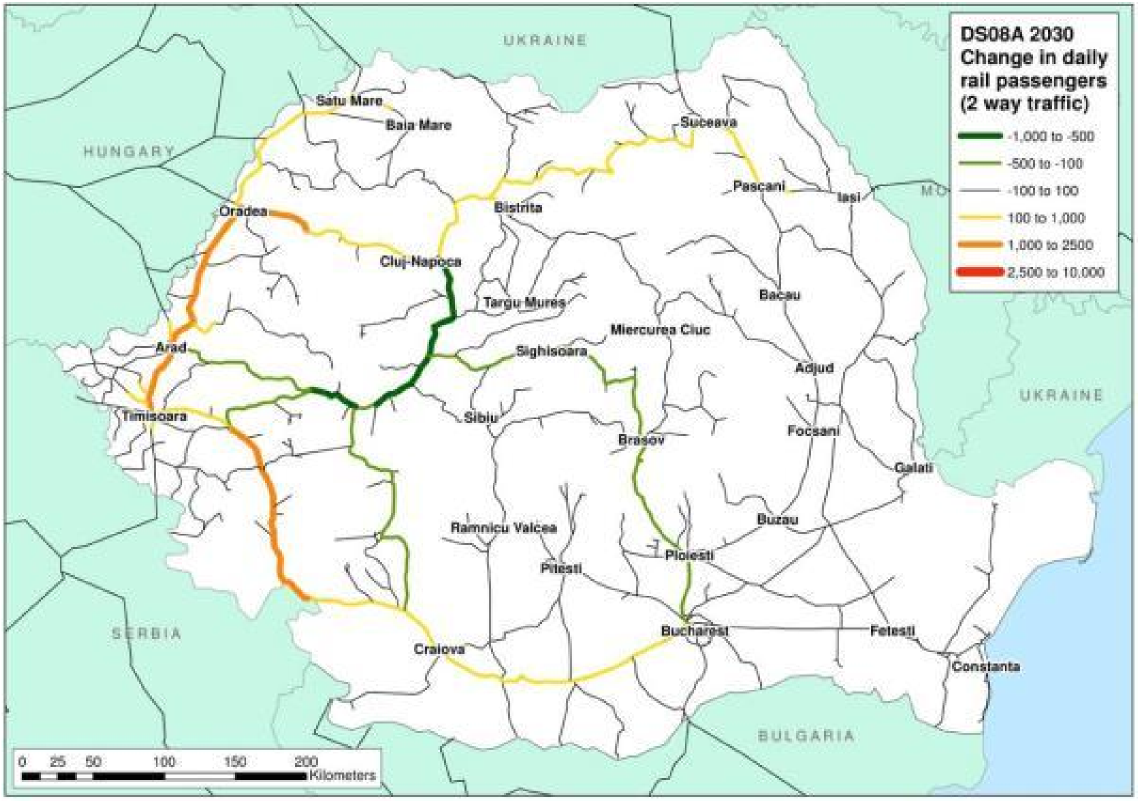
Undiscounted costs
It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

Item	**Undiscounted costs (Million €, 2014 prices)**	**Description of improvements included**
CAPEX	276	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock Improved station facilities
OPEX	425	Additional train operating costs
Total	701	CAPEX + OPEX

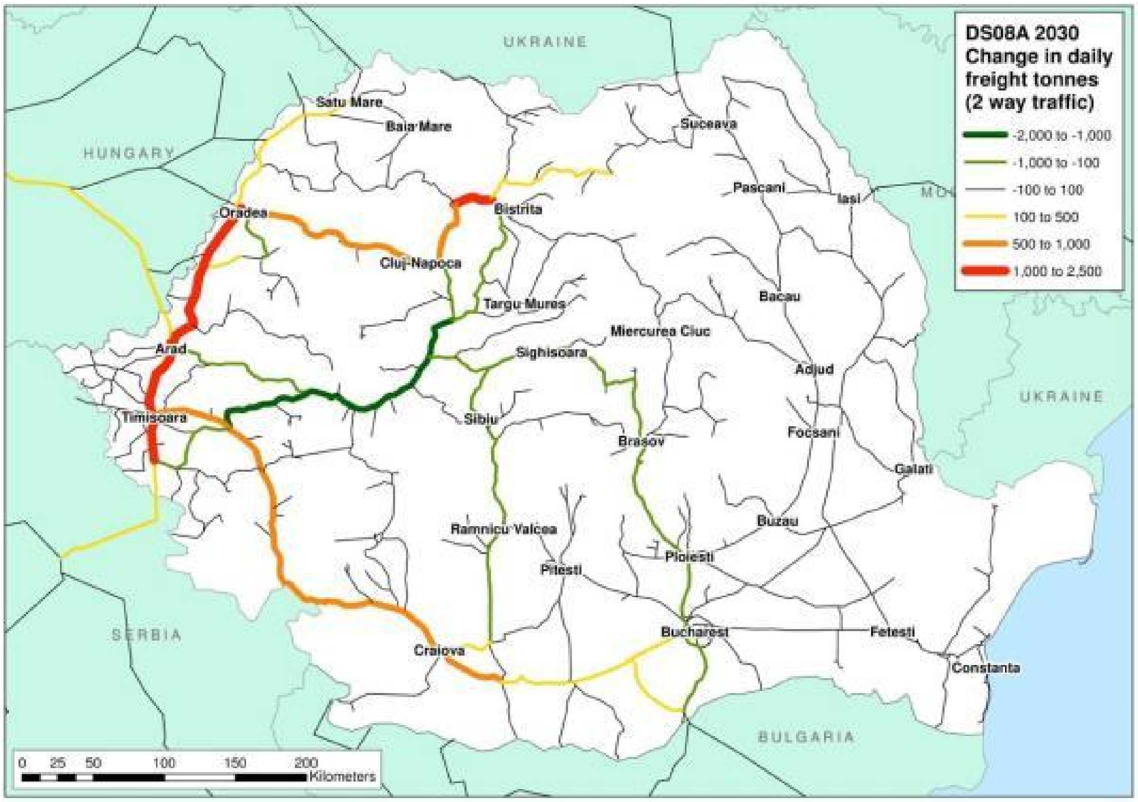
Outcomes
This intervention returns poor value for money (BCR = 0.70), and a small increase in rail passenger and freight traffic, of +6% and +1% respectively over the whole system, see table below:

Test code	**DS08A**
Overall inc. in Pass-km (1000's 2030)	+1,212 (+6%)
Overall inc. in Pass-km share (2030)	+0,4%
Overall inc. in Tonne-km (1000,s 2030)	+281 (+1%)
Overall inc. Tonne-km share (2030)	0.1%
NPV € Mill (2014 Prices)	**-56**
BCR	**0.70**
EIRR	**3.32%**
Upgraded main line infrastructure (track-km)	200
Required rolling stock units	6

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



This project is expected to generate significant passenger demand on the upgraded infrastructure, with demand more than doubling along the corridor. The following traffic increases have been forecast: Timisoara to Arad +350%, Arad to Salonta +195% and Salonta to Oradea +110%. Other routes also benefit from a sensible patronage increase, traffic between Caransebes and Lugoj is for example expected to increase by 30%. The line Arad – Deva – Cluj-Napoca will lose some demand to the upgraded corridor.



Freight demand has been forecast to increase markedly. In particular it has been estimated that in this scenario freight traffic will grow by about +40% on the section Arad to Timisoara and by 100% between Arad and Cluj-Napoca.

