



**SEVENTH FRAMEWORK
PROGRAMME**

THEME 7

**Transport including Aero-
nautics**



Project NEAR²

NETWORK OF EUROPEAN – ASIAN RAIL RESEARCH CAPACITIES

Coordination Action
Grant Agreement No: 314254

Deliverable D3.9

Concept Document Human Factors/Societal Aspects

Version: _____ Final

Date: _____ November 2013

Dissemination level: _____ Public

PROJECT INFORMATION

Title: _____ Network of European – Asian Rail Research Capacities

Acronym: _____ NEAR²

Grant Agreement no: __314254

Programme: _____ 7th Framework Programme

Funding Scheme: _____ Coordination and Support Action

Start date: _____ 1st December 2012

Duration: _____ 24 months

Web site: _____ <http://www.near2-project.eu/>

PROJECT PARTNERS

No	Name	Short name	Country
1 (co-ordinator)	Centre of Research and Technology Hellas / Hellenic Institute of Transport	CERTH/HIT	Greece
2	EURNEX e.V.	EURNEX	Germany
3	TECHNISCHE UNIVERSITAT BERLIN	TUB	Germany
4	CESKE VYSOKE UCENI TECHNICKE V PRAZE	CVUT	Czech Republic
5	VILNIAUS GEDIMINO TECHNIKOS UNIVERSITETAS	VGTU	Lithuania
6	Moscow State University of Railway Engineering	MIIT	Russian Federation
7	A-TRANS LLC	A-TRANS	Russian Federation
8	Petersburg State Transport University	PSTU	Russian Federation
9	TONGJI UNIVERSITY	IRRT	China (People's Republic of)
10	EIRC Consulting Private Limited	EIRC	India
11	State Higher Educational Establishment Donetsk Railway Transport Institute of Ukrainian State Academy of Railway Transport	DRTI	Ukraine
12	INSTYTUT KOLEJNICTWA	IK	Poland
13	TRAI NOSE METAFORES-METAFORIKES YPIRESIES EPIVATON KAI FORTIOU AE	TRAI NOSE	Greece

DOCUMENT PROFILE

Document status: _____ Final

Deliverable code: _____ D3.9

Deliverable title: _____ Concept Document: Human Factors/Societal Aspects

Work Package: _____ 3

Preparation date: _____ June - November 2013

Submission date: _____ November 2013

Dissemination level: _____ Public

Author: _____ Dr. Martin Schiefelbusch MA MSc

Contributors: _____ Natalia Invanova

Quality control: _____ Prof. Maria Boile

Abstract: _____ D3.9 includes the identified needs, gaps and barriers, as well as the future research priorities on the topic of “Human Factors/Societal Aspects”.

<i>Document History</i>	<i>Version</i>	<i>Comments</i>	<i>Date</i>	<i>Authorised by</i>
	1	First release among project partners	03/07/2013	CERTH
	2	Interim version	05/09/2013	-
	3	Second release after completion of work	10/09/2013	CERTH
	4	Restructured text	06/12/2013	CERTH
	5	Minor editing changes	28/01/2014	
<i>Classification:</i>	Public			

<i>Number of pages:</i>	24
<i>Number of annexes:</i>	-

EXECUTIVE SUMMARY

One of the main goals of the NEAR² project is the creation of Concept Documents that will map the current situation along the Eurasian railway land bridge in specific fields of expertise (based on the ten poles of excellence of the European rail Research Network of Excellence – EURNEX) and will define future research needs based on identified gaps in technology and knowledge.

The current document has been developed within the activities of Work Package 3 (“Investigation of the current situation of research gaps, needs and priorities”) and it comprises one of the ten Concept Documents that will be created under the NEAR² activities, dealing with the fields of “Human Factors” and “Societal Aspects”. Its aim is:

- To define the topics that are related to the working environment of the railways in the region (Human Factors) regarding for example the impacts of very long distance services or intercultural communication.
- To synthesize the railways’ role in the region’s transport policy and social environment as well as cross-border collaboration in rail infrastructure development and planning.
- To discuss the role of such factors for the efficiency of the Europe-Asia railway corridors.
- To identify the problems, need, gaps and barriers that exist and degrade the regular rail movement of goods between Europe-Asia, always in regards to the relevant topics.
- To identify future research needs and priorities that will support the formulation of a research agenda for the Eurasian land bridge.

The current Concept Document will form the basis for discussion, both in the framework of the project and beyond, comprising the cornerstone for bridging the gaps in knowledge and technology in order to improve the efficiency of the railways in the Trans Eurasian land bridge.

CONTENTS

PROJECT INFORMATION	2
PROJECT PARTNERS	2
DOCUMENT PROFILE	3
EXECUTIVE SUMMARY.....	4
LIST OF TABLES	5
LIST OF FIGURES.....	6
ABBREVIATIONS AND TERMINOLOGY	6
1 INTRODUCTION	7
1.1 The NEAR ² project	7
1.2 Human factors as a neglected field?	8
1.3 Objectives of the Working Group and links to other WGs	8
2 ISSUES AND CHALLENGES AND THEIR RELEVANCE FOR EURO-ASIAN RAIL TRANSPORT.....	10
2.1 “Micro level” of human factors”	10
2.1.1 General overview and structure of the field	10
2.1.2 Specific relevance for Euro-Asian rail freight transport	11
2.2 “Macro level” of human factors and societal issues	14
2.2.1 General overview and structure of the field	14
2.2.2 Specific relevance for Euro-Asian rail freight transport	14
3 OUTLINE OF A RESEARCH AGENDA	19
3.1 Human Factors - “micro level”	19
3.2 Societal aspects - “macro level”	20
4 RESEARCH NEEDS AND NETWORK BUILDING	21
5 POLICY RECOMMENDATIONS.....	22
BIBLIOGRAPHY	23

