EJTIR

Issue **9**(1)
March 2009
pp. 4-30
ISSN: 1567-7141
www.ejtir.tbm.tudelft.nl

Assessing the Variation in Rail Interoperability in 11 European Countries, and Barriers to its Improvement

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Work conducted within REORIENT, a Sixth Framework project for the European Commission (EC), is described. One objective of REORIENT was to explain the status of transformation of the European railway sector into a functionally integrated, liberalized, interoperable system. The status of interoperability within and between eleven countries in a corridor stretching from Greece to the Nordic countries was assessed, and conditions in the countries that appear to be barriers to achieving the EC's goals were identified. (Barriers were defined as shortcomings in conditions that would facilitate the implementation of requirements presumed by the EC to lead to seamless international freight transport ("implementation conditions")).
The primary data source for the analysis was a set of interviews with the major actors and stakeholders associated with each country's rail freight system. The (qualitative) information from the interviews was translated into numeric scores, which were subjected to statistical analysis. The primary objective of the statistical analysis was to provide an assessment of the relationships between the requirements and the implementation conditions. The statistical analysis involved both the identification of relevant relationships and an assessment of the strength of these relationships. Overall, we found that there was considerable variation in interoperability status across the countries on practically all of the requirements. However, there was also considerable variation in the status of the implementation conditions across the countries. As a result, we found that most of the variability was able to be explained by relationships that were found to exist between the requirements and implementation conditions.

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A 'Barrier Significance Score' (BSS) was computed for each country and for each implementation condition. These scores were used to assess the relative importance of barriers across the countries, and to identify the most critical barriers to be removed in order to improve interoperability. Large differences in BSS's were found among countries. In general there are fewer barriers in Nordic countries and more barriers in the south.

Keywords: international rail freight transport; Eastern Europe; interoperability; liberalization

1. Introduction

In 2001, the European Commission (EC) issued a White Paper entitled "European Transport Policy for 2010: Time to Decide" (European Commission, 2001). One of the primary policy goals of the White Paper was to revitalize the railways, and thereby attract more freight transport to rail. The reasoning behind this goal was that more freight traveling by rail would mean less freight traveling by road, which would lead to less road congestion, less road noise, and less air pollution. Rail freight transport has been steadily losing market share. For example, between 1970 and 1998 the goods carried by rail in the EU-15 (tonne-kilometers) fell both in absolute terms (from 283 billion tonne-kilometers to 241 billion tonne-kilometers) and in relative terms (from 21% to 8%) (European Commission, 2001). The EC's target is for rail to increase its market share of goods traffic from 8% to 15% by 2020. This would require a restructuring of national railways through market liberalization (the introduction of intramodal competition), fair and efficient pricing for all transport modes, sustained investment to modernize the infrastructure and rolling stock, and technical improvements to improve the interoperability among the networks and systems.

Following up on the White Paper, the Council of Ministers of the Member States and the European Parliament approved two packages of legislation (in March 2001 and April 2004) that included several Directives imposing on all European Union (EU) Member States the adoption of a new regulatory framework for railways. The enactment of these Directives has been the most important tool used by the Commission to open the European rail market to competition and fundamentally reform the rail transport system in the EU. The Directives (whose details and implications are discussed by Eichinger (2004), Kirchner (2006), Jarzembowski (2006), and Rothengatter (2006) are:

- Directive 2001/12/EC (OJ 2001 L75a), which sets out the general framework for European railways. It also provides for the EC to monitor technical and economic conditions and market developments of European rail transport consistently;
- Directive 2001/13/EC (OJ 2001 L75b), which covers the licensing of railway undertakings (RUs);
- Directive 2001/14/EC (OJ 2001 L75c), which includes the allocation of infrastructure capacity, charging for the use of infrastructure, and safety certification. It also requires Member States to set up regulatory bodies to ensure market access.
- Directive 2001/16/EC (OJ 2001, L110), which defines essential requirements for rail safety and introduces the concept of Technical Specifications of Interoperability (TSIs).

In 2005, the EC initiated a two-year project named REORIENT, one of whose objectives was to evaluate the progress and effects of the two packages with respect to the creation of an integrated, liberalized, competitive European railway system that would provide seamless international rail freight transport through eleven countries: Norway, Sweden, Finland, Poland, Austria, the Czech Republic, Slovakia, Hungary, Romania, Bulgaria, and Greece, which we called the 'REORIENT Corridor'. This paper describes the work on the REORIENT project that focused

on assessing the progress toward the development of an integrated freight railway system in the countries located along the REORIENT Corridor by identifying the status of interoperability in each country, explaining the variation that existed at that time in this status across the countries, and understanding the barriers to improving the degree of interoperability. For the purposes of the project, we defined interoperability broadly, in line with all four of the Directives listed above. Traditional definitions of interoperable transport networks focus on technical interoperability. For example, Directive 2001/16/EC, which deals specifically with "the interoperability of the trans-European conventional rail system", talks about "technical standardisation" and "compatibility between the characteristics of the infrastructure and those of the rolling stock, as well as efficient interconnection of the information and communication systems of the different infrastructure managers and operators."

However, there is a recent literature that defines interoperability in the broader terms used by REORIENT (and which is related to the other three Directives). For example, Mulley and Nelson (1999) discuss four dimensions of interoperability: (1) *technical interoperability*, which requires the various systems of physical infrastructure in a transport system to interface effectively and efficiently, (2) *corporate interoperability*, which occurs when different organizations are willing and able to cooperate to provide transport services, (3) *juridical interoperability*, which involves the harmonization of legislation at all government levels that has an affect on transport in the jurisdictions within the boundaries of the transport system, and (4) *cultural interoperability*, which recognizes that such things as language differences, religious differences, and different cultural attitudes about access to travel facilities can impede the provision of seamless transport. Nijkamp (1995) describes five key success factors for an efficient, competitive, market-oriented European railway system: (1) hardware, which refers to the tangible material aspects of the transportation infrastructure, (2) software, which refers both to computer software used to control the hardware facilities and to information services offered to the user of the railway system, (3) orgware, which comprises the regulatory, administrative, legal, management, and coordination activities and structures of the system, (4) finware, which refers to ways of financing and maintaining railway infrastructures and to fare structures, and (5) ecoware, which refers to environmental and ecological concerns (including safety and energy questions).

The four EC Directives, which were designed to integrate the rail systems of the Member States into a single European rail system providing seamless rail freight transport, and to encourage market competition, cover all four of Mulley and Nelson's dimensions of interoperability and most of Nijkamp's key success factors. They recognize that technical interoperability is not enough. As Rothengatter (2006) explains, intra-modal competition is required to foster productivity and innovation within the European railway system, and "this is impossible without interoperable networks." So, the EC legislation contains detailed provisions on the opening of the markets for rail transport of freight, on the conditions under which state aids can be granted and public service obligations and contracts can be concluded, on technical standards, on the access to the networks, etc. This paper focuses on understanding the variation in rail interoperability in Europe (in the broad sense described above) and barriers to attaining it. For further details of the work reported on in this paper, see (REORIENT Consortium, 2007b). The paper is divided into six sections:

- The analytical framework for the work
- Country status assessments
- Explaining variability across countries on requirements
- Explaining variability across countries on implementation conditions
- Country-specific Barrier Significance Scores (BSS)
- Results and conclusions

2. Analytical framework

The analytical framework for this work is composed of three main components:

- *Requirements* to achieve seamless rail freight transport, which include all conditions related to the institutional/legal framework, market opening, and the physical railway system that appear to be necessary for seamless rail freight transport. These were divided into two categories:
  1) *EC requirements*, which refer to all of the mandated requirements covered in the relevant EC Directives, EU legislation, and other EC documents;
  2) *Other requirements*, which relate to other conditions, mainly in terms of characteristics of infrastructure, rolling stock, and terminal facilities, as well as the capacity and skills of personnel.
- *Implementation conditions*, which are conditions that must be met or situations that would help to facilitate the implementation of one or more (interoperability) requirements for achieving seamless rail freight transport. (*Implementation barriers* are shortcomings in implementation conditions.)
- *Country macro indicators,* which are country descriptors on a macro level that we expected would be helpful in explaining the likelihood of implementation conditions being established.

The interoperability requirements are closely related to Mulley and Nelson's (1999) *dimensions of interoperability*; the implementation conditions are closely related to what they called *impediments to interoperability*.