Implementing organisation

This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years

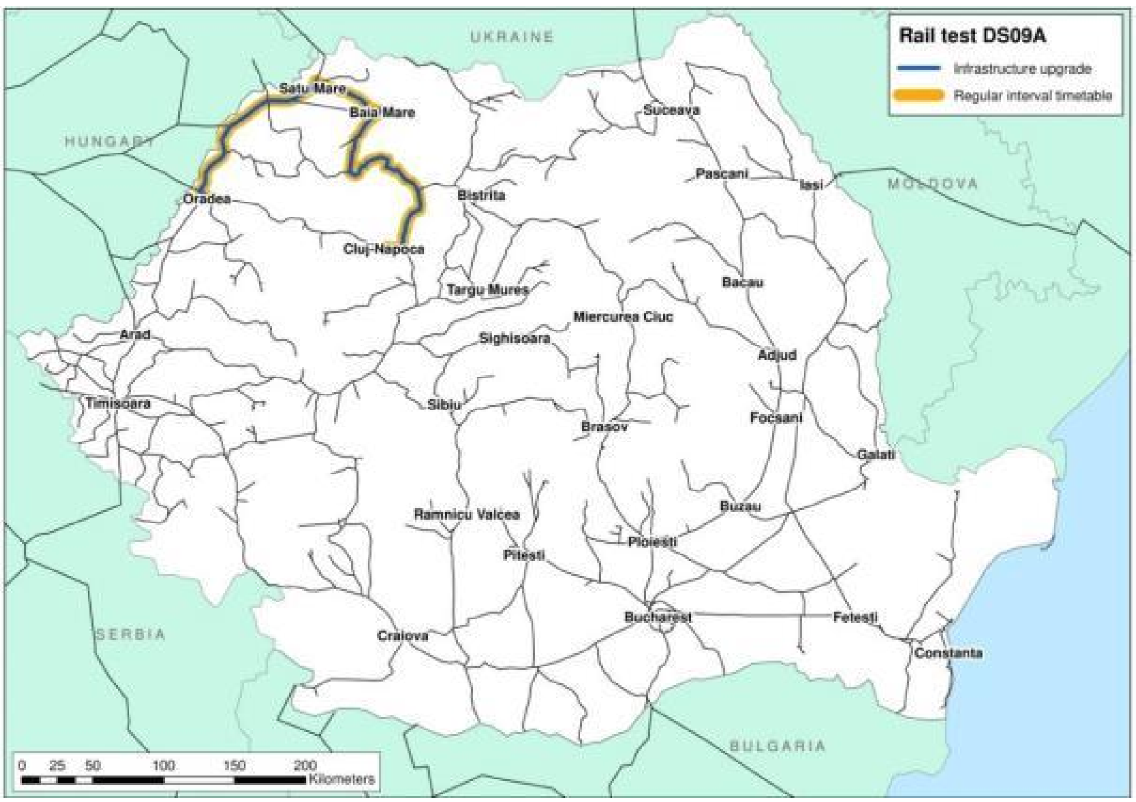
It has been estimated that the project could be implemented by 2030 if funding is secured.

Line Oradea to Satu Mare and Satu Mare to Cluj-Napoca to design speed (Test DS09A)

Proposal description

Upgrade programme for the rail line between Oradea and Baia Mare via Satu Mare, and Baia Mare to Cluj-Napoca via Dej. This project includes:

- Rehabilitation to design speed of corridors: 300 between Oradea and Episcopia Bihor, 402 between Episcopia Bihor and Satu Mare, 400 from Satu Mare to Dej, 401 from Dej to Apahida and Corridor 300 between Apahida and Cluj-Napoca.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Improved station facilities at Oradea, Sacuieni, Valea lui Mihai, Carei, Satu Mare, Baia Mare, Jibou, Dej and Cluj-Napoca.
- InterRegio regular interval timetable operated by new rolling stock. The proposed regular interval service pattern is: Baia Mare to Oradea via Satu Mare (0.5 tph) and Satu Mare to Cluj-Napoca via Baia Mare (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition and speed restrictions due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains between Satu Mare and Cluj-Napoca.
- Delays due to poor infrastructure condition and speed restrictions. Commercial speeds below design parameters between Apa and Baia Mare and Apahida to Dej Calatori.

- Low rail market share of rail trips between Satu Mare and Baia Mare, significant potential to increase rail patronage on this section.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.
- Limited capacity and obsolete signalling systems.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

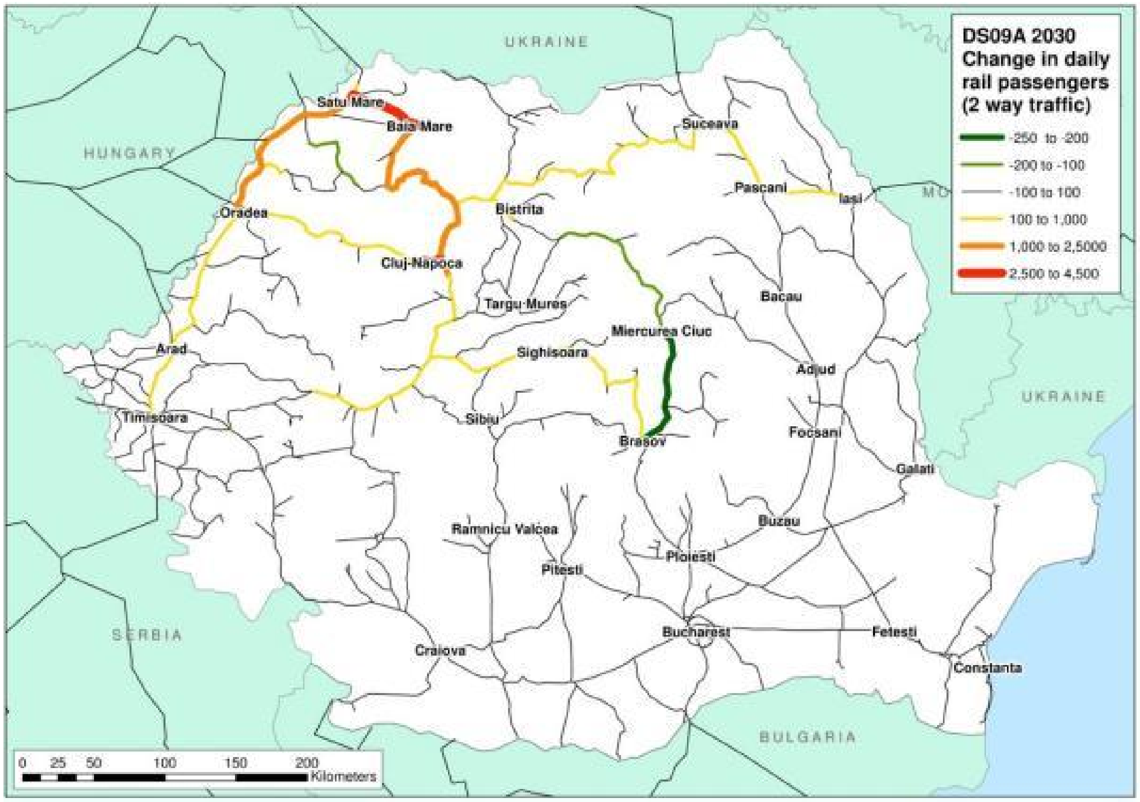
Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	922	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment New rolling stock
OPEX	394	Additional train operating costs
Total	1,315	CAPEX + OPEX