LIST OF TABLES

Table 1: Stakeholders in rail development along the Euro-Asian landbridge	15
---	----

LIST OF FIGURES

Figure 1: Levels of Human Factors	11
---	----

ABBREVIATIONS AND TERMINOLOGY

ADB	Asian Development Bank
AED	Association of Railway International Electronic Documents Circulation Operators
CAREC	Central Asia Regional Economic Cooperation Program
CCTT	Coordinating Council for Trans-Siberian Transportation
CD	Concept Document
CIC CIS	Coordinating Transport Council of the CIS Members
CIS	Community of Independent States
EBRD	European Bank for Reconstruction and Development
ECO	Economic Cooperation Organisation
EU	European Union
EURNEX	European Rail Research Network of Excellence
GETO	Association of European Trans-Siberian Operators
HF	Human Factors
JIFFA	Japan International Freight Forwarders Ass.
OSJD	Organisation for the Cooperation between Railways
OTIF	Intergovernmental Organisation for International Carriage by Rail
SMPS	International Agreement on Rail Passenger Transport
SMGS	International Agreement on Rail Freight Transport
TRACECA	Transport Corridor Europe-Caucasus-Asia
UIC	International Union of Railways
UNCTAD	United Nations Conference on Trade and Development
UN ECE	UN Economic Commission for Europe
UN ESCAP	UN Economic and Social Commission for Asia and the Pacific
WB	World Bank
WG	Working Group

1 INTRODUCTION

“The freight train from China to Germany could be nine days faster through harmonisation of legislation with China, better processing at the borders and digitalisation of the necessary documentation.” (DB CEO Rüdiger Grube, 9 Sept. 2013)

1.1 The NEAR² project

The rapid development of Asian economies, particularly China, India and Russia has dramatically increased the trade volumes between Europe and Asia, with the largest trading partners of Europe actually being located in Asia. Nowadays, the most important trade loads are being transported between the two continents by sea.

Railway transport, using the existing and new land routes for the Trans-Eurasian land bridge presents a viable alternative to the maritime routes, which is gaining significant momentum. Due to the origins and current nature of this rail land bridge, numerous issues need to be resolved to bring the system to a modern state of infrastructure, services and operations. Furthermore, to build the capacity to fully exploit the systems potential adaptation of new technologies, interoperability solutions and optimized operations should be considered. In order to support this objective, NEAR² proposes the creation of a Rail Research Network along the Trans-Eurasian land bridge, exploiting the structure and leveraging the achievements of the existing European Rail Research Network of Excellence (EURNEX), engaging this way all the existing research centres in a continuous and fruitful international cooperation.

One of the core activities of NEAR² is the formulation of 10 Concept Documents (CDs) that will map all the technological issues that concern the achievement of interoperability along the EU-Asia railway network. The gaps in the existing knowledge in terms of barriers and potential solutions are also being investigated, thus resulting to the identification of research needs and priorities. Each Concept Document covers a specific thematic area, based on the 10 EURNEX Poles of excellence, and is supported by a project-partner-membered NEAR² Working Group (WG). The 10 WGs of the project are the following:

1. Strategy and Economics
2. Operation and System Performance
3. Rolling Stock
4. Product Qualification Methods
5. Intelligent Mobility
6. Safety and Security
7. Environment and Energy Efficiency
8. Infrastructure and Signalling
9. Human Factors and Societal Aspects
10. Training and Education

1.2 Human factors as a neglected field?

As with most transport issues (cf. Schiefelbusch 2010), the evolution of rail transport is often seen through a technology-focused lens and understood as a predominantly technical (and economic) challenge. However, railways depend on people to use them and to plan the system, hence “people are central, both because a large part of the rail business is to move people from place to place in an effective and affordable manner, ... but also because the reliable, safe, high quality and efficient railway of the future will depend upon the workforce and upon the artefacts and systems that they use” (Wilson/Norris 2005:655).” Earlier research found that “many if not most products are manufactured without adequate consideration of human factors. Designers tend to focus ... on the product and its functions without considering the use of the product from the human point of view” (Wickens et al 1998). “This means that there are great opportunities for ergonomics in several areas of support, but chiefly in research to generate new knowledge, develop and transfer standards, guidance and analysis/assessment tools, and establish processes to integrate human factors within the total rail systems life cycle” (Wilson/Norris 2005:655).

The persons involved in the rail sector not only need to find good working conditions, they also have to be able and willing to work together. To do so, they have to develop a common understanding of their tasks and develop joint projects. Collaboration is therefore a key prerequisite for the improvement of transport connections, both on the personal and institutional level. The above quote shows the important contribution a better collaboration can make to the competitiveness of rail transport.

Working Group 9 therefore places its emphasis on the people in the rail system. As such, it has close links especially with WG 1 Strategy/Economics and 10 Training/Education, where the “human dimension” also plays a major role. The thematic realm of WG 9 is described in more detail in the next section. The present document outlines the research needs in WG 9’s area of interest, based on a brief review of the policy environment and an assessment of potential issues that currently limit the potential of rail transport on the various Euro-Asian corridors.

1.3 Objectives of the Working Group and links to other WGs

This working group has its origin in the established ten thematic EURNEX poles, which also includes a group no. 9 “Human Factors” (HF). The subject area of the NEAR2 Working Group nevertheless evolved as part of the Prague meeting in May 2013, and the WG was consequently renamed “Human Factors/Societal Aspects”. In essence, this means that WG 9 looks at the “human dimension” in a wider sense, incorporating also organisational issues and market needs, as described in more detail below.