2.1 Requirements

The *EC requirements* refer to the provisions of the Directives mentioned above (Directives 2001/12/13/14/16/EC). For example, Directive 2001/12/EC, relating to market opening and integration, requires the separation in railway undertakings' financial accounts of freight and passenger activities. The *other requirements* refer to all other conditions for interoperability, mainly in terms of characteristics of the network, such as the infrastructure, rolling stock, terminal facilities, and technical/organizational interoperability at border crossings, but also including the capacity and skills of the personnel.

Within the main category of 'EC requirements', the following subcategories were distinguished:

- LF: legal framework regarding freight railway system
- IA: interoperability and accessibility procedures
- MO: market opening and changes in market structure
- TI: technical interoperability according to Technical Specifications of Interoperability (TSIs)

Within the main category of 'other requirements', the following subcategories were distinguished:

- NL: network links
- TP: terminals and transfer points
- BC: border crossings
- RS: rolling stock

The TI and 'other requirements' subcategories relate directly to Mulley and Nelson's (1999) technical interoperability dimension, the LF subcategory is related to their juridical interoperability dimension, and the IA and MO subcategories are related to their other two

categories. The subcategory MO is related to one of the major objectives of the EC legislation – liberalization of the rail markets in Europe (i.e., opening the markets to competition and attracting new rail operators to compete with previously nationalized "incumbents"). According to Rothengatter (2006), "intramodal competition can be regarded as a most important element of restructuring the railway sector". A study prior to REORIENT by IBM Business Consulting Services (2004) focused on the status of implementation of the EC requirements for this subcategory of interoperability.

Table 1 provides an overview of the detailed EC requirements and Table 2 provides an overview of the other requirements (individual requirements are coded by the above categories plus a sequential number). Note that it is not necessarily true that all requirements are actually important in establishing seamless rail freight transport, or that they are equally important. But, they were considered important by the EC and by other researchers (e.g.., Mulley and Nelson (1999)). In this respect, Tables 1 and 2 can be regarded as lists of 'potentially important' requirements. The issue of importance was considered in other parts of the REORIENT project (REORIENT Consortium, 2007d).

Note that the requirements can be interpreted from two perspectives. In a positive sense, they refer to a need to be fulfilled to achieve seamless rail freight transport. In a negative sense, they refer to the existence of a shortcoming or *problem* standing in the way of achieving seamless rail freight transport — i.e., a situation in which an essential requirement is not (adequately) met. The work reported on here assessed the status of the interoperability requirements for the eleven countries in the REORIENT Corridor. This assessment provides information on the extent to which interoperability requirements are met, and on the still existing gaps (problems and their causes) in adequately meeting these requirements. Other analysis on the REORIENT project indicated that filling these gaps could lead to substantial shifts in freight from road to rail transport. For example, analysis suggested that infrastructure improvements across the REORIENT Corridor (improvements in the track, electrification of the track, and terminal processing time improvements) had the potential to increase the amount of freight traveling by rail by about 10% (REORIENT Consortium, 2007c).

Table 1. EC requirements to achieve seamless rail freight transport

EC Requirements	Description
Legal/institutional framework regarding freight railway system (LF)	
LF1: Transposition of EC legislation into national law	Actions to provide legal national basis for implementation of EC legislation aiming to achieve seamless and competitive rail freight transport ("in the books").
LF2: Implementation of EC legislation	General status of actual implementation of rail freight interoperability requirements following from EC legislation ("in practice").
LF3: System of state railway funding	Transparency, efficiency and fairness of state funding of infrastructure managers and rail operators in order to warrant fair competition across transport modes and non-discriminatory treatment of rail transport sector.
LF4: Accounting separation: IM versus RU	Financial separation of infrastructure management and rail freight transport operations.
LF5: Accounting separation: passengers versus freight	Financial separation of passenger and freight operations (no cross subsidies).
Interoperability and accessibility procedures (IA)	
IA1: Division of responsibilities including independence of IM	Assignment of powers and duties to warrant independence of IM and efficient, non-discriminatory capacity allocation and provision of related services to all operators.
IA2: Rules for inter-organizational operations/communications in rail sector	Cooperation and communication between and among IMs, RUs and terminal managers in (international) capacity allocation and train operation.
IA3: Licensing and safety certificates	Availability of transparent and non-discriminatory procedures to enable new entrants to meet requirements for obtaining licensing and safety certificates.
IA4: Network statement	Availability of complete and adequate (accessible, transparent) network statement.
IA5: Train path allocation	Availability of transparent and non-discriminatory procedures for train path allocation among competing operators, including new entrants.
IA6: Access to terminals	Availability of transparent and non-discriminatory procedures for access to freight terminals and related services.
IA7: Framework agreements	Availability of transparent and non-discriminatory procedures for establishing framework agreements with rail operators, including new entrants.
IA8: Handling of complaints	Establishment of independent body and transparent procedures for managing conflicts of interest between and among infrastructure manager and rail operators, including new entrants.
Market opening and market conditions (MO)	
MO1: Infrastructure charging principles	The extent to which charging schemes support efficient use and financing of infrastructure and procedures for charging of infrastructure use and ancilliary services are transparent and non-discriminatory.
MO2: Accessibility to new entrants	Openness and accessibility of markets and infrastucture facilities to new entrants.
MO3: Supply of intermodal services	Sufficient supply and quality of intermodal services to attract intermodal transport.
MO4: Fair/equal transport market conditions of rail versus other modes	Transparent, fair and equal competitive conditions for rail transport in relation to other transport modes (in particular road transport).
Technical interoperability according to TSIs	
TI1: Control/command and signaling interfaces TI2: Telematic applications for freight services TI3: Traffic operation and management TI4: Infrastructure TI5: Energy TI6: Rolling stock: freight wagons and traction units TI7: Maintenance	Detailed technical requirements according to subjects in left hand column as specified in the various Technical Specifications of Interoperability (TSIs) following from Directive 2001/16/EC.

TI8: Noise	

Table 2. Other requirements to achieve seamless rail freight transport

Other Requirements	Description
Network links (NL)	
NL1: Configuration and alignment	Configuration and alignment of the rail freight transport network as a whole in relation to network density and coverage.
NL2: Physical capacity	Physical capacity and admissible speed of railway tracks, crossings and specific bottlenecks including passages, bridges and tunnels.
NL3: Condition/quality	Condition and quality of transport network (age, maintenance situation) in relation to failures, availability.
NL4: Capacity and skills of personnel	Capacity and skills of network related personnel (infrastructure manager).
NL5: Technical/organizational interoperability	Observed technical and organizational interoperability problems related to network links.
Terminals/transfer points (TP)	
TP1: Number, location and types of transfer points	Number, location and types of transfer points in relation to coverage of the intermodal transport supply network.
TP2: Physical characteristics	Physical characteristics of transfer points: capacities, accessibllity and lay-out.
TP3: Actual availability	Actual availability of terminal facilities as a result of capacity allocation procedures and service times.
TP4: Condition/quality (age, maintenance situation)	Condition and quality of terminal facilities (age, maintenance situation) in relation to failures, availability.
TP5: Capacity and skills of personnel	Capacity and skills of terminal related personnel (terminal/transfer point manager).
TP6: Technical/organizational interoperability	Observed technical and organizational interoperability problems related to terminal operation.
Border crossings (BC)	
BC1: Number, location and types of border crossings	Number, location and types of border crossings in relation to coverage of the intermodal transport supply network.
BC2: Physical characteristics	Physical characteristics of border crossings: capacities, accessibllity and lay-out.
BC3: Actual availability	Actual availability of border crossing facilities as a result of capacity allocation procedures and service times.
BC4: Capacity and skills of personnel	Capacity and skills of border crossing related personnel.
BC5: Technical/organizational interoperability	Observed technical and organizational interoperability problems related to border crossings.
Rolling stock (RS)	
RS1: Physical capacity	Physical capacity of rolling stock: numbers, types and sizes of freight wagons and traction units.
RS2: Actual availability	Actual availability of rolling stock as a result of capacity allocation procedures (traction units).
RS3: Condition/quality	Condition and quality of rolling stock (age, maintenance situation) in relation to failures, availability.
RS4: Capacity and skills of personnel	Capacity and skills of train operation related personnel (railway undertakings).
RS5: Technical/organizational interoperability	Observed technical and organizational interoperability problems related to rolling stock.