Outcomes

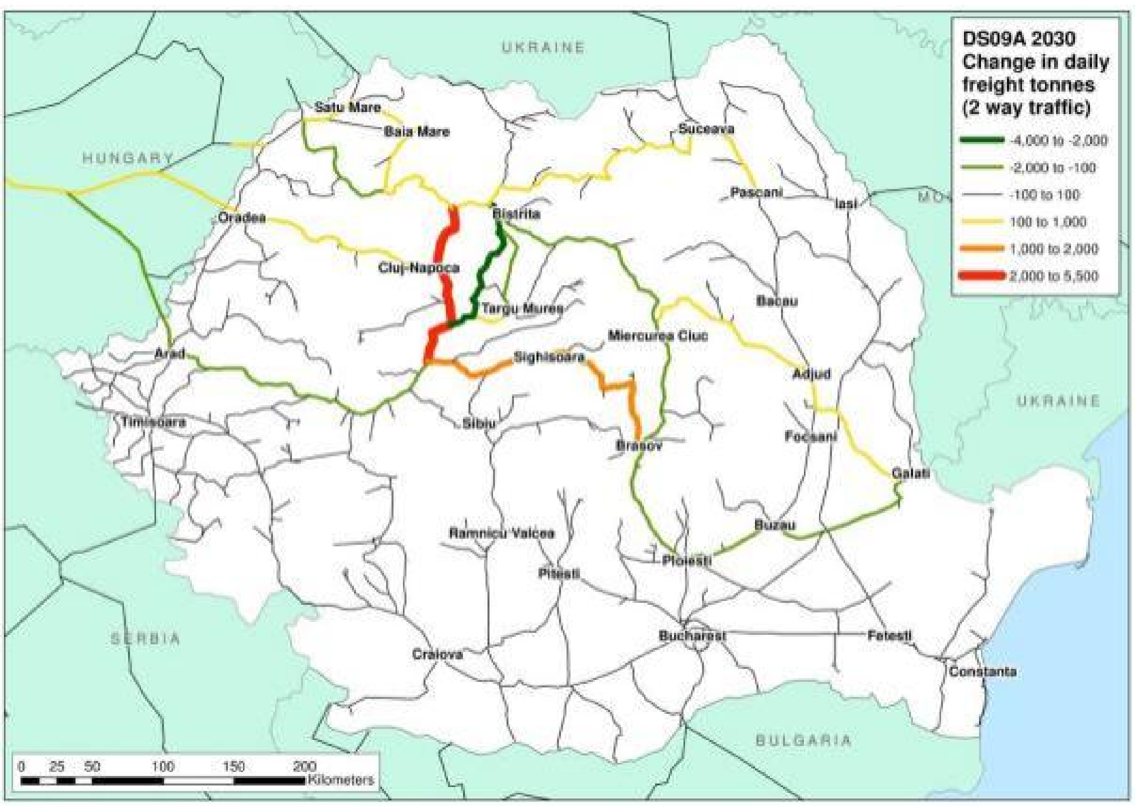
This intervention returns poor value for money (BCR = 0.26), and a small increase in rail passenger and freight traffic, of +6% and +1% respectively over the whole system, see table below

Test code	**DS09A**
Overall inc. in Pass-km (1000's 2030)	+1,085 (+5%)
Overall inc. in Pass-km share (2030)	0.3%
Overall inc. in Tonne-km (1000,s 2030)	+414 (+1%)
Overall inc. Tonne-km share (2030)	0.1%
NPV € Mill (2014 Prices)	**-480**
BCR	**0.26**
EIRR	**-1.24%**
Upgraded main line infrastructure (track-km)	475
Required rolling stock units	7

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



Patronage between Baia Mare and Satu Mare is expected to soar in this alternative, with an average growth factor above 3. Significant demand increases are also forecast between Satu Mare and Oradea +150%, Baia Mare and Dej + 130%, and Dej to Cluj-Napoca +45%.



Freight traffic in this alternative increases mainly on the Alba Iulia to Dej section, in particular the demand between Apahida and Dej is expected to rise by +130%. An overall growth in rail freight traffic has been forecast as a result of the proposed network improvement. The predicted impact extends to the East side of the country.

Implementing organisation
This scheme would be implemented by CFR SA and the Rail Operating Companies

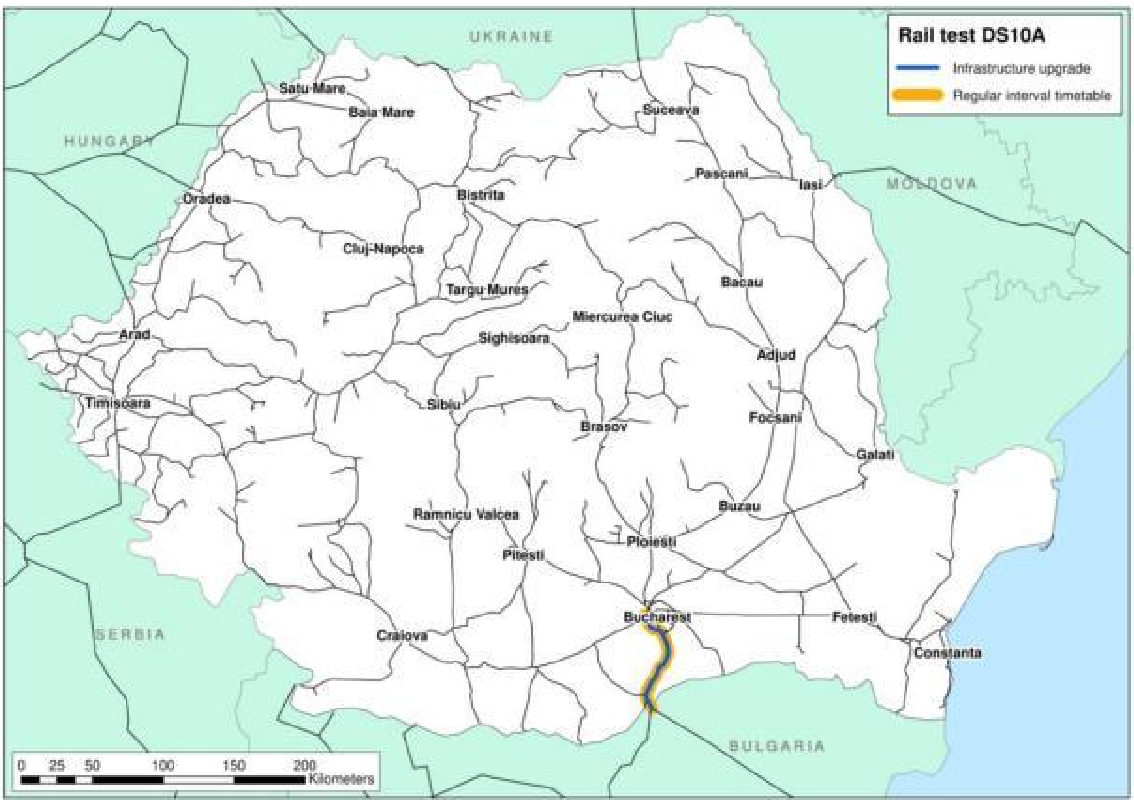
Implementation years
It has been estimated that the project could be implemented by 2030 if funding is secured.

Line Bucharest to Giurgiu via Gradistea to design speed (Test DS10A)

Proposal description

Upgrade programme for the line between Bucharest Nord and Giurgiu via Gradistea. This project includes:

- Rehabilitation to design speed of corridor 902 between Bucharest and Giurgiu.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- It has been considered that the Arges River bridge reconstruction is part of the Reference case scenario, a Do Minimum project.
- Regio regular interval timetable operated by existing rolling stock. The proposed regular interval service pattern is: Bucharest to Giurgiu (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Passenger services currently diverted via Videle.
- Halts on corridor 902 have currently no direct rail connection to Bucharest. Travel times from Giurgiu to Bucharest are markedly higher on the route via Videle.
- Low rail market share between Giurgiu and Bucharest, potential to increase rail patronage on the corridor significantly.
- Poor rolling stock condition and frequency on the services between Gradistea and Giurgiu, country wide issue.

- Limited capacity and obsolete signalling systems.