More specifically, WG 9 addresses human behaviour in rail transport, looking at the “human dimension” on two levels:

1. **“micro level”** ► interactions of rail personnel with rail technology, other rail personnel and other persons, hence the realm of Human Factors (with capital letters) research in the traditional sense, but also organizational studies, communication research and possibly others
2. **“macro level”** ► interactions between rail industry institutions, performed by their members/staff, as analysed by political science, political economy, history of economy and technology or organizational studies.

Furthermore, according to the general tasks of the project (Description of Work), WG 9 has a general duty to oversee new, cross-cutting issues, framed as “new directions with other poles”. The distinction between the “micro” and “macro” levels has been proven useful in the analysis and is maintained in the following parts of this document. However, there are other possibilities of structuring the field, including disaggregation of the two levels into further topics, as described in more detail in section 2.

This framing of the WG’s area of responsibility has two implications: First, relevant research activities and potential network members are not only to be found in the area of (technical and operational) rail research, but also in other fields where people may have worked on rail-related issues from their respective (economic, political, social) perspectives.

Second, the realm of WG 9 has overlap with several other WGs, in particular WG 1 (Strategy and Economics). Starting from different considerations, both WGs address conceptual and strategic issues of rail development. To handle preparing the concept documents in an efficient and balanced way, the following allocation of tasks was agreed between the WG leaders:

1. WG 1 focuses on the operators/providers and tasks typically done by them, hence all economic and business development aspects
2. WG 9 focuses on human factors in operations as well as typical activities of political / administrative institutions, international arrangements, “user” needs

Due to mutual membership of the WG leaders in the respective other group, the further details could be settled informally in parallel with the work on the documents.

The research activities framed in WG 9 (and documented in the present paper) shall contribute to bringing rail transport in a better position on the long-distance Euro-Asian transport market. As part of this overall objective, WG 9 will contribute to

1. understanding market needs, the policy and social context of rail transport
2. developing the working environment in the field of human factors in light of changing requirements and workforce characteristics (aging societies)
3. evolving the institutional and procedural framework for international rail transport

From the links with other WGs, two shall explicitly be mentioned here: First, human activity inevitably implies risks, and there is a huge body of literature discussing the impact of human factors on the safety of rail operations. Such issues, however, are not dealt with here, but in WG 6 (Safety and Security). Second, human factors have to be considered in the technical and operational shaping of the rail system, but of course also in the formation of the staff working there. Again, the question of training the rail industry’s workforce is addressed in another WG (no. 10).

2 ISSUES AND CHALLENGES AND THEIR RELEVANCE FOR EURO-ASIAN RAIL TRANSPORT¹

2.1 “Micro level” of human factors”

2.1.1 General overview and structure of the field

As described above, the micro-level of human factors addresses the role of humans at work, in this case the operation of rail services along the Euro-Asian land bridge routes. To capture strengths and weaknesses of rail on the market for long-distance transport, the analytical perspective should, however, be widened to include not only rail operations alone, but also the interface of rail-related work with actors involved in organising transport between Europe and Asia. In other words, this implies to look at the complete travel chain from origin (factory, mine, warehouse etc.) to destination, thus including the logistics of organising such complete long-distance journeys.

It is evident that, from this perspective, human activity cannot be treated as homogeneous. Rather, people are active in different roles or functions and act either on their own or as part of an institution, of which there are again many. Following established practice in HF research, the main stakeholders include

“signallers and controllers (electrical and traffic); drivers; station and on-train staff; planners, engineers and managers; track (maintenance) workers—mechanical and electrical, lookouts and safety controllers; passengers and the general public (the latter legitimate—e.g. at level crossings, and illegitimately— suicides and trespassers)” (Wilson/Norris 2005:652, emphasis added)

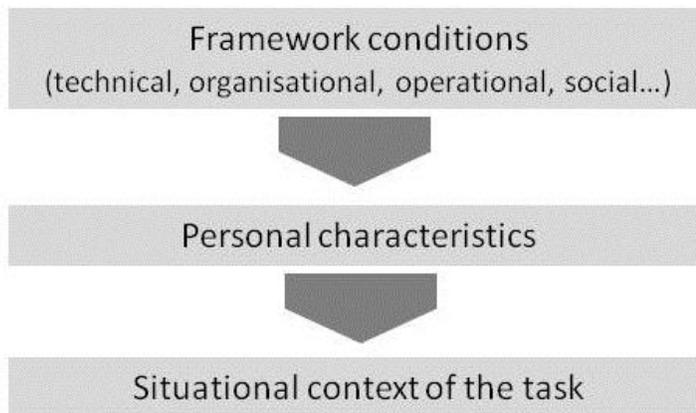
Even if passengers are less relevant in the context of the NEAR2 project, it is clear that a large number of possible interactions are to be considered for a comprehensive analysis of the HF field. For the design of interventions in the working environment, another distinction which is probably useful is that between the framework conditions, personal circumstances of the person itself and the task currently to be performed (figure 1). The latter, comprising the concrete man-machine or person-person interaction, is only one element affected by several “higher level” layers. For inter-organisational and inter-cultural settings, these layers will often have different connotations - even in the same thematic field of work.

Another level of complexity can be seen in the way the framework conditions influence the personal and situational level. As in many other large technical systems (cf. Hughes 1983), the rail

¹ The following content is based on the general discussions in the consortium and a simplified literature review, mainly using the multinational TRID database for transport research documentation. This covers English, French, German and Spanish sources, so studies from Russia, China and other countries not published in one of these languages is unfortunately excluded. For the “macro level” of human factors, desk research on the various organizations’ activities was used in addition to the quoted literature.

industry has organised its work based on hierarchy, tight control, centralisation, standardisation and formalisation of tasks. The “rule book” is thus very important for guiding and structuring work (Wilson et al 2001:240, Grote et al 2009:22), which implies (a) the need to update and monitor the rules themselves regularly and (b) the question what happens in cases where the rules are incomplete or inconsistent. From the rules, routines emerge, and “tacit knowledge” on how to deal with things is developed by staff, but there is so far much more limited use of work models based on flexibility and “loose coupling” (Grote et al 2009). This setting is arguably common for much of the rail sector in Europe and Asia, but this is not necessarily so when other stakeholders or business partners are taken into account.