2.2 Implementation Conditions

An *implementation condition* is defined as a condition that must be met or a situation that would help to facilitate the implementation of one or more requirements for achieving seamless rail freight transport. An *implementation barrier* is defined as the opposite of that: a shortcoming in an implementation condition. Thus, the existence of a national rail regulator with the skills, knowledge, and insights to implement administrative changes towards seamless rail freight transport would be a condition that would help to facilitate the implementation of some of the requirements. The lack of such an entity would be an implementation barrier. We used the status of the implementation conditions to help us explain the status of interoperability in a country, variations in the status of interoperability among countries, and barriers to achieving interoperability.

In the analytical framework, implementation conditions/barriers are specified based on a definition of:

- Implementation condition/barrier *categories* and *subcategories*.
- Relevant *actors*.
- Implementation condition/barrier *types*.

The implementation condition/barrier *categories* are:

P: Political conditions/barriers.

A: Administrative conditions/barriers.

S: Social/cultural conditions/barriers.

T: Technical conditions/barriers.

F: Conditions/barriers related to the financial perspective.

M: Conditions/barriers related to the market perspective.

I: Institutional & organizational conditions/barriers.

Implementation condition/barrier *subcategories* are distinguished in order to provide the option to make a distinction between the conditions/barriers related to the *achievement* (e.g., in law) and the *actual functioning* (in practice) of an interoperability requirement.

Further, the barrier subcategories are related to specific actors in order to clarify the distinctions among barriers and to provide a better basis for the identification of possible actions or measures to reduce or eliminate barriers. The relevant *actors* considered in REORIENT are:

GOV: Transportation Department/National Government.

NCA: National Competition Authority.

NRR: National Rail Regulator.

RU: Railway Undertakings.

IM: Infrastructure Managers.

RWU: Railway Workers Unions.

TM: Terminal/Transfer Point Managers.

PU: Community at large (the public).

The railway sector (**RS)** as a whole is referred to, indicating the actor group comprising the RU, the IM, and the TM, when it is not necessary to distinguish among the individual actor groups. Furthermore, in some cases it is useful to make a distinction between incumbent railway undertakings and new entrants (**RSNE**). Actual implementation conditions/barriers are identified within the above dimensions.

The achievement of an interoperability requirement mainly relates to the quality and effectiveness of the decisionmaking process. When considering the conditions/barriers related to

the functioning of a requirement, relevant sub-categories are involved with the processes of implementation, enforcement, and operation. The barrier *types* refer to:

- "Ability" – the degree to which the resources to achieve a required condition or situation are present and/or available.
- "Interest" – the degree to which the attitudes, objectives, or behavior of specific actors would support or resist the creation of a required condition or situation.

The following are brief definitions of the implementation condition/barrier categories.

- **Political**: conditions/barriers with respect to decisionmaking on the relevant legal framework regarding the freight railway system from the perspective of the role and functioning of the national government.
- **Administrative**: conditions/barriers with respect to implementation and enforcement of administrative changes (in terms of interoperability and accessibility procedures) following from the adoption of the legal framework to achieve seamless rail freight transport, from the perspective of the functioning of the National Rail Regulator and the National Competition Authority, as well as the railway sector as a whole.
- **Social/cultural**: conditions/barriers with respect to decisionmaking on the legal framework regarding the freight railway system from the perspective of the public at large and the railway workers unions, and conditions/barriers with respect to the consequences of implementation of changes in the freight railway system for the working environment from the perspective of the railway workers unions.
- **Technical**: conditions/barriers with respect to implementation and operation related to the technical suitability of existing rail freight infrastructure systems and to available technical knowledge/skills, as well as conditions/barriers related to the acceptance of new technological systems from the perspective of the railway sector.
- **Financial perspective**: conditions/barriers with respect to implementation and operation related to the ability and willingness to invest in rail freight transport from the perspective of the railway sector (both incumbents and new entrants) and the national government.
- **Market perspective**: conditions/barriers related to the capabilities and willingness of the railway sector to adjust to required changes in market structure and the market positions of the incumbent railways and the new entrants.
- **Institutional & organizational**: conditions/barriers with respect to implementation and operation related to skills and knowledge, and to the feasibility of institutional and organizational structures, of the railway sector, the National Competition Authority, and the National Rail Regulator, as well as conditions/barriers to the willingness of the railway sector to adjust co-operation practices and to accept institutional and organizational changes.

It should be noted that these categories are not independent of each other, but may be highly correlated. For example, there is obviously a close connection between political implementation conditions/barriers and financial implementation conditions/barriers. Also, the 'administrative' and 'institutional & organizational' categories are closely related, but have different foci. The 'administrative' category focuses on the implementation and enforcement of administrative changes (bringing about the appropriate mandates and authorities); the 'institutional & organizational' category focuses on the operational functioning of the railway system and its directly related institutions after they were put into place administratively.

A more detailed overview of the conditions/barriers is provided in Table 3. In this table, individual conditions/barriers have been coded using the first letter of the category, followed by a sequential number.

Table 3. Overview of implementation conditions/barriers

Category	Subcategory	Relevant actor	Type	Code	Condition/barrier	Description/indicator
Political	Decision-making	GOV	Ability	P1	Skills, knowledge and insights to achieve and enforce political and legal changes towards seamless rail freight transport	Political capabilities of responsible authorities
			Ability	P2	Authority to achieve and enforce political and legal changes towards seamless rail freight transport	Political power of responsible authorities
			Ability	P3	Compatibility and reconcilability of rail transport related EC legislation with existing legislation	Extent to which rail transport related EC legislation is compatible and reconcilable with existing legislation
			Interest	P4	Willingness to achieve and enforce political and legal changes towards seamless rail freight transport	Political interests and incentives of responsible authorities
Administrative	Implementation	NRR	Ability	A1	Skills, knowledge and insights of NRR to implement administrative changes towards seamles rail freight transport	Skills, knowledge and insights of NRR to implement administrative changes towards seamles rail freight transport
			Ability	A2	Mandate and authority to implement administrative changes towards seamless rail freight transport	Scope and extent of power of NRR
			Interest	A3	Willingness to implement administrative changes towards seamless rail freight transport	Interests and incentives of NRR
	Enforcement	NCA	Ability	A4	Skills, knowledge and insights of NCA to enforce administrative changes towards seamless rail freight transport	Administrative capabilities of NCA
			Ability	A5	Mandate and authority to enforce administrative changes towards seamless rail freight transport	Scope and extent of power of NCA
			Interest	A6	Willingness to enforce administrative changes towards seamless rail freight transport	Interests and incentives NCA
	Implementation & enforcement	RS	Interest	A7	Willingness to co-operate with implementation and enforcement of administrative changes towards seamless rail freight transport	Interests and incentives of RS
Social/cultural	Decision-making	PU	Interest	S1	Level of acceptance/support of government decisions related to changes in rail freight transport	Trust in and respect for government and government decisions. Benefits and disbenefits of changes in rail freight transport perceived or experienced by different groups in society in relation to level of social organization (interest groups)
		RWU	Interest	S2	Acceptance of changes in employment opportunity	Changes in numbers and types of jobs in rail freight sector in relation to level of labor organization
	Implementation	RWU	Interest	S3	Acceptance of changes in working environment and requirements related to technical knowledge and skills	Extent of required changes (working conditions, training, education) and threats to position of professional establishment
Technical	Implementation & operation	RS	Ability	T1	Technical suitability of existing rail freight transport systems	Quantity, quality and compatibility gaps between available and required rail freight transport systems
			Ability	T2	Suitability of available technical knowledge/skills of RS personnel	Quality and compatibility gaps between available and required technical capabilities and education levels of RS personnel
			Interest	T3	Acceptance of introduction of new technological systems by RS	Benefits and disbenefits of technological changes perceived by RS
Financial perspective	Implementation & operation	RS	Ability	F1	Potential to accommodate required investments	Available financial resources or access to financial resources by incumbent RS
		RS	Interest	F2	Willingness to invest in technological improvement and new business concepts	Level of changes in costs and benefits (profitability) and associated risks perceived by incumbent RS
		RSNE	Interest	F3	Willingness to invest in rail freight operation by new entrants in rail sector	Level of profitability and associated risks perceived by new entrants in rail sector
		GOV	Ability	F4	Government potential to support investments in rail freight system	Available financial resources or access to financial resources by national government
		GOV	Interest	F5	Willingness to invest in rail freight system by national government	Interests and incentives to invest in rail freight transport by national government
		GOV	Interest	F6	Willingness of national government to balance competition conditions between road and rail transport	Interests and incentives to balance competition between road and rail by national government
Market perspective	Implementation & operation	RS	Ability	M1	Potential to adjust to required changes in market structure and market position	Degree of flexibility and capabilities to adjust to changes in business environment by incumbent RS
		RS	Interest	M2	Willingness to go along with changes in market structure and market position	Interests and incentives to support required changes in the market
Institutional & organizational	Implementation & operation	RS	Ability	I1	Skills and knowledge, and feasibility of institutional and organizational structures of RS to adequately handle institutional and organizational changes and changes in task execution	Professional capabilities to deal with institutional and organizational change. Coverage and clarity of tasks, mandates and responsibilities (conflicting and overlapping jurisdictions). Extent to which co-operation and co-ordination mechanisms have been established and are actually functioning (in relation to number of organizations and administrative layers)
		NCA/NRR	Ability	I2	Skills and knowledge, and feasibility of institutional/organizational structures of NCA and NRR to adequately handle institutional and organizational changes and changes in task execution	
		RS	Interest	I3	Willingness to adjust co-operation and co-ordination practices and to accept/implement institutional and organizational changes	Degree of changes in operational tasks, working relationships and working conditions