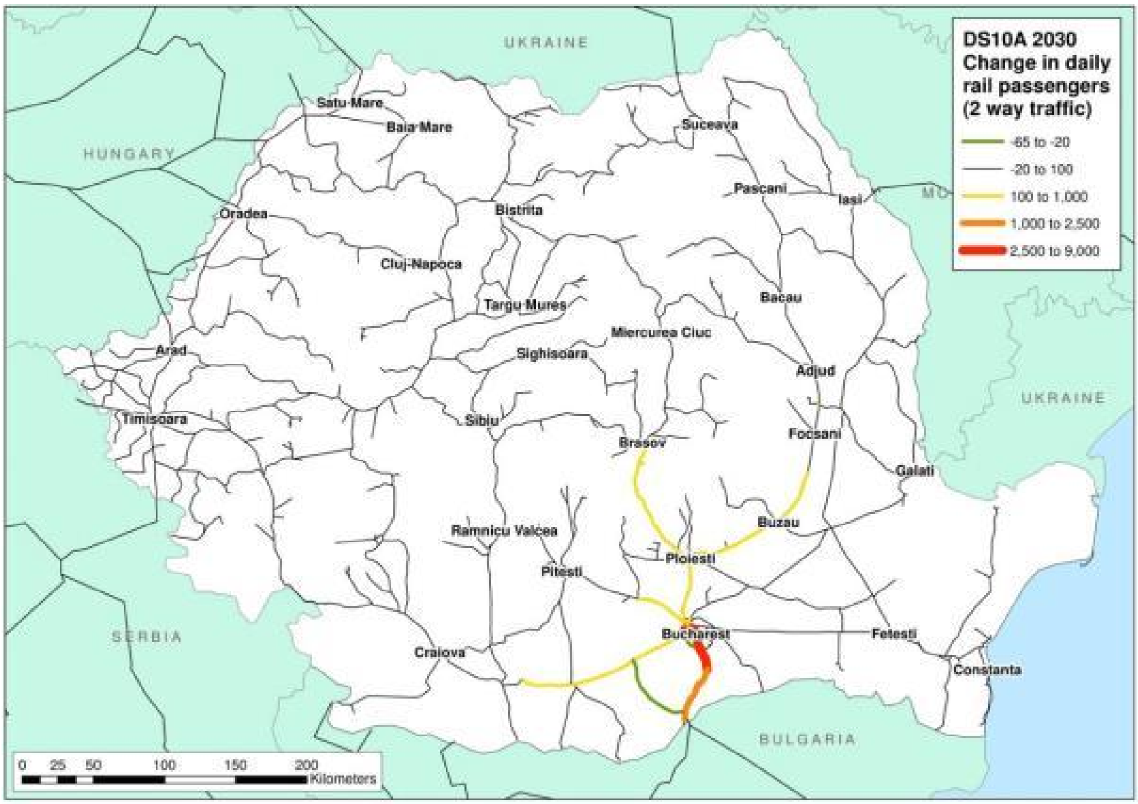
Undiscounted costs
It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
CAPEX	113	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment
OPEX	132	Additional train operating costs
Total	245	CAPEX + OPEX

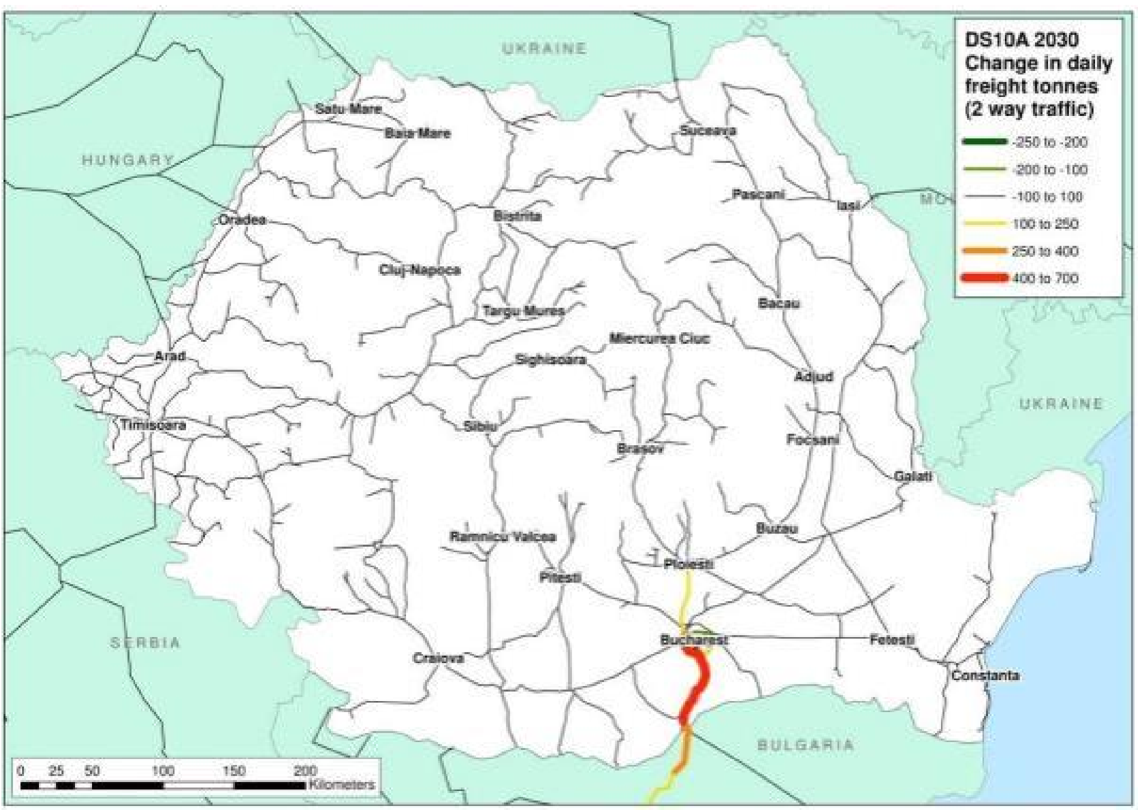
Outcomes
This intervention returns very good value for money (BCR = 4.20), and a minimal increase in rail passenger and freight traffic, of +3% and +1% respectively over the whole system, see table below:

Test code	**DS10A**
Overall inc. in Pass-km (1000's 2030)	+545 (+3%)
Overall inc. in Pass-km share (2030)	0.2%
Overall inc. in Tonne-km (1000,s 2030)	+123 (+0%)
Overall inc. Tonne-km share (2030)	0.0%
NPV € Mill (2014 Prices)	**263**
BCR	**4.20**
EIRR	**14.67%**
Upgraded main line infrastructure (track-km)	95

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



The results of this test evidence the significant level of suppressed demand on the Bucharest to Giurgiu line. A frequent regular interval timetable will generate considerably higher patronage (+185%) on this corridor compared to the reference case.



Upgrading corridor 902 also leads to a minimal rise in transported tonnes, the forecast increase in freight traffic ranges between 5% and 10%.

Implementing organisation
This scheme would be implemented by CFR SA and the Rail Operating Companies

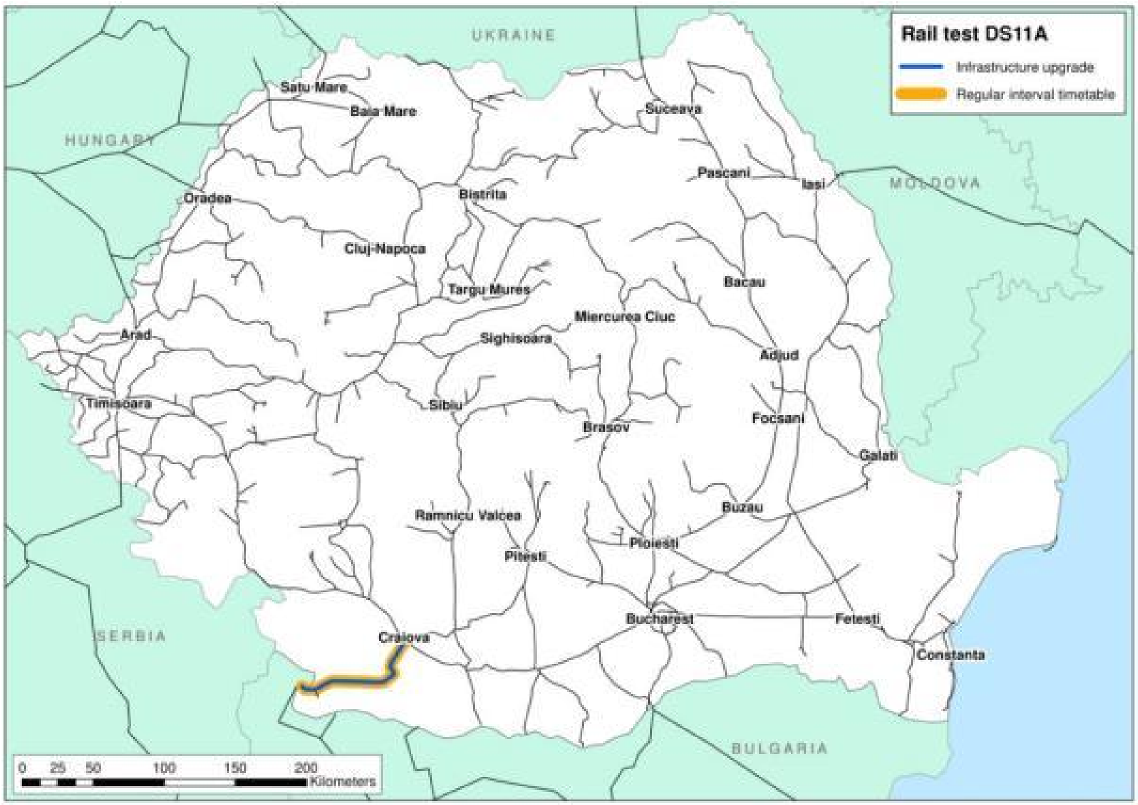
Implementation years
It has been estimated that the project could be implemented by 2020 if funding is secured.