Figure 1: Levels of Human Factors



(Simplified version of Maag/Schmitz/Fröschl 2009:654)

Understood in this wider sense, a tentative list of topics on the micro level of human factors includes:

1. **Direct working environment:** Human-machine interaction, anthropometrics, workloads and workflows, staff working conditions
2. **Interaction:** Communication across borders and language barriers, interaction with third parties' personnel, interaction in the planning and implementation of logistical chains
3. **Tasks:** Allocation of tasks between persons and machines (automatisation), surveillance and management of technical systems, handling of external influences (weather conditions, customs procedures, other delays, theft and other security risks)

2.1.2 Specific relevance for Euro-Asian rail freight transport

These terms describe areas that are relevant to any (or at least any international) rail operation, hence including the Euro-Asian land bridge routes. Existing rail and logistics operations along these routes have found ways to manage these issues, which may be more or less suitable for future, enhanced rail services. The relevance of these issues for the specific requirements posed

by the Euro-Asian routes require further examination. To identify the most important aspects, it may be helpful to consider the specificities of Euro-Asian transport. Three features seem to be worth mentioning, outlined below with an indication of their human factors implications:

Length/distance: Euro-Asian transport involves much longer distances than any other relevant land-based traffic flow (in any case more than 10,000 km, considering central Europe and eastern China as end points). The same applies to travel times. As trains do not (and probably will not) be driven by the same personnel over the whole route, this does not in itself raise particular human factors challenges beyond those known today - but the monotony of train driving in the highly regulated environment is already an issue of workplace design (Maag/Schmitz/Fröschl 2009:659). From a logistics perspective as well, the distance covered is in itself less important than the number of places in which the shipment has to be handled (shunting, modal shift, customs clearance etc.). However, the distance also has implications that are relevant to the human factors dimension:

- Even if different crews are responsible for running trains along the routes, the distances involved for each can still be long (compared to the European situation), requiring specific approaches in designing the drivers' workspace, staff scheduling, rest facilities and the like.
- Distance increases the risk of low reliability of the service (delays). This calls for appropriate contingency plans and hence the provision of appropriate resources in operations (including staff) and awareness in the planning of logistical chains using these routes.
- Distance and the number of ruptures for various reasons also lead to a greater risk for the cargo in terms of damage and theft. Suitable staff allocation and training is therefore required.

There is a huge body of research on shift work in general and the rail sector in particular. Some research has also been done on the design of work environments for long-haul rail freight, mainly in Australia where such trains are for example manned by two crews who rest in turns in dedicated coaches (Darwent/Lamont/Dawson 2008, see also Anderson/Grunstein/Rajaratnam 2013, Dorrian/Baulk/Dawson 2011, Jay et al 2008, Ashton/Fowler 2005).

International character/border crossings: In addition to the geographical distance, rail transport on these corridors is also of a distinct international character, as all routes involve a multitude of nations. In spite of already existing forms of cross-border cooperation (such as the OSJD), nation states are still important as the territorial units defining customs rules, the institutional structure, shape of the rail system (see below), but also working conditions. Furthermore, language and cultural differences mainly manifest themselves along language barriers. Implications for the human factors environment can be seen in the language and communication skills required (cf. de la Garza/Weill-Fassina/Kaplan 2008). This applies to

- first and foremost the communication between rail operational *managers, planners and logistics experts* involved in the work on long-distance transport as developers, managers or controllers

- but also between *operational personnel* (train drivers, marshalling yard and warehouse staff, other operational personnel) who need to communicate across national (resp. language) borders

As a result, it is necessary to design man-machine interfaces in a way that can be universally understood and/or to provide explanations and documentation in all relevant languages. This task should usefully be linked to the wider question of how the user interface of equipment used in different cultural setting can be designed in a way that cross-boundary workers are not subject to an overflow of information and an abundance of country-specific equipment (cf. Maag/Schmitz/Fröschl 2009:692-694).

Independently from the issues of language and terminology, the content of communication has to be considered. There are cultural conventions of what is said by whom in which situation. Such cross-cultural differences can in part be overcome by rules, but are likely to remain in case of unforeseen situations like incidents. The same situation is likely to be handled differently in case of a “denial”, a “rule-based” or a “pro-active” safety culture (cf. Johnsen et al 2006).

Technical boundaries: Third, the Euro-Asian routes have to be planned across technical boundaries. Most evidently the gauge breaks at the borders between the central European countries and the CIS states, between Russia/Mongolia and China and along the corridors to south-east Asia have to be handled, but there are further technical differences in the countries’ rail systems. In addition, to consider the complete logistical chain requires to consider road/rail/river feeder services. Some corridors like TRACECA involve modal breaks (from rail to ship or ferry) along the route as well. Generally speaking, this has implications on the micro-level human factors field in the following ways:

- Handling of *variety in the technical systems* employed: In essence, there are three ways of addressing variety in the technical systems used: the man-machine interface can be designed to compensate for, minimize or eliminate completely the technical differences of equipment used in different settings. (Human) users can be given specific instructions, “translating” tools can be used (cf. Grote et al 2009:25) or the user interface of the equipment can be designed in a homogeneous way, so that technical differences do not become apparent to the user. Of the three options, the first requires most human skill and least technological input, for the last the reverse applies.
- Handling of *transfers between the different technical systems*: The transfer between modes of transport, gauge systems etc. requires specific facilities, which in turn have their own requirements in terms of skills and man-machine interfaces.
- There may be a case for *new technical solutions* and/or operational practices which are especially suited to the long-distance character of Euro-Asian transport, but which create new technical boundaries or interfaces. For example, longer train units than those currently formed could be envisaged, which would require not only rolling stock and infrastructure adjustments, but also new driving skills (cf. Mc Clanachan/Cole 2012, Schaffer/Barkan 2008).