2.3 Country Macro Indicators

Country macro indicators were defined in terms of country descriptors on a macro level as explanatory factors that were expected to determine the likelihood of implementation conditions to be established. The country macro indicators were used as a bridge to the explanatory factors explaining the barriers to interoperability in a country, and variations in the barriers among countries. Country macro indicators were identified within the following categories:

PS: political system – level of openness, transparency, democracy of political system (e.g. in terms of democratic influence).

GS: governance/administrative system – level of reliability, fairness, effectiveness of governance system as perceived by relevant parties and the general public. The governance system is to be regarded as the whole of relevant government related processes, institutions, and organizations.

ED: economic development – actual economic development level and growth rate (to be expressed in terms of high-low).

TD: technological development – actual technological development level and development rate (to be expressed in terms of high-low).

SE: social security and employment – level of social security/protection and (un)employment.

EA: education and awareness – general knowledge and information level of relevant parties and the community at large (the public).

BE: business environment – the environment in a country of relevance to companies in order to efficiently conduct profitable businesses.

Table 4 provides an overview of the set of country macro indicators that we used within the various categories. In choosing the set of country macro indicators, the following criteria were applied:

- Information on the values of the indicators for the countries in the REORIENT Corridor should be readily available.
- The indicators should be provided by a respected unbiased international organization and be comparable across all of the countries.
- All of the implementation conditions/barriers should be 'covered' by at least one of the country macro indicators.
- The number of macro indicators should remain limited (1 or a maximum of 2 per category).

Table 4. Overview of country macro indicators

	Code	Description	Unit	Year	Source
PS		**Political System**			
PS2		Political Voice and Accountability Index	Index (0-100)	2004	World Bank
GS		**Governance System**			
GS1		Government Effectiveness Index	Index (0-100)	2004	World Bank
GS2		Perception of Corruption Index	Index (0-10)	2003	Transparency Intl.
ED		**Economic Development**			
ED1		GDP (purchasing power parity) per capita	US$	2004	World Bank
TD		**Technological Development**			
TD1		ICT Development Index	Index	2004	World Economic Forum
EA		**Education and Awareness**			
EA1		Education Index	Index (0-1)	2003	UNDP
BE		**Business Environment**			
BE1		Doing Business Index	Ranking index	2005	World Bank

3. Country status assessments

3.1 Scoring

The assessment of status variation and the identification of barriers was performed using a wide variety of information, most of which was gathered in interviews. (For details of who was interviewed, the questions asked, and the resulting information, see (REORIENT Consortium, 2007a)). The interviews were conducted between August 2005 and February 2006. This information was used to assign scores to the various components of the analytical framework for each of the countries along the REORIENT Corridor. Scores were associated with all three components of the analytical framework – the requirements, the implementation conditions, and the country macro indicators. It should be noted that we tried to make the scores as reliable and consistent across countries as possible. After we had assigned the scores for a country, we had them verified by experts inside each country. However, the scores are mainly subjective, and the results must be considered in this light. We are confident about the overall aggregate patterns described here, but not necessarily about the individual scores.

Based on the scores, a statistical analysis was carried out in order to provide the desired inputs to the analysis of variation in rail interoperability and the barrier analysis. The objective of the statistical analysis was to provide an assessment of the relationships between the requirements and the implementation conditions, and between the implementation conditions and the country macro indicators. The statistical analysis involved both the identification of the relevant relationships and the assessment of the strength of these relationships.

A nine-point numerical scale, expressed by the numbers 1 through 9, was used to score the various components of the analytical framework. Characteristics of this scale are:

- the worst possible score is associated with 1.
- the best possible score is associated with 9.
- intermediate situations are associated with numerical scores between 1 and 9.

The implication of using this numerical scale is that, for each aspect, the ratio of the best to the worst score is always equal to 9. In practice, it is not really possible to find meaningful specifications of all discrete scores from 1 to 9. Therefore, in specifying the scales, meanings were defined for only the scores 1, 3, 5, 7 and 9. With 1 and 9 expressing the worst and best situation, score 5 represents the medium or neutral position. Scores 3 and 7 represent a situation with rather severe limitations, and rather few limitations, respectively. In between scores (2, 4, 6, and 8) were then used to further fine tune the nuances between situations. If no information was available, a score of zero was assigned. This structure was consistently applied to define the scores for the various requirements and implementation conditions considered. Two examples (for EC requirements LF4 and MO2) are presented below.

Example 1. The meaning of scores for requirement LF4 – separation of infrastructure manager (IM) from incumbent railway undertaking (RU)

Score	Description
1	No separation of infrastructure and transportation departments of formal national railway
3	Only accounting separation
5	Organizational, accounting and legal independence of infrastructure and transportation departments
7	Organizational, accounting and legal independence of infrastructure and transportation departments as well as functional separation of essential functions
9	Complete institutional division including legal separation of proprietorship

Example 2. The meaning of scores for requirement MO2 – accessibility of rail freight network to new entrants

Score	Description
1	No access to new entrants
3	Severe restrictions in access to and use of rail freight network by new entrants
5	Significant limitations in access to and use of rail freight network by new entrants
7	Few limitations in access to and use of rail freight network by new entrants
9	Open access to new entrants without any restrictions

3.2 Scores on Requirements

Generally, scores for meeting the requirements are higher in the Nordic countries (Norway, Sweden, Finland) and lower in new Member States, but also in Greece. Interactive thematic maps are available on the REORIENT project Website that will allow exploration of these results. For a quick overview of the scores assigned to any or all of the 25 EC requirements and the 21 other requirements based on the survey results, click on the following link, and choose the requirement you want to see in the drop-down menu at the bottom of the map: https://www.reorient.org.uk/content/map/Requirement_aspects.

Example 1: Figure 1 is an example of a thematic map for one of the EC requirements (IA1 –- Division of responsibilities/ independence of Infrastructure Manager). It shows that, for this requirement, Norway and Finland has the highest score, and Greece has the lowest.

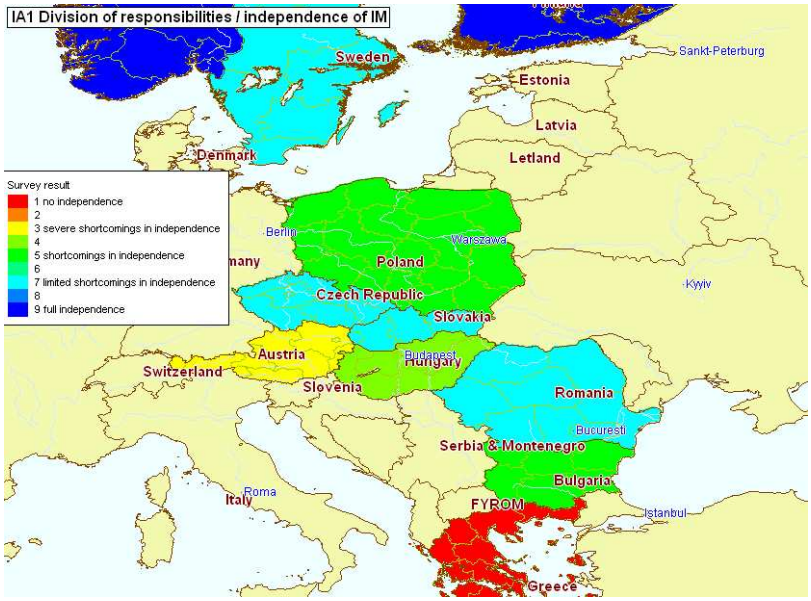

Figure 1. Thematic map for requirement IA1 (Independence of Infrastructure Manager)

Example 2: Figure 2 is the thematic map for the EC requirement that there should be non-discriminatory access for all freight railway undertakings to the Trans-European Rail Freight Network (TERFN). It shows a somewhat different pattern from that for the independence of the Infrastructure Manager. No country has full open access. Each country has some conditions that are unfavorable for new entrants. The best performing countries in this case are Norway, Poland,

and the Czech Republic. Greece currently provides no access for new entrants. Some severe limitations also exist in Finland and Hungary, although for different reasons.