Core TEN-T corridor IV-N section Craiova to Calafat to design speed (Test DS11A)

Proposal description

Upgrade programme for the line between Craiova and Calafat. This project includes:

- Rehabilitation to design speed of corridor 912 between Craiova and Calafat.
- Steady state maintenance of the core network (baseline assumption for all Do Something tests).
- Improved signalling and communication systems to enhance running speeds and increase the corridor's capacity.
- Regio regular interval timetable operated by existing rolling stock. The proposed regular interval service pattern is: Craiova to Calafat (0.5 tph).



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition and speed restrictions due to underspend in maintenance and renewals. Travel times by rail markedly higher than by car.
- Delays due to poor infrastructure condition. Commercial speeds below design parameters between Segarcea and Calafat. Although the design speed of that section is 80 km/h, passenger services between Segrarcea and Calafat are limited to 40 km/h.
- Very low market share of rail trips between Craiova and Calafat, significant potential to increase rail patronage on this section.
- Poor rolling stock and station facilities condition, country wide issue.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems, network wide issues.

- Limited capacity and obsolete signalling systems.
- Slow speeds on the access to the new rail bridge over the Danube East of Calafat.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network.

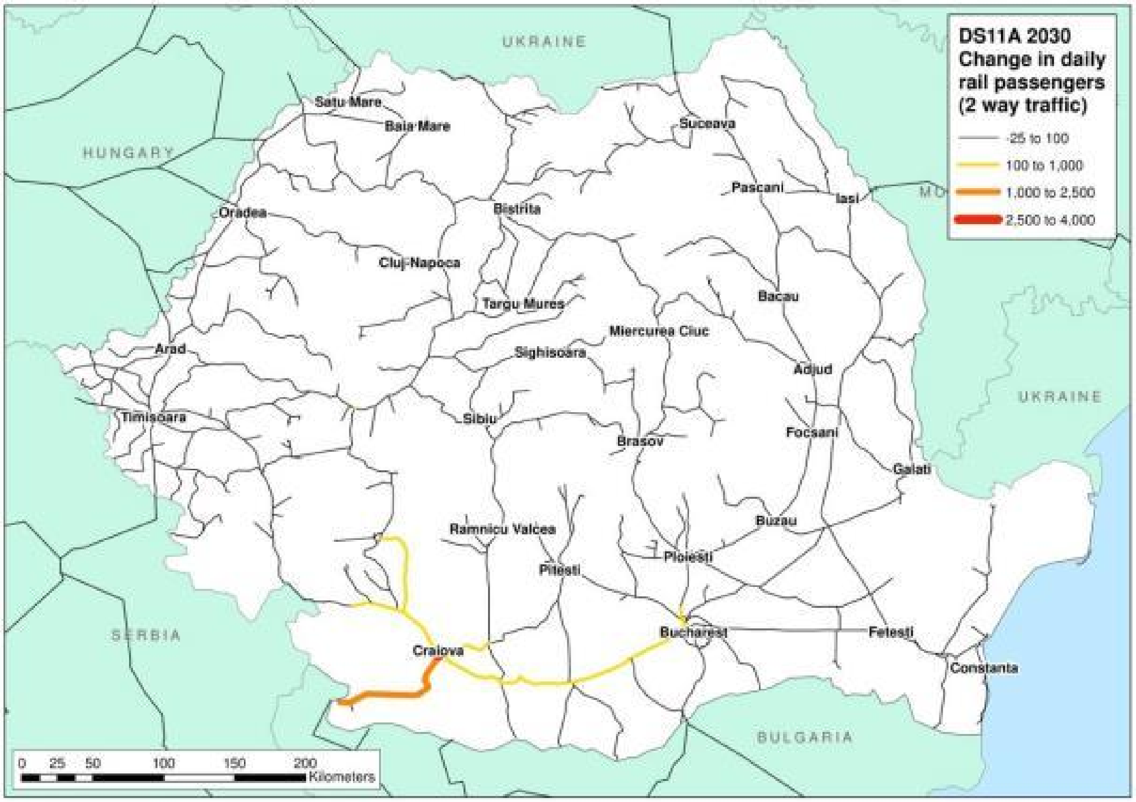
Item	**Undiscounted costs (Million €, 2014 prices)**	**Description of improvements included**
CAPEX	144	Rehabilitation of track to provide current design speeds Rehabilitation of power supply, including regenerative braking Rehabilitation of signalling equipment Improved station facilities
OPEX	43	Additional train operating costs
Total	187	CAPEX + OPEX

Outcomes

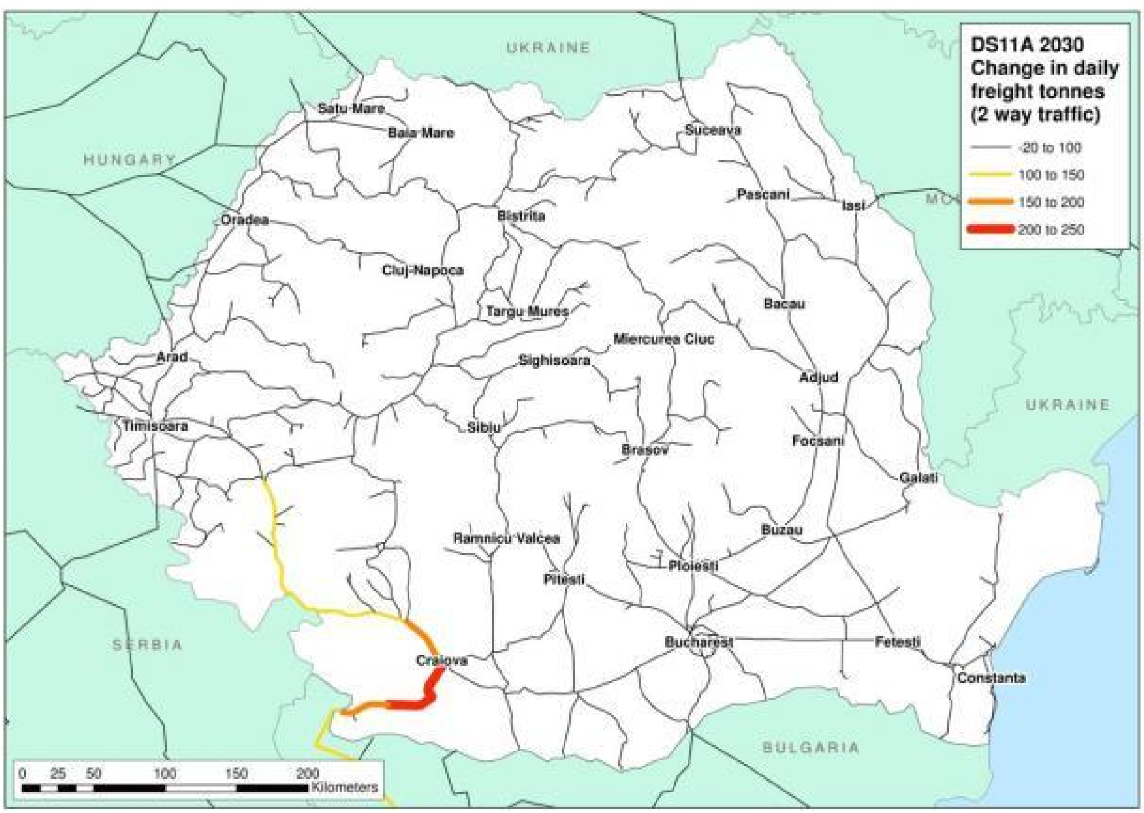
This intervention returns poor value for money (BCR = 0.91), and a minimal increase in rail passenger traffic of +2% over the whole system, see table below:

Test code	**DS11A**
Overall inc. in Pass-km (1000's 2030)	+363 (+2%)
Overall inc. in Pass-km share (2030)	0.1%
Overall inc. in Tonne-km (1000,s 2030)	+92 (+0%)
Overall inc. Tonne-km share (2030)	0.0%
NPV € Mill (2014 Prices)	**-9**
BCR	**0.91**
EIRR	**4.47%**
Upgraded main line infrastructure (track-km)	115

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



The proposed upgrades will lead to a very high growth of patronage in relative terms; demand in the reference scenario is very low as a result of the numerous speeds restrictions existing on the line. Growth coefficients between 10 and 15 have been forecast on line 912.