2.2 “Macro level” of human factors and societal issues

2.2.1 General overview and structure of the field

It follows from the long-distance character of Euro-Asian transport as well that transport services and logistical chains have to be organised across a number of institutional systems. Furthermore, these activities have to be placed in different political and cultural environments. The issues arising from this situation are addressed on the “macro level” of human factors referred to above. Again, it is important to look not only at the rail industry itself, but also at the wider setting, so that the complete travel chain and all relevant stakeholders are covered. The “macro level” perspective hence deals with

1. the activity of political bodies, administrations, regulators, but of course also of rail operating companies, infrastructure providers and logistics
2. international and supranational institutions and agreements dealing with cross-border transport issues
3. the general context of rail transport, such as the importance of rail in national policy and on the transport market

The relevance of this field lies, first, in the need to address the numerous practical limitations of rail transport along the Euro-Asian land bridge (described in this and other Concept Documents). Appropriate political support (including, but not limited to funding) is necessary to address many of these issues. Second, by looking at the users of rail freight and the political environment, the activities also address the important issue of market requirements and expectations towards rail transport.

This is also a good location to reflect on the relative position of European interests in this thematic field. As the following pages will show, there are a large number of stakeholders in rail transport spread across the large geographical area of interest for the NEAR2 project. It is clear that the EU has interests in connecting itself better to this region, an objective which has led among others to the establishment of this very project. However, much of the (potential) activities which are part of the further pursuit of these European interest will take place in and affect areas outside of the EU. Other institutions (from research, industry, politics) will usually have at least part of the responsibility of implementing, funding or otherwise accompanying such measures. Quite naturally, they also have their own interests and those of their countries to observe. Hence the question of how to link the “European” activities to the “domestic” ones and how to balance the two types of interests is a very fundamental one that cuts across all the topics discussed in the course of the project.

2.2.2 Specific relevance for Euro-Asian rail freight transport

Of the three characteristics of the Euro-Asian land bridge (length, internationality, technical barriers) described in section 2.1.2 for the “micro level”, the international dimension is the most relevant in this respect: The multitude of countries touched by the land bridge means that a large number of institutions has to get involved in measures for their development. Rail compa-

nies, regulators, administrations and other governmental bodies are usually established on national level. They are the relevant institutions to take action for their respective territory and area of responsibility. Vice versa, they have no authority over measures located on another country's territory, even if they are affected by them. With these clear-cut areas of responsibility, international projects depend on cross-border agreement between stakeholders for their success. This refers not only to the (political) agreement as such. It is also necessary to get a common understanding on the meaning of this agreement and coordinate the practical measures required to implement it. Past experience has shown that even if the general agreement exists, it is not guaranteed that implementation follows in a harmonious way.

The other two characteristics of the Euro-Asian land bridge routes - length and technical boundaries - seem of minor importance, because most of the differences can be traced to the dimensions of politics and history. But it is worth considering the following aspects:

- The distances to be covered mean the competitive situation between rail and road (but also road and air) is fundamentally different from that found in Europe.
- As on any rail network, transiting services and domestic ("local") ones have to be coordinated on infrastructure of more or less limited capacity, conflicting requirements may have to be addressed.
- In this respect, the implications of the large geographical distance between origin and destination (Europe and Asia with their shippers and logistics companies) and the "transit regions" (local businesses, rail companies and population) has to be considered as well.
- Technical boundaries have also a political relevance: they often coincide geographically, but technical frontiers may also be used to "defend" established industry stakeholders' interests (as operators or equipment suppliers) against newcomers from other territories.

Closely linked to the importance of internationality is the fact that the countries along the land bridge corridors have a different history than Europe and consequently different conditions to develop rail transport. They are also far more heterogeneous among themselves in terms of size, population, economy and political traditions. These differences are likely to lead to a wider range of expectations towards rail integration. For the area of the former Soviet Union, and similarly the former Eastern Bloc, some "inherited" forms of cross-border cooperation exist. In other cases, there is no such tradition at all because there never were through rail links (like between India and Myanmar) or they have suffered from political tensions as between China and North Korea or India and Pakistan.

While the national level will remain important, there are a number of international bodies working in the field of transport, very briefly presented in the following table. The list does not claim to be exhaustive, but it includes members from different types of organisations: supranational bodies, intergovernmental organisations, global and regional rail industry bodies with or without a role in management tasks, lobbying bodies and funding agencies.