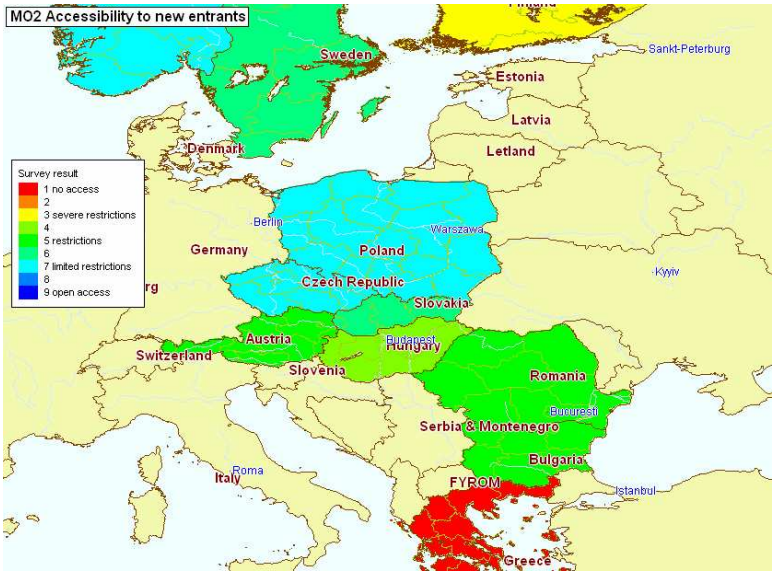

Figure 2. Thematic map for requirement MO2 (Accessibility to new entrants)

In order to allow for a further interpretation of this information, the quantitative scores were aggregated across the requirements within each of the eight categories of interoperability requirements. The scores were aggregated by taking the average value of the scores (by country) across the requirements included in each of the categories, while correcting for missing values. Table 5 presents a summary of the results across the eleven countries along the REORIENT Corridor for each of the categories. Overall, it is clear that there is considerable variation in interoperability status across the countries. However, excluding the category "Technical interoperability according to Technical Standards for Interoperability (TSI's)", it appears that practically all countries are doing a reasonable job of complying with the requirements of the Directives. (There has been no substantial progress in TSI implementation in any country so far, since most of the TSIs have only recently been specified and translated into local languages.)

Table 5. Summary of scores on requirements

Requirement Category	Adequate (7-9)	Less Adequate (5, 6)	Not Adequate (3, 4)	Severe Limitations (1, 2)	Total
Legal/institutional framework	6	4	1	0	11
Interoperability and accessibility procedures	5	4	1	1	11
Market opening and market conditions	2	5	3	1	11
Network links	2	9	0	0	11
Terminals/transfer points	4	5	1	1	11
Border crossings	4	6	1	0	11
Rolling stock	3	7	1	0	11
Technical interoperability according to TSIs	0	0	5	6	11
Average no. of countries (excl. TSIs)	3.7	5.7	1.2	0.4	11

3.3 Scores on Implementation Conditions

As with the requirements, scores for the implementation conditions are higher in the Nordic countries (Norway, Sweden, Finland) and lower in new Member States, but also in Greece. Interactive thematic maps are available on the REORIENT project Website that will allow exploration of these results. For a quick overview of the scores assigned to any or all of the 28 implementation conditions/barriers based on the survey results, click on the following link, and choose the condition/barrier you want to see in the drop-down menu at the bottom of the map: https://www.reorient.org.uk/content/map/Implementation_conditions.

Example 1: Figure 3 is an example of a thematic map for one of the implementation conditions that falls within the subcategory "Administrative" within the category "Interest" (A3 – National rail regulator's willingness to implement the required administrative changes). It shows that there is strong support in the Nordic countries and Hungary for implementing the necessary administrative changes, while there is some degree of opposition in Bulgaria, Romania, and Greece.

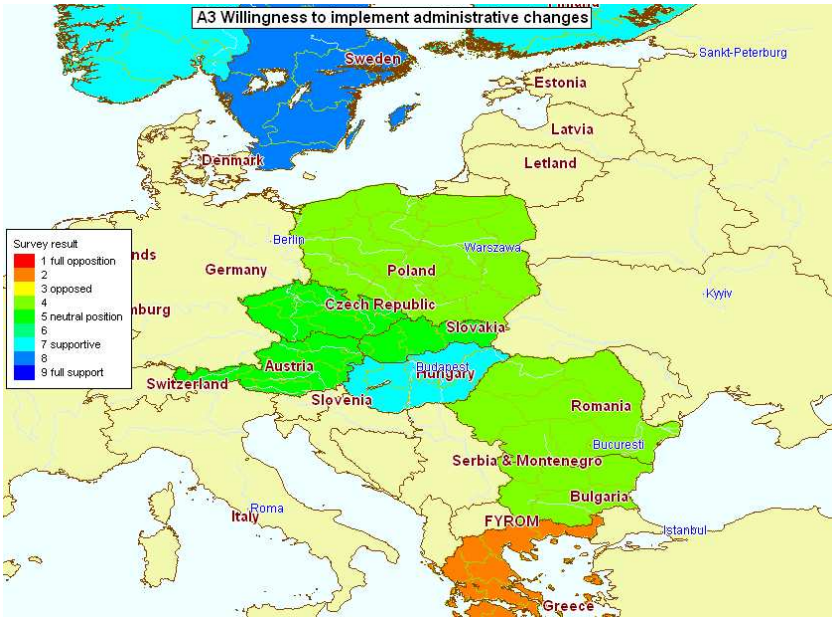

Figure 3. Thematic map for interoperability condition A3 (Willingness of the national rail regulator to implement administrative changes)

Example 2: Figure 4 is an example of a thematic map for one of the implementation conditions that falls within the category "Ability" (F4 – Government potential to support investments). It shows that there are significant financial barriers to achieving the goals of interoperable international rail freight transport in Romania, Bulgaria, and Greece. No such barriers exist in the Nordic countries or Austria.

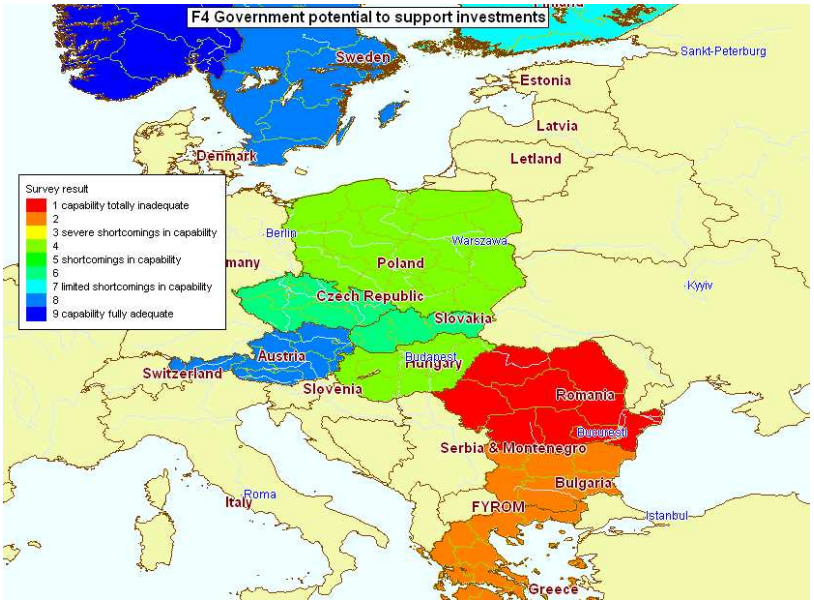

Figure 4. Thematic map for interoperability condition F4 (Government potential to support investments)

Table 6 presents a summary of the results across the eleven countries along the REORIENT Corridor for each of the seven categories of implementation conditions for both the ability and interest subcategories. As was the case for the requirements, the scores were aggregated by taking the average value of the scores (by country) across each implementation condition category. Overall, in terms of ability, the implementation conditions are generally less than adequate. (On average, the abilities are adequate in an average of only about 4 of the 11 countries.) However, there are severe limitations in very few cases. The biggest 'ability barrier' to implementing the EC's interoperability Directives is clearly financial.