A modest freight traffic growth has been forecast for this rail line after the line is upgraded. It has been acknowledged however that in practice freight demand may grow beyond the forecast levels if further enhancements are implemented.

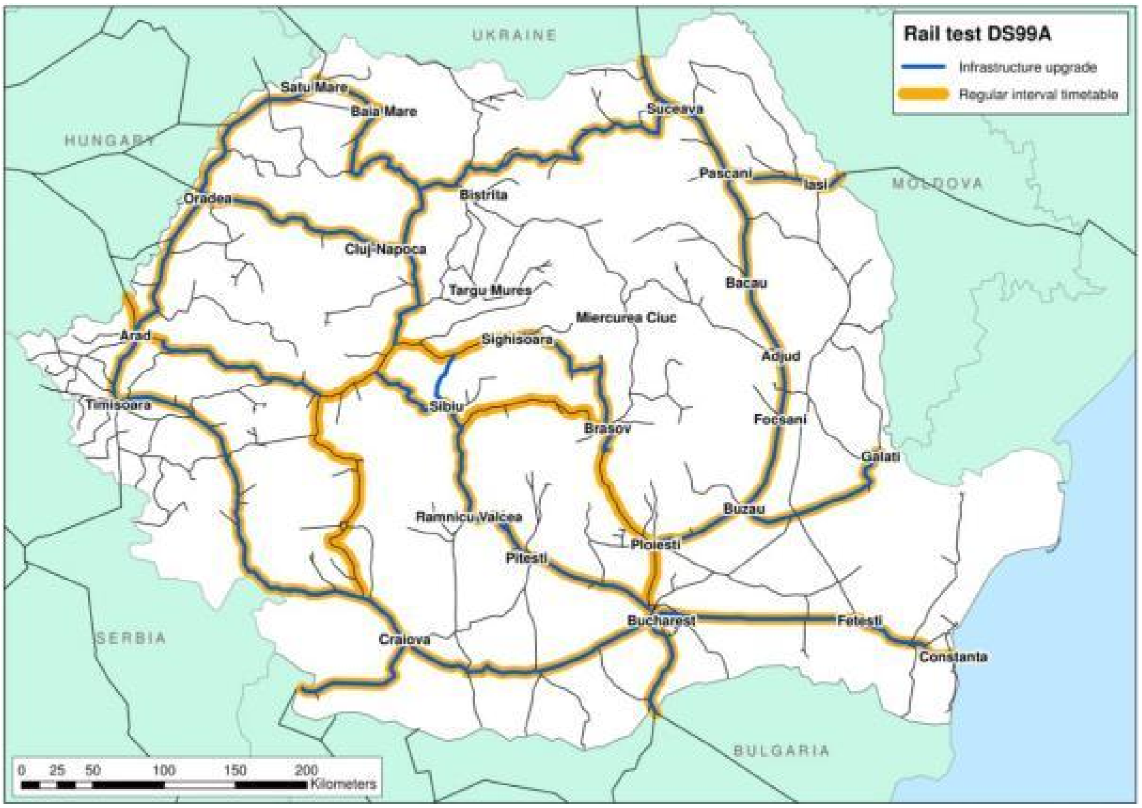
Implementing organisation
This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years
It has been estimated that the project could be implemented by 2020 if funding is secured.

Combined strategy (Test DS99A)

Proposal description

This test combines the best performing solution for each corridor to assess synergies and incompatibilities. A combined scenario with more frequent regular interval timetables running on more corridors will enhance the role of rail interchanges, providing a more robust and reliable transport alternative to passengers. This project includes the upgrades contemplated for tests DS01A, DS02A, DS03A, DS04A, DS05B, DS06A, DS07A, DS08A, DS09A, DS10A and DS11A. DS07A has been selected as the preferred alternative over DS07B for its higher NPV, the modest traffic increase of this scenario does not justify the higher construction costs of test DS07B.



Problems addressed

This intervention addresses the following issues:

- Deteriorated track condition due to underspend in maintenance and renewals. Slow running speeds of passenger and freight trains on several corridors in the network.
- Delays due to poor infrastructure condition and speed restriction, commercial speeds are often below design parameters.
- Low rail market share, marked road competition.
- Poor rolling stock condition.
- Inefficient timetable leading to low staff efficiency and poor rolling stock usage. Long turnaround times and irregular stopping patterns, network wide issues.
- Poor reliability record and inefficient signalling systems.
- Limited capacity and obsolete signalling systems.

Undiscounted costs

It has been estimated that the project will incur in the following costs, excluding steady state maintenance of the core network and infrastructure rehabilitation of corridors either previously restored or under upgrade.

Item	Undiscounted costs (Million €, 2014 prices)	Description of improvements included
		Rehabilitation of track to provide current design speeds
		Rehabilitation of power supply, including regenerative braking
CAPEX	11,052	Rehabilitation of signalling equipment
		New rolling stock
		Improved station facilities
OPEX	4,248	Additional train operating costs
Total	15,300	CAPEX + OPEX

Outcomes

This intervention returns low value for money (BCR = 1), and a very high increase in rail passenger and freight traffic, of +115% and +19% respectively over the whole system, see table below:

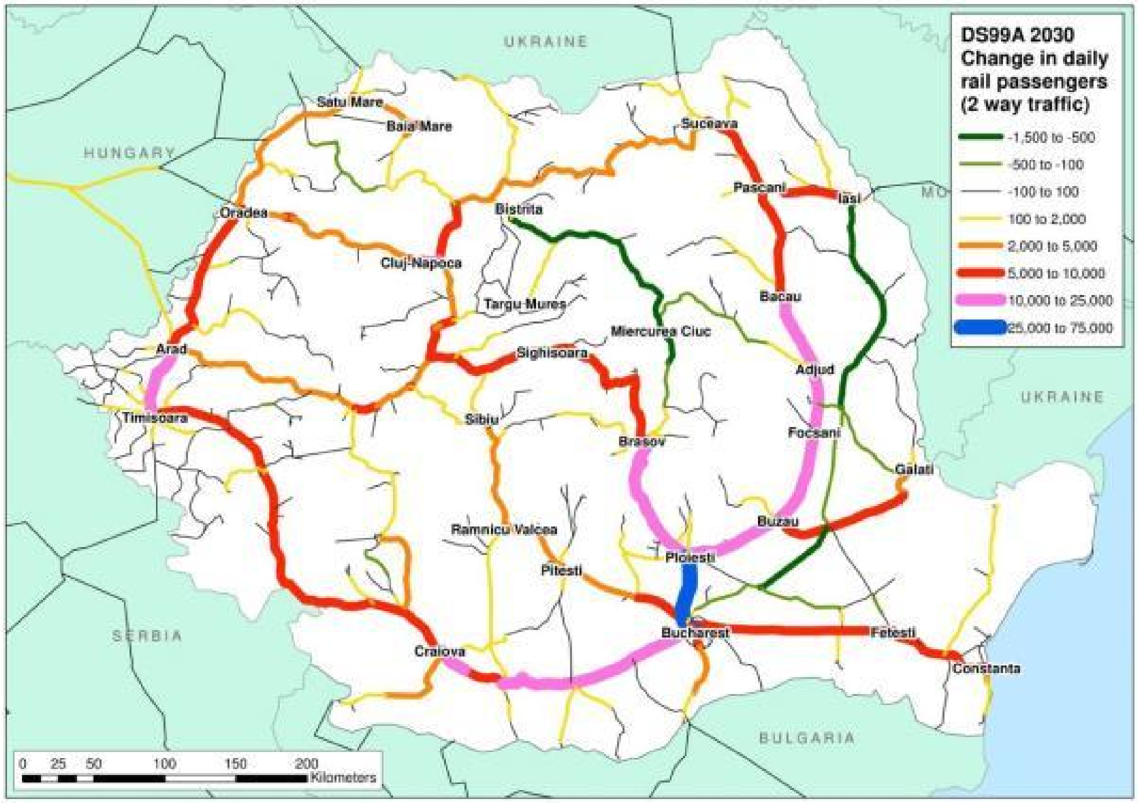
Test code	**DS99A**
Overall inc. in Pass-km (1000's 2030)	+24,289 (+115%)
Overall inc. in Pass-km share (2030)	7.1%
Overall inc. in Tonne-km (1000,s 2030)	+8,525 (+19%)
Overall inc. Tonne-km share (2030)	2.5%
NPV € Mill (2014 Prices)	**32**
BCR	**1.00**
EIRR	**5.02%**
Upgraded main line infrastructure (track-km)	4620[1] + 225[2] + 520[3]
Required rolling stock units	109