Table 1: Stakeholders in rail development along the Euro-Asian landbridge

Acronym	Full name	Role
ADB	Asian Development Bank	Possible co-funder of investment in transport infrastructure
AED	Association of Railway International Electronic Documents Circulation Operators	Association of intermodal freight operators active in former Soviet Union, active in promoting intermodal transport and technical support
CAREC	Central Asia Regional Economic Cooperation Program	Partnership of 10 Central Asian countries and 6 multilateral funding institutions promoting regional cooperation also in transport infrastructure
CCTT	Coordinating Council on Trans-Siberian Transportation	Interest organisation lobbying for and coordinating freight transport along the Trans-Siberian rail line
CIC CIS	Coordinating Transport Council of the CIS Members	Inter-governmental forum for the coordination of transport policies in CIS countries
EBRD	European Bank for Reconstruction and Development	Possible co-funder of investment in transport infrastructure in Europe and Central Asia
ECO	Economic Cooperation Organisation	Intergovernmental organisation of Orient and Central Asian countries supporting cooperation between members also in infrastructure sectors
GETO	Association of European Transsiberian Operators	Western-European network of freight forwarders and other stakeholders interested in Trans-Siberian transport
JIFFA	Japan International Freight Forwarders Ass.	Grouping of freight and logistics industry members from Japan
OSJD	Organisation for the Cooperation between Railways	Association of rail companies operating in the former Soviet Union
TRACECA	Transport Corridor Europe-Caucasus-Asia	Inter-governmental commission of Central Asian countries (working in part with assistance from the EU)
UIC	International Union of Railways	Global association of railway industry, including the main European and Asian rail companies
UNCTAD	United Nations Conference on Trade	permanent UN organisation with focus on promotion of trade, especially between developed and developing

	and Development	countries
UN ECE	UN Economic Commission for Europe	UN regional organisation with technical committees including transport, which discuss and develop policy programmes
UN ESCAP	UN Economic and Social Commission for Asia and the Pacific	UN regional organisation with technical committees, which discuss and develop policy programmes, including the "Trans Asian Railway"
WB	World Bank	Possible co-funder of investment in transport infrastructure

These institutions indicate that activities to improve long-distance transport along the land bridge corridors do not have to start from scratch. The existence of such organisations as well as the bilateral and multilateral activities agreed directly between governments and railways are a resource upon which further measures can be built. However, thorough and comprehensive research must also take a critical look at the existing situation and identify limitations and problems.

On the whole, it is evident that the level of political integration is far lower than in the EU not only, but also in the field of transport. But the status quo regarding international cooperation also differs widely between the three main corridors considered in the NEAR2 project. More specific information for the three main corridors has been put together in the background document, but in essence the situation can be summed up as:

- the Trans-Siberian route in its various forms including the one going partly through Kazakhstan benefits from the already existing infrastructure, services and hence experiences;
- for TRACECA and the other potential "modern Silk Roads", such experiences only exist in some parts; furthermore parts of the region are affected by political tensions (Tschaidse et al 2001, anon. 2008, Anastasiadou/Tympas 2014);
- the southern route is the most ambitious in terms of cooperation, in particular if the whole corridor until south-east Asia is considered, but even in the Turkish-Iranian-Arabic region, both railways in general and cross-border services are not very developed (cf. Babalik-Sutcliffe 2007).

A brief review of the activities conducted by the organisations included in the above table reveals several threads which are interesting to be taken into account - or to connect to - when conducting further activities for the Eurasian land bridge. A more detailed analysis, including an assessment of their relation to EU interests in land bridge transport (supporting, neutral, hindering) still has to be made and should be part of the research agenda in this field (section 3.2). However, four clusters of activities can be identified: established practices for international collaboration, modernisation of the industry, infrastructure development and lobbying for rail transport.

Established practices: In those countries where rail networks are already connected across borders, there is usually also a set of political agreements and industry collaboration in place which frames current practices for service provision. This is most evident in the former Soviet Union, where the Organisation for the Cooperation between Railways (OSJD) has accompanied and survived the system of planned economies. The OSJD and various related bodies (e.g. AED, CCTT) deal with many practical issues of cross-border rail transport, in particular in the field of legislation and tariffs. The OSJD committee and secretariat implement and manage the common rules for passenger and freight transport (SMPS, SMGS) adopted by its members. However, the organisation's realm also includes more general topics of policy harmonisation, support of technical and operational research and collaboration with other international organisations (OSJD 2012). The area covered by this "acquis ferroviaire" extends over much of Asia and Eastern Europe, including the CIS, China, Vietnam and India, but not South Korea, India or other countries in South/South East Asia or the Middle East.

A second, much smaller region of common practices exists in the Orient, where Armenia, Turkey, Iran and Pakistan share membership of the OTIF and hence some common agreements in rail transport legislation. However, cross-border rail services in this region are fairly small or inexistent at present and have been so for much of recent history, with few exceptions (anon. 2008, 2008a). Vice versa, deficits (inexistent or less developed activities) in the field of industry collaboration are found between these two areas (hence in the Caucasus), between China, Russia and Korea, China and South Asia and of course between India and its neighbours. This situation is in most cases linked to past or present political tensions, a physical lack of rail connections or both.

Modernisation of the industry: The modernisation of rail transport is carried forward in many ways and by many parties, including of course the railway companies themselves, the national governments and the international organisations mentioned above (Tschaidse 2003, Sachidow 2003, Burkitbatjew 2000, anon. 2008a). "Modernisation" overlaps with the other activities described here, but it is mentioned as a separate item because it is different in policy terms from "established practices": Modernisation requires investment, for which political support will usually have to be gained. It will usually aim at improving the viability and competitiveness of rail transport as against other modes, but could also be conceived as a mere rationalisation measure without such ambitions. Other stakeholders Modernisation is therefore a much more prominent and potentially controversial issue than the sole carrying on of established operations.