Table 6. Summary of scores on implementation conditions (no. of countries)

	Ability				**Interest**		
Implement. Condition Category	**Adequate**	**Less adequate**	**Not Adequate**	**Severe Limitations**	**Favourable**	**Neutral**	**Unfavourable**
Political/legal	5	5	1	0	2	7	2
Administrative	4	6	1	0	2	8	1
Social/cultural	na	na	na	na	1	5	5
Technical	2	8	1	0	0	10	1
Financial perspective	3	3	2	3	1	8	2
Market perspective	5	5	1	0	0	9	2
Institutional & Organizational	4	4	2	1	3	7	1
Average	3.8	5.2	1.3	0.7	1.3	7.7	2.0

With respect to the subcategory "Interest", we used a different scale to define the scores. We rated a country's interest as favorable (scores 7-9), neutral (scores 4-6), or unfavorable (scores 1-3). In most countries and most categories, we found the interest in implementing the Directives to be neutral. However, there do appear to be some strong social/cultural barriers to implementation in many countries.

4. Explaining variability across countries on requirements

Overall, we found that there was considerable variation in the status of interoperability across the eleven countries on practically all of the interoperability requirements. However, there was also considerable variation in the status of the implementation conditions across the countries. In this section, we address the question: Are the variations in a country's implementation status consistent with the underlying implementation conditions?

Based on the scores explained above, a statistical analysis was carried out in order to explain the variability in interoperability. The analysis was designed to provide an assessment of the relationships between the requirements and the implementation conditions. The statistical analysis involved both the identification of the relevant relationships and the assessment of the strength of these relationships. The data for the statistical analysis consisted of the quantitative scores for the requirements (with 46 variables) and for the implementation conditions (with 28 variables). Because of the large number of variables and the relatively small sample size (only 11 countries), the statistical analysis was kept simple, in order to clearly see the structuring of the data and to be able to reveal all internal relationships.

The first step in the statistical analysis was to look at the inter-correlations within each data group, and also within each subgroup. By analyzing simple correlation matrices of each data group and subgroup, many high correlations were found. This was not surprising, since it is most natural that within a certain group the state of matters has developed hand-in-hand, which leads to high correlations among the variables.

The next step was to look at the interrelationships between the requirements and the implementation conditions. Because of the high number of variables and their internal correlations (multi-collinearity), pairwise correlations were used for this analysis. The significance of the pairwise correlations were established according to Pearson's 2-tailed test. In this process two significance levels were used – 0.01 (99% significance level, which was referred to as 'high significance'), and 0.05 (95% significance level, referred to as 'lower significance'). This allowed us to make a distinction between relatively stronger and weaker relationships.

Preceding the pairwise correlation analysis, the relationships that would be logically 'expected' in view of the assumed causal characteristics of the system were identified.

Following the results of a 'first round' statistical analysis, both the scores and the expectations were reiterated. Some revisions were made in the scores by executing a number of consistency checks and by carefully considering and updating some of the most critical information. In certain cases, where the statistical analysis showed a significant relationship while initially no relationship was assumed, expected causal relationships were also reconsidered. A second round of statistical analysis was then performed. The results of this second round were processed as follows:

- all 'expected' relationships that turned out to be significant were accepted;
- other significant relationships were once more critically reviewed and accepted only if the existence of a causal relationship was deemed plausible;
- all other relationships were rejected.

Considering the relationships between the *EC requirements* and the *implementation conditions*, a total of 148 significant and meaningful relationships were found (73 of high significance and 75 of lower significance). For example, interoperability requirement LF4 (the accounting separation between the infrastructure manager and the incumbent railway undertaking) is significantly related to three Political implementation conditions (P1, P2, P3), four Administrative implementation conditions (A4, A5, A6, A7), two Market implementation conditions (M1, M2), and three Institutional implementation conditions (I1, I2, I3). (For descriptions of all of the implementation condition codes, see Table 3.)

Considering the relationships between the *other requirements* and the *implementation conditions*, a total of 85 were found to be meaningful and significant (40 of high significance and 45 of lower significance). For example,

- The Financial implementation conditions (F1-F6) are much more relevant with respect to these requirements than they are for the interoperability requirements.
- Social/cultural implementation conditions (S1-S3) are significantly related to the capacity and skills of the personnel.
- Political implementation conditions are significant only for requirements related to terminals and border crossings.

In summary, we found that most of the variability was able to be explained by relationships that were found to exist between the requirements and implementation conditions. Table 7 shows the numbers of scores for the interoperability requirements per country that were not able to be explained using the statistical analysis.

Table 7. Number of scores for interoperability requirements that are not explained by the statistical analysis

Country	Number of interoperability requirements that are	
	more positive compared to related implementation conditions	more negative compared to related implementation conditions
Norway	0	0
Sweden	0	0
Finland	1	1
Poland	2	0
Cz. Rep.	0	0
Slovakia	1	0
Austria	1	2
Hungary	0	2
Bulgaria	0	1
Romania	2	1
Greece	0	4
Total	7	11
% of reqts.	4.2%	6.7%

As shown in Table 7, 11% of the scores were not able to be explained using the statistical analysis. So, for 89% of the scores, we were able to explain the variability in the status of the requirement by differences in scores of the interoperability conditions. The 18 scores for interoperability requirements that were not able to be explained by the related implementation conditions were generally found to be special cases; that is, there were explanatory factors specific to their situations that were able to explain their unexpectedly high or low scores. For example, Romania's two positive outliers appear to be the result of its doing its best (better than some existing EU Member States) to meet the requirements of the EC Directives in order to make itself as attractive as possible for EU membership. (This analysis was carried out prior to Romania's accession to the EU.) And Greece's four negative outliers result from the fact that it has seriously delayed the harmonization of its laws and organizations with what is required in the EC Directives. (It should be pointed out that the fact that a score is an outlier does not mean that the relevant requirement score was very high or very low in absolute terms, but that it was very high or very low given the status of the country's implementation conditions.) Details of the analysis can be found in (REORIENT Consortium, 2007b).

5. Explaining variability across countries on implementation conditions

The approach to assess the variability across countries for the implementation conditions is very similar to the variability assessment for requirements described in the previous section. Considering the relationships between implementation conditions and country macro indicators, the statistical analysis produced a total of 81 significant and meaningful relationships (30 of high significance and 51 of lower significance). The detailed results of the statistical analysis revealed that most of the country macro indicators within each of the various categories are highly correlated. For this reason it did not seem useful to consider all macro indicators in the further analysis, as some of the indicators may in fact not be contributing to the explanation of variability. Therefore, a step was taken to further reduce the number of macro indicators in order to maintain the ones that would best explain the observed variability in implementation conditions. The reduction process was based on two considerations:

- the potential overlaps between different macro indicators;
- the number of acceptable, significant relationships found.

Within each of categories, we selected the most meaningful macro indicator (i.e., the indicator with the largest number of significant relationships). Listed below are all of the country macro indicators and the seven that were finally selected (indicated in bold). Between parentheses is the number of significant relationships found for each macro indicator.

PS Political System

- PS1 Economic Freedom Index (3)
- **PS2 Political Voice and Accountability Index** (9)

GS Governance System

- **GS1 Government Effectiveness Index** (10)
- **GS2 Perception of Corruption Index** (10)
- GS3 Rule of Law Index (6)

ED Economic Development

- **ED1 GDP per capita** (4)

TD Technological Development

- **TD1 ICT Development Index** (4)
- TD2 Expenditure on R&D as % of GDP (3)

EA Education and Awareness

- **EA1 Expenditure on education as a % of GDP** (8)
- EA2 Percentage of adult population participating in training / education (7)

BE Business Environment

- **BE1 Doing Business Index** (12)
- BE2 Business Competitiveness Index (5)

One macro indicator was retained in each of the categories considered, except for the category Governance System (GS). Two macro indicators were retained in this category (GS1 and GS2), since both indicators have a considerable number of significant relationships and show a certain variation in the implementation conditions for which significant relationships were found.