[1]Line upgrade

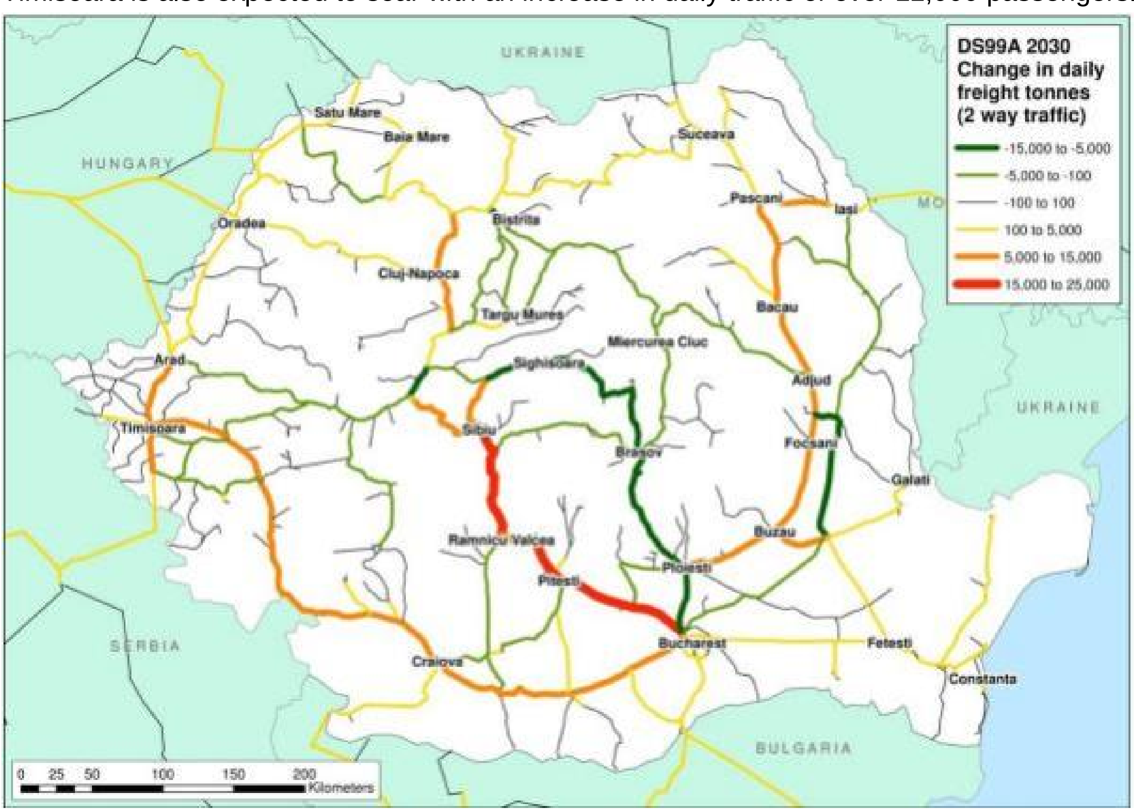
[2]Remove speed restrictions existing on the 225 track-km line

[3]Line electrification

The drawings below illustrate the forecast changes in passenger and freight traffic for 2030 assuming that the project is in operation from 2020.



The drawing above illustrates the marked impact of the network upgrades comprising the combined scenario. Patronage grows markedly over the whole network, with a particularly strong performance between Bucharest and cities 2 to 3 hours travel time from the capital. Demand between Arad and Timisoara is also expected to soar with an increase in daily traffic of over 11,000 passengers.



The combined scenario will also see a significant rise in freight traffic over the whole system, with more tonnes transported on most rail links compared to the reference scenario. The new link between Valcele and Ramnicu Valcea provides a shorter connection for freight traffic from the Constanta and Galati areas to the West and central Europe, which attracts a significant number of freight trains.

Implementing organisation
This scheme would be implemented by CFR SA and the Rail Operating Companies

Implementation years
The implementation of this project is greatly constrained by the available budget.

11.4 Appendix D. Potential Electrification Schemes

Summary of Current and Proposed Daily Frequencies (one-way)

Route Section	Current	Future	Route Section	Current	Future
Galati – Barlad – Crasna – Iasi - Husi	10	10	Brasov – Sibiu – Alba Iulia	14	17
Veresti – Botosani – Dangeni - Iasi	4-9	4-9	Blaj – Tarnaveni	11	11
Darmanesti – Dornesti	10	10	Tarnaveni – Praid	4	4
Dornesti – Nisipitu	4	4	Razboleni – Targu Mares – Deda	13	13
Bicaz – Bacau	9	9	Razboleni – Sarmasu – Sieu Magherus	7	7
Roman – Buhaiesti	6	6	Deva – Arad via Santana	6	6
Ploiesti – Urziceni – Giurgeni	5	5	Santana – Oradea	12	19
Bucharest – Urziceni – Faurei	10	10	Oradea – Cluj Napoca	23	27
Faurei – Tecuci	2	2	Oradea – Satu Mare	10	10
Ploiesti – Slanic	3	3	Satu Mare – Baia Mare	9	14
Ploiesti – Maneciu	2	2	Baia Mare – Dej	11	19
Bucharest – Pitesti	16	22	Jibou – Saculeni	6	6
Pitesti – Curtea de Arges	4	4	Satu Mare – Bixad	6	6
Pitesti – Argesel	5	5	Jibou – Carei	5	5
Pitesti – Rosiori de Vede	10	10	Timisoara – Resita	11	11
Pitesti – Craiova	10	10	Timsisoara – Jimbola	3	3
Rosiori de Vede – Zimnices	9	9	Timisoara – Sannicolau Mare	5	5
Rosiori de Vede – Turnu Magurele	4	4	Salva – Valea Viseului	6	6
Corabia – Caracal	6	6	Medgidic – Tulcea	4	4
Caracal – Sibiu	10	13	Medgidic – Negru Voda	2	2
Craiova – Calafat	4	4	Eforie – Mangalia	7	7
Bucharest – Oltenita	2	2	Videle – Giurgiu	7	7
Buzau – Neholasu	9	9	Caransebes – Subcetate	5	5
Sibiu – Copsa Mica	13	13	Lugoj – Illa	9	9