Infrastructure development: Various significant activities can be identified in Asia aiming at the improvement of the continent's transport infrastructure. A broad range of stakeholders and funding institutions is involved, both nationally and on a cross-border or multinational level (cf. table above). Euro-Asian links have already been improved significantly in some areas in the recent past, for example with the opening of the cross-border connection at Drushba between Kazakhstan and China (Atamkulow 2004). It is useful to distinguish several types of infrastructure improvements, in particular as not all of these are similarly relevant in Europe:

- Closure of major gaps in the network, such as the already mentioned Drushba border crossing, but also connections between Iran and the CIS, Iran and Pakistan, China and Kyrgyzstan and towards India and South East Asia (Anastasiadou/Tympas 2014, anon. 2008, Krivoruchko 2003, Brice 2005)
- Other new lines closing smaller gaps

- Capacity expansion of routes (double-tracking, passing loops, electrification etc.)
- Capacity expansion in stations, marshalling yards, gauge-changing facilities (e.g. Usatova et al 2008)
- Re-gauging of routes on a larger scale (proposed standard gauge connection from China to Europe, Zhangaskin 2004)

European involvement in these programmes is so far limited, in spite of the initiatives undertaken as part of TRACECA (Behrens et al 2009). Quite naturally the Asian (national or regional) perspective prevails. From a European point of view one main question must be how the requirements of the long-distance land bridge connections can be integrated in this process (cf. Amos 2000). A thorough understanding of the various individual schemes, programmes and projects is necessary to establish where these are sufficient, beneficial or in contrast to these interests and where new initiatives or alliances with established structures are necessary.

Lobbying for rail transport: A fourth group of activities can be seen in the general lobbying for rail transport in order to get political and societal support. Following from the above, two main settings can be distinguished: first, to raise awareness and support for rail as part of the transport system - in other words to defend transport interests against other policy fields. Second, to create a policy environment that supports rail transport in particular, including decisions that may be detrimental to the interests of other transport modes. In this case, more resistance is likely to occur. The recent renaissance of rail transport in Europe can be traced back to several driving forces outside the rail industry itself which have contributed to a growing interest and support: environmental concerns, road congestion, the contribution of public transport to social cohesion and political concerns about the economic situation of the railways. These factors are not relevant in the same way in the Asian context. Research must therefore be undertaken to see how the necessary measures can be “linked” to the societal needs of the countries involved.

3 OUTLINE OF A RESEARCH AGENDA

3.1 Human Factors - “micro level”

HF Research addressing the situation of the rail industry has been comparatively rare until the 1990s (cf. Wilson et al 2005:649), which means that there is still a certain catching up to do independently from the specific Euro-Asian case. Hence the above presentation to some extent has conceptual and tentative character. The **research issues** suggested here are based on the above thoughts and references. The list can be divided into two kinds of subjects. Considering the limited knowledge about the status quo, the “stock-taking” and analytical topics (first part) dominate. The second part includes more “forward looking” topics that seek to develop new ideas.

First group:

1. Inventory of existing human factors solutions along the Euro-Asian land bridge corridors, assessment of their relevance as barriers and needs for action (can be broken down ac-

ording to corridors or sub-themes of human factors, such as language, man-machine interfaces, skills)

2. Inventory of existing staff working conditions along the Euro-Asian land bridge corridors, assessment of their relevance as barriers and needs for action
3. Assessment of human resources present along the corridors and establishment of future human resource needs, in particular considering the aging workforce, changing qualifications (cf. Wilson/Norris 2009:650) and depopulation of certain regions
4. Analysis of logistical chains in Euro-Asian transport regarding their processes of establishment and operation

Second group:

5. Development and test of new work arrangements and facilities for uninterrupted long-haul operations (e.g. Darwent/Lamont/Dawson 2008)
6. Possibilities for reducing the need for location-specific knowledge and information (cf. Maag/Schmitz/Fröschl 2009:693-694)
7. Possibilities for harmonising man-machine interfaces in particular for driving staff, following on from the idea of the “European Drivers Desk” (Rentzsch/Gelbert 2003)

Independent from these ideas, another agenda has been proposed for a safety culture integrating HF (de la Garza/Weill-Fassina/Kaplan 2008:66). Its items are listed in full here, because they certainly fit also to the Euro-Asian situation in most respects:

1. Comparison of the main technical and organisational characteristics of the rail systems for which closer collaboration is envisaged
2. Knowledge of the physical and technical working environment (routes and marshalling yards)
3. Establishment of a common knowledge among staff, bearing in mind that the same job titles do not imply an identical understanding of tasks
4. Training of staff to the “ground language” agreed between the companies concerned (not in a universally common language)
5. Support measures for staff in case of difficulties
6. Strong institutional collaboration between companies to support staff across borders
7. Careful management of the transition period (summed up and amended from de la Garza/Weill-Fassina/Kaplan 2008:66).

To gain better knowledge about much of the above requires a detailed look at staff attitudes and activities, and thus methods which give sufficient room to direct communication. The same is true for implementing new concepts - dialogue and organisational learning are key elements to achieve a widely-shared common understanding (cf. Johnsen et al 2006:79seq.).

3.2 Societal aspects - “macro level”

The societal framework of rail transport is a topic often not covered explicitly by transport research itself. Vice versa, for social and political sciences transport issues are only one of many possible fields, and the specific context of international transport, freight and railways finds even less interest. Although non-English literature from the region was not available for this review, it is likely that the inclusion of such sources would not change the picture significantly. Research focusing on international projects and themes also is a growing, but still comparatively recent field (cf. the contributions to Schiefelbusch/Dienel 2014).

But an understanding of these issues is crucial for designing policy interventions in a way that responds to the real needs as well as for the proper implementation of these measures.

The following areas emerge as relevant research issues:

1. Review of past experiences with international collaboration along the corridors and national policy traditions
2. Establishment of expectations towards rail transport in the countries involved, identification of common interests and possible areas of conflict
3. Formulation of a vision (targeted level of service quality, capacity etc) for rail transport in Europe and in the region
4. Inventory of existing stakeholders and their cooperation arrangements (agreements, institutions, “informal” practices)
5. Analysis, identification and valorisation of needs for action

4 RESEARCH NEEDS AND NETWORK BUILDING

Human factors do play a role in achieving attractive rail services also on the Euro-Asian land bridge. However, they cannot compensate limitations imposed by lacking capacity or quality of infrastructure, rolling stock and other equipment, which are essential fields for improvement. The importance of human factors lies in their contribution to an intelligent and efficient use of the possibilities offered by technology.