In summary, we found that most of the variability in implementation conditions was able to be explained by relationships that were found to exist between the implementation conditions and the country macro indicators. Table 8 shows the number of scores for implementation conditions that were not able to be explained using the statistical analysis.

As shown in Table 8, 20 outliers were identified where a score for an implementation condition is more positive than would be expected from the status of the related country macro indicators. Also, 21 outliers were identified where a score for an implementation condition is more negative than would be expected based on the status of the related macro indicators. So, variations in the values of the country macro indicators are able to explain 83% of the variation seen in the scores of the implementation conditions we examined. The scores on most of the outliers could be explained by special situations within the countries. For example, Romania has 14 of the 20 positive outliers. Based on our interviews, we concluded that Romania was going out of its way to facilitate the implementation of the EC Directives and to improve the situation with respect to freight transport in the country, in order to prove that it deserved membership in the European Union and to mitigate negative feelings toward their joining the EU. On the other hand, although Finland has been fairly complete in its implementation of the EC Directives, it has some unique conditions that explain its negative outliers. In particular, there are few incentives for competition to be created in Finland's international rail freight market, since there are small freight flows, long distances, demanding weather conditions, and an unusual track gauge (the same as Russia's, not the same as that of other European countries). Details of the analysis can be found in (REORIENT Consortium, 2007b).

Table 8. Number of scores for implementation conditions that are not explained by the statistical analysis

Country	Number of implementation conditions that are	
	more positive compared to related country macro indicators	more negative compared to related country macro indicators
Norway	0	2
Sweden	0	2
Finland	0	10
Poland	0	0
Czech Rep.	2	0
Slovakia	1	0
Austria	0	5
Hungary	1	1
Bulgaria	2	0
Romania	14	0
Greece	0	1
Total	20	21
% of conditions	8.3%	8.7%

6. Country-specific barrier significance scores

A *barrier* is defined as a shortcoming in an implementation condition, where an implementation condition relates to a condition that must be met or a situation that would help to facilitate the implementation of one or more (interoperability) requirements for achieving seamless rail freight transport.

A Barrier Significance Score (BSS) was computed for each implementation condition in each country. (Since there are 28 implementation conditions and 11 countries, there are 308 BSSs.) The BSS provides a way of identifying the most important barriers to meeting the requirements within a specific country, and a way of identifying the relative importance of a specific barrier across the set of countries. The calculation of each BSS used the country-specific scores for implementation conditions and requirements, and the significant relationships between

requirements and implementation conditions that were found in the statistical analysis. In particular, the importance of a barrier (implementation condition) by country is determined by:

- The number of significant relationships of a given implementation condition with the requirements.
- The significance of the relationships (distinguishing between the two significance levels).
- The actual country score for the implementation condition.
- The actual country scores of the requirements to which the implementation condition is related.

The BSS for implementation condition *ic* in country *c* was computed as follows:

$$BSS_{c,ic} = \Delta SIC_{c,ic} * \Sigma_{sr} (\Delta SRA_{c,ic,sr} * W_{sr})$$

where:

$\Delta SIC_{c,ic}$ Difference between 9 (highest score) and actual score of the implementation condition (ic) for the country (c).

$\Delta SRA_{sr,c,ic}$ Difference between 9 (highest score) and actual score of the requirement for all requirements that have a significant relationship (sr) with the relevant implementation condition (ic) for the country (c).

W_{sr} Weight for the significance of the relationship (sr).

In the barrier analysis presented here, the weights used for the relationships of high (99%) and lower (95%) significance were respectively 2 and 1. Note that a barrier for any implementation condition in any country is not only more important if the score for the implementation condition in question is lower, but also if there is a larger number of requirements (to which the implementation condition is significantly related) with low scores.

The BSS analysis results in (European Commission, 2001) a country-specific assessment of the relative importance of the various implementation conditions in terms of barriers (i.e., a BSS for each of the 28 implementation conditions, in absolute terms), and (2) a cross-country assessment of the importance of each implementation condition (i.e., the BSS for a given implementation condition in each country relative to the highest BSS for that implementation condition). Interactive thematic maps are available on the REORIENT project Website that allow exploration of these results. For a quick overview of the BSS results, click on the following link, and choose the implementation condition you want to see in the drop-down menu at the bottom of the map: https://www.reorient.org.uk/content/map/Country_Barrier_Significance_Score. Figure 5 is an example of a thematic map showing the absolute scores for one of the implementation conditions (Railway sector willingness to go along with changes in the market).

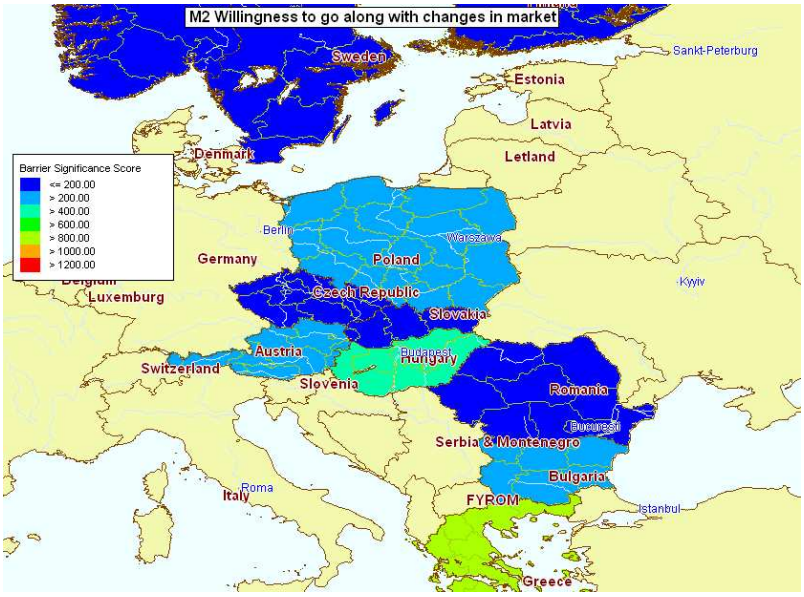

Figure 5. Country-specific BSS for implementation condition M2 (willingness to go along with changes in the market)

Figure 6 is an example of a thematic map showing the scores for the same implementation condition (Railway sector willingness to go along with changes in the market) relative to the score for Greece, which has the highest BSS for this implementation condition.

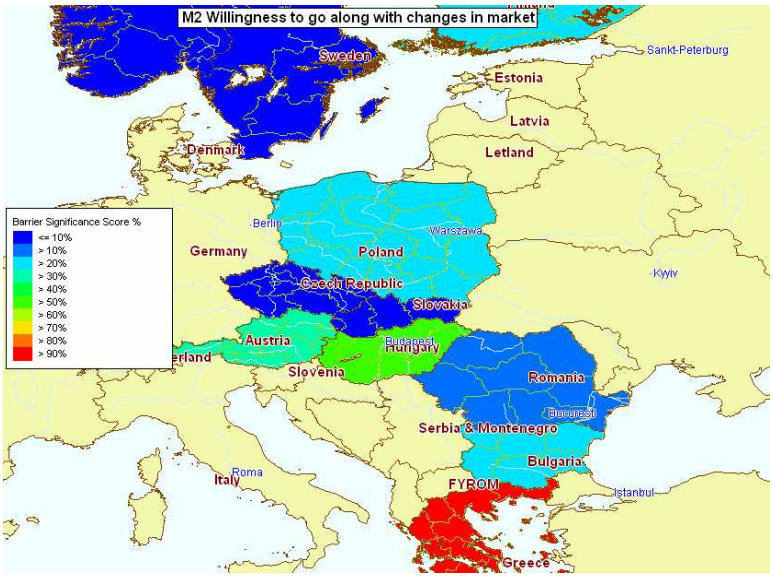

Figure 6. Relative BSS for implementation condition M2 (willingness to go along with changes in the market), BSS for Greece = 100%

7. Results and conclusions

Overall, we found that there was considerable variation in the status of interoperability across the eleven countries on practically all of the interoperability requirements. However, there was also considerable variation in the status of the implementation conditions across the countries. As a

result, we found that most of the variability was able to be explained by relationships that were found to exist between the requirements and implementation conditions. The relationships between the country macro indicators and the implementation conditions were not as strong as between the implementation conditions and the requirements. Nonetheless, 83% of the implementation condition scores are explained by the country macro indicators. Special cases are able to explain practically all of the others.