11.5 Appendix E. List of Reference Case Projects

Project Title	Undiscounted Cost (mill EURO, 2012 prices)
Modernization of movement areas and beakoning system, control tower and ILS navigation system in Suceava Airport	31.897
Rehabilitation of the apron and parkings in Constanta (M. Kogalniceanu) Airport	31.151
Stationary platform at the entrance of the Danube - Black Sea Channel	14.111
Extension of the breakwater in the Constanta Port	133.287
Extension to the south of the gauge berth in the Port of Constanta	4.664
Rehabilitation and modernization of the infrastructure in Oltenita Port	4.596
Infrastructure works in the Port of Braila - berths 23 and 25	7.812
Building an administrative complex in Port of Giurgiu	2.596
Newada Duo Project	0.238
CO-WANDA: Convention for waste management for inland navigation on the Danube	6.3
Master Plan for the Constanta Port	2.033
DAHAR - Strategic Development Plan for the Danube interior Ports	0.145
GIFT- Green Intermodal Freight Transport Corridors in South East Europe	0.242
Modernizing port infrastructure by providing increasing depths of channels and basins and safety of navigation in Constanta Port	37.535
Developping of the rail infrastructure system in the Constanta Port (the fluvial-maritime sector)	16.858
Rehabilitation of the bridges, culverts and railways tunnels - Sucursala Craiova	18.239
Rehabilitation of the bridges, culverts and railways tunnels - Sucursala Cluj	26.579
Rehabilitation of the bridges, culverts and railways tunnels - Sucursala Brasov	11.155
Rehabilitation of the bridges, culverts and railways tunnels - Sucursala Bucuresti	17.657
Rehabilitation of the bridges, culverts and railways tunnels - Sucursala Iasi	9.566
Rehabilitation of the bridges, culverts and railways tunnels - Sucursala Timisoara	8.91
Rehabilitation of the bridges, culverts and railways tunnels - Sucursala Constanta	2.371
Rehabilitation works for the Danube bridges at km 152+149 and at km 165+817, railway line Bucharest - Constanta - Regional Branch Constanta	40.592
Modernisation of the railway level crossings - 112 crossings - Stage I	20.077
Current repairs for the public railway infrastructure for 2013-2020	558
RK for the 2013-2016 period	73.615
Rehabilitation of the Bucharest-Constanta line	904.389
Modernisation of the Coșlariu - Sighișoara line at maximum speed of 160 km/h for passenger trains	944.826
Modernisation of the Simeria - Coșlariu line at maximum speed of 160 km/h for passenger trains	663.06
Modernisation of the Border-Curtici-Arad-Simeria line: Section Border-Arad-km 614	282.713
Electrification of the Doaga-Tecuci-Barbosi line	57.227

Project Title	Undiscounted Cost (mill EURO, 2012 prices)
Developping the strategic noise maps and action plans for the major railways having more than 30,000 train movements per year - Stage I	61.826
Modernisation of the railway stations in Romania: Slatina, Râmnicu Vâlcea, Reşiţa Sud	18.525
Modernisation of the railway stations in Romania: Bistrita, Zalau	28.4
Modernisation of the railway stations in Romania: Giurgiu Oraş, Slobozia Veche, Călăraşi Sud	18.102
Modernisation of the railway stations in Romania: Sfântu Gheorghe, Târgu Mureş	22.322
Modernisation of the railway stations in Romania: Pitesti	15.584
Modernisation of the railway stations in Romania: Piatra Neamţ, Botoşani, Vaslui, Brăila	29.398
Modernisation of the Focsani station	2.517
Detection system for overheated axles and closed brakes (21 locations)	12.694
Operational pilot project for a ECTS/ERTMS Level 2 aplication on the line section Buciumeni Junction - Brazi	45.125
Upgrading the electromechanical interlocking systems for 11 stations	35.985
Upgrading the electromechanical interlocking systems for 16 stations	68
Modernization of Videle interlocking station	9.581
Bridge on DN2E km 57+400, at Clit	0.298
Bridge over Arges river, DN61 km 74+015 at Ionesti	7.035
Bridge over Sai at DN54 km 67+774 and new road alligment for DN54, km 65 +950 - km 70 +600 at Turnu Magurele	5.753
Link road DN66A km 47+600 - km 66+204, Campu lui Neag-Cerna	54.221
Rail overpass on the Arad Bypass (DN7 km 540 +248)	10.575
Rail overpass on the Arad Bypass (Brad-Curtici rail section and DJ709B)	10.663
Modernization DN 72 Gaiesti - Ploiesti km 0 +000 - km 76 +180	56.451
Modernization of Bucharest Ring Road between A1 - DN7 and DN2 - A2 (widening to 4 lanes)	121.873
Bridge over the Danube-Black Sea Channel at km 0+540 and the access infrastructure in the Constanta Port; Phase 1 - construction of the bridge	30.887
Bridge over the Danube-Black Sea Channel at km 0+540 and the access infrastructure in the Constanta Port; Phase 2 - construction of the road connections	5.961
Alesd South and Alesd North Bypass	76.65
Alexandria Bypass	41.619
Bacau Motorway Bypass	231.539
Brasov Bypass	85
Caracal Bypass	12.5
Carei Bypass	19.543
Cluj-Napoca East Bypass	132.228
Craiova South Bypass	31.833
Deva - Orastie Motorway	296.852
Iasi South Bypass: Phase 4	24.316
Lugoj - Deva Motorway	1136.3
Mihailesti Bypass	8.708
Nadlac-Arad Motorway	307.673
Oradea Bypass	52.934

Project Title	Undiscounted Cost (mill EURO, 2012 prices)
Orastie - Sibiu Motorway	600.18
Sacuieni Bypass	12.083
Satu Mare Bypass	139.646
Sebes - Turda Motorway	811.122
Stei Bypass	113.592
Suceava Bypass	68.689
Targu Jiu Bypass	88.284
Targu Mures Bypass	72.566
Tecuci Bypass	18.883
Access Road to Agigea Lock and sea-port Agigea, CDMN, left bank, between km 61 +800 and 63 +500, L = 1.700 m	1.668
Consolidation works DN29D, km 18 +500 - km 20+816	7.669
Ease of traffic on DN1 km. 8+100 - km. 17+100 - Phase 7, the bypass ring section DN7-DN1A	44.66
Rehabilitation DN66 Filiasi - Petrosani, km 0+000 - km 131+000	127.412
Rehabilitation DN76 Deva-Oradea, km 0+000 - km 184+390	223.488
Modernisation DN2N km 52+860 - km 60+000 Jitia - Biscoa and new bridge over Ramnicu Sarat river la km 53+300	5.218
Modernisation DN5, section Bucuresti - Adunatii Copaceni	22.417
Rehabilitation DN2D Focsani - Ojdula km 0+000 - km 118+893	179.071
Building the A3 motorway section in Bucharest Municipality	89
Rehabilitation DN24 (county limit Galati/Vaslui - Crasna)and DN24B	107.424
Rehabilitation DN6 Alexandria-Craiova	171.338
Rehabilitation DN66 Filiasi - Petrosani, km 0+000 - km 131+000	127.412
Rehabilitation of DN56 Craiova - Calafat km 0 +000 - km 87+047	111.72
Rehabilitation DN1H Rastoci -Zalau, km 75 +446 - km 128 +823	32.951
Traffic calming measures on 4 lanes national roads	29.032
Safety measures on DN1 in linear villages and black spots	37.984
IRIS Europe 3	1.077
Stationary platform for barges at the confluence of the Black Sea and Danube waterways Gate Alba Midia Navodari	2.702
The modernization of the water management system on the navigable channels by installing automatic monitoring stations	3.562
Upgrading the locks, equipments and installations for CDMN and CPAMN	175.639
System for gathering and processing of the ships waste and for pollution intervention on the Danube sector administrated by CN APDF SA Giurgiu	8.634
Monitoring the environmental impact of the works to improve navigation conditions on the Danube between Calarasi and Braila, km 375-km 175-Phase II	1.4
Protection for banks at Sulina Channel - Stage I	76
Improving the navigation conditions on the lower Danube (Calarasi-Braila)	38.671
Pier berth 31 in Port Docks Outdoor Galati	
Creating a support system works on the Danube river in order to ensure minimum depth for navigation	
Giurgiu bridge over the Danube at km 64+884 DN5	
Road Bridge over Olt in Slatina on DN6, km 48 +570	
Oituz road bridge over the Poiana Sarata on DN 11 km 90 +450	

Project Title	Undiscounted Cost (mill EURO, 2012 prices)
Road Bridge over Jiu in Arginesti on DN6, km 268+371	
New bridge at Cosmesti , over Siret river on DN24 km 7+620	

Locations of the Reference Case Schemes