The “macro level” human factors perspective can be seen as a kind of foundation for other fields: Future research activities and policy measures need to be based on a good understanding of not only the technological challenges, but also the institutional and cultural environment in which these measures are to be implemented. Better knowledge in this field is therefore important to frame further activities, also in other thematic fields. It will also help to disseminate findings and gain (political) support for the measures to be developed.

In terms of research integration, an attraction of further research capacities to future activities of WG 9 has to remain a priority, in particular from areas beyond traditional rail transport research. The subject of the WG also highlights the need to develop links with industry and governmental bodies, who can be observers/advisors to research and will be key users of the research outcomes. Appropriate dissemination and awareness-raising activities are therefore necessary.

The network building efforts must also aim at extending the geographical scope of the persons and institutions involved. Although the present document already includes material from a wide range of countries, it remains based on what could be identified with a limited web-based search and material predominantly in English. Less recent works, and material from the academic and professional communities of the CIS, China, the Middle East and other regions may have easily been missed.

5 POLICY RECOMMENDATIONS

Policy recommendations can be derived from many of the proposed activities, and still have to be worked out in detail. The field of WG 9 covers many issues in which the role of public sector institutions is strong, even in a deregulated or liberalised market environment. The research activities of WG 9 are likely to have impacts on (for example):

- regulations on health and safety at work
- legal and technical standards regarding working conditions
- inter-governmental agreements affecting rail transport
- legal/administrative enforcement of interoperability
- institutional arrangements dealing with cross-border mobility

BIBLIOGRAPHY

- Amos, P. (2000). Ost-West-Eisenbahnverkehr: Die Rolle der EBWE. *Rail International*, März 2000, 2-6.
- Anastasiadou, I., Tympas, A. (2014). Iron Silk Roads: Comparing Interwar and Post-war Transnational Asian Railway Projects. In: M. Schiefelbusch, H. L. Diemel (Eds.), *Linking networks: The formation of common standards and visions for infrastructure development*. Aldershot: Ashgate (Transport+Society series).
- Anderson, C., Grunstein, R. R., Rajaratnam, S. M. W. (2013). Hours of work and rest in the rail industry. *International Medicine Journal*, 43, 6, 717-721.
- Ashton, R., Fowler, A. (2005). Human-friendly rosters: reducing the need of fatigue. In: J. R. Wilson (Ed.), *Rail human factors: supporting the integrated railway* (pp. 203-214). Aldershot: Ashgate.
- Atamkulow, E. (2004). Die Eisenbahn-Grundlage des Transportpotenzials der Republik Kasachstan. *Rail International*, Januar 2004, 30-37.
- Babalik-Sutcliffe, E. (2007). Pro-rail Policies in Turkey: A Policy Shift?, *Transport Reviews*. 27, 4, 485-498.
- Behrens, R., Hansmann, A., Usatova, Y. (2009). Von der Karanwanserei zum modernen Logistikzentrum. *Internationales Verkehrswesen*, 61, 10/2009, 390-394.
- Brice, D. (2005). Iran plans network expansion as Mashhad-Bafgh line opens. *Railway Gazette International*, May 2005, 281-283.
- Burkitbajew, S. (2000). Die Eisenbahn Kasachstans: Stand und Perspektiven. *Rail International*, März 2000, 18-23.
- Darwent, D., Lamont, N., Dawson, D. (2008). The sleep and performance of train drivers during an extended freight-haul operation. *Applied Ergonomics*, 39, 614-622.
- De la Garza, C., Weill-Fassina, A., Kaplan, M. (2008). Integrating human factors in freight interoperability safety design. *Cognition, Technology & Work*, 10, 61-68.
- Dorrian, J., Baulk, S. D., Dawson, D. (2011): Work hours, workload, sleep and fatigue in Australian Rail Industry employees. *Applied Ergonomics*, 42, 202-209.
- Grote, G. et al (2009): Coordination in high-risk organizations: the need for flexible routines. *Cognition, Technology & Work*, 11, 17-27.
- Hughes, T. P. (1983). *Networks of Power: Electrification in Western Society, 1880-1930*. Baltimore: Johns Hopkins University Press.
- Jay, S. M. et al (2008). Driver fatigue during extended rail operations. *Applied Ergonomics*, 39, 623-629.
- Johnsen, S.O. et al (2006). Cross border railway operations: improving safety at cultural interfaces. *Cognition, Technology & Work*, 8, 76-88.

- Krivoruchko, S. (2003). Landbridge Planning moves ahead. *Railway Gazette International*, July 2003, 449-451.
- Maag, C., Schmitz, M., Froeschl, T. (2009): Psychologie des Eisenbahnverkehrs. In: *Enzyklopädie der Psychologie*, Themenbereich D: Praxisgebiete, Serie VI: Verkehrspsychologie, Band 2: Anwendungsfelder der Verkehrspsychologie, 16.Kapitel. Göttingen, Germany: Hogrefe Verlag, 639-709.
- McClanachan, M., Cole, C. (2012). Current train control optimization methods with a view for application in heavy haul railways. *Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit*, 226, 1, 36-47.
- Organisation for Co-Operation between railways (OSJD) (2013). *Bericht über die Tätigkeit der Organisation für die Zusammenarbeit der Eisenbahnen für 2011*. Warsaw: OSJD
- Rentzsch, M., Gelbert, L. (2003). Ergonomic