In the analytical framework, the requirements to achieve seamless rail freight transport were divided into two categories: *EC requirements* (related to the EC-mandated documents), and *other requirements*. The analysis found that, if only the EC requirements are taken into account, within the REORIENT Corridor countries the main barriers to achieving interoperability relate to:

- Inadequate mandates and lack of willingness of national regulators to implement and enforce administrative changes.
- Inadequate organizational structures, skills, and knowledge of rail institutions (railway undertakings, infrastructure managers, and regulators) to handle changes in task execution.
- Lack of resources and lack of willingness of the railway sector (railway undertakings and infrastructure managers) to adjust to changed market structures.

If only the other requirements (which relate primarily to the railway network) are taken into account, financial barriers are dominant. The main financial barriers are the ability of both the railway sector and the national governments to accommodate required investments and the willingness of the railway sector to invest in technological improvements and new business concepts. Other barriers for improving the railway network are inadequate organizational structures, skills and knowledge of rail institutions, and technical barriers.

Barriers related to the EC requirements (market perspective and administrative) are thus generally different from barriers related to the other requirements (financial perspective and technical). Institutional/organizational barriers play a role in the achievement of both types of requirements. Consequently, these barriers dominate when looking at the picture across all requirements.

Another conclusion from the BSS analysis is that significant barriers are not so much related to the decisionmaking process (passing enabling legislation within the country), as they are to enforcement and implementation of the spirit of the terms of the EC Directives. Furthermore, from an actor perspective, on average the most significant barriers are related to the national regulators and the railway sector. Finally, barriers are more related to shortcomings in required conditions or skills, and less to negative attitudes of the actors.

If one looks at differences in the BSS across the countries, the main conclusion is that these differences are very large. The average absolute score for the BSS across all requirements for Norway, for example, is less then 5% of the average for Greece. In general, there are fewer barriers in Nordic countries and more barriers in the Southern part of the REORIENT Corridor. For the newer Member States considered in the analysis, the significance of barriers in the Czech Republic and Slovakia is relatively low. The average BSS across all requirements for these two countries is, for example, lower than the average BSS for Austria. Furthermore Romania and Bulgaria (Member States from 2007 onwards) are doing relatively well if one looks at barriers related to EC requirements. However, Romania and Bulgaria have the most significant barriers (mainly financial) related to the other requirements.

One way of summarizing all of the BSS across all of the countries is to use a radar/spider chart, such as the one shown in Figure 7. In order to highlight the important barriers by country, this figure displays all BSS (for all implementation conditions and all countries) that have high values (over 300). This figure highlights some of the conclusions mentioned above:

- There is great variability in the scores across the interoperability conditions (the maximum value of the BSS across all implementation conditions ranges from 0 (for S1 and T3) to 1337 (for I2);
- There is great variability across the countries (scores are generally lower in the Nordic countries and higher in the Southern part of the REORIENT Corridor);
- Barriers are very high in only a few countries (only six countries – Poland, Austria, Hungary, Bulgaria, Romania, and Greece – have any BSS over 300);
- There are only a few major barriers (only 45 of the 308 BSS are over 300; the most important barriers are in the institutional/organizational, market, administrative, and financial categories).

These results are good news in terms of understanding the underlying problems in achieving seamless international rail freight transport. They provide us new insights into these problems. However, it is bad news with respect to solving the problems, since they suggest that changing the current status of the related implementation conditions is not just an issue of solving technical problems of interoperability, but may require major changes in a country's economic, political, cultural, educational, etc. situation. Achieving seamless international rail freight transport in Europe will, therefore, require more than the implementation of EC Directives.

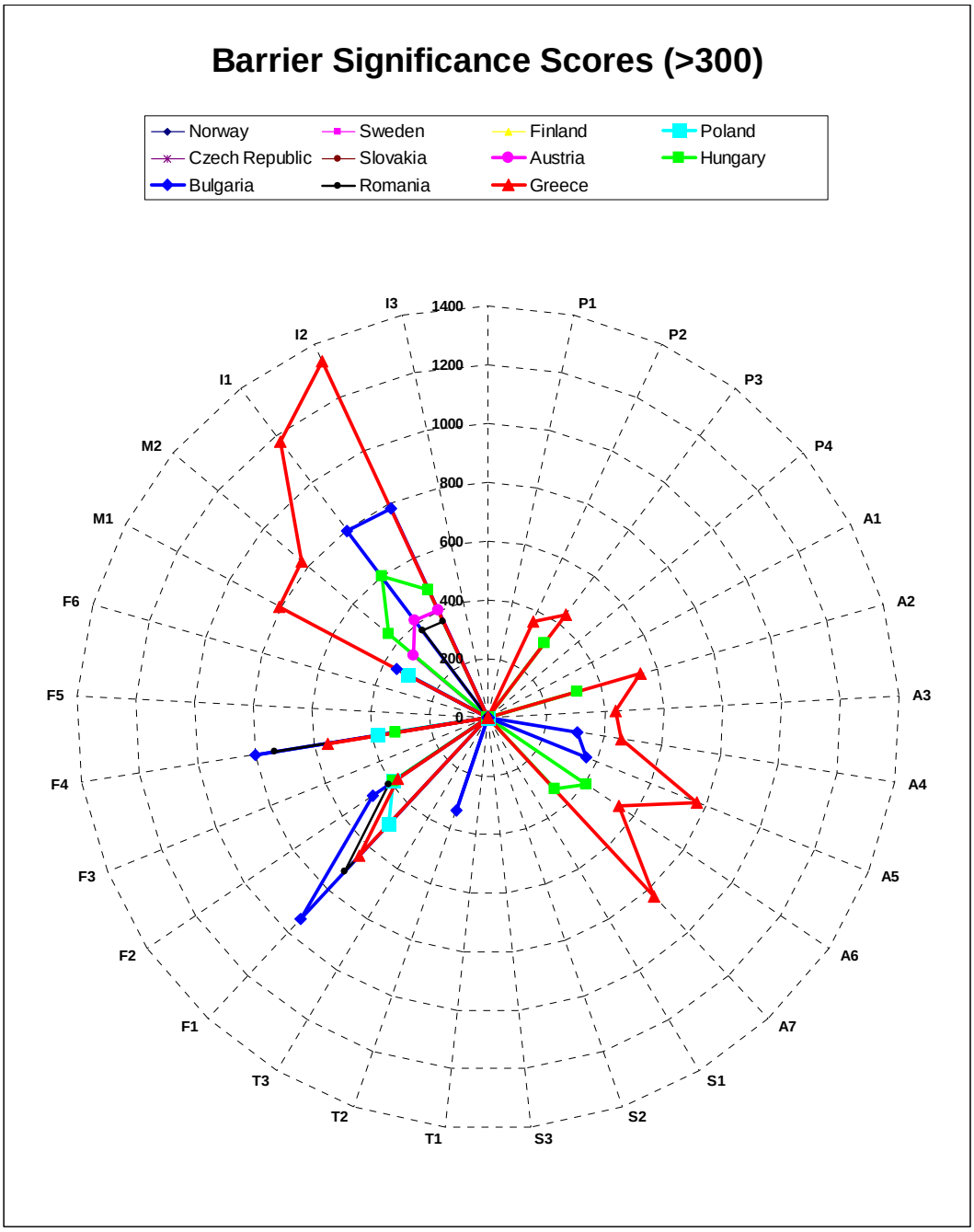

Figure 7. Barrier Significance Scores > 300 (for all implementation conditions)

Acknowledgements

This work was supported by the European Commission as part of its Sixth Framework Programme under the project name REORIENT. Further information on the project can be found on the REORIENT Website: https://www.reorient.org.uk/. The project's partners were: Ingeniería de Sistemas para la Defensa de España S.A. (Spain), Demis B.V (the Netherlands), Deutsches Zentrum für Luft-um-Raumfahrt e.V. (Germany), Institute of Transport Economics (Norway), Napier University (United Kingdom), University of Bologna (Italy), and University of

Maryland (United States). This paper has benefited from comments by the editor of this special issue, and from several anonymous reviewers.

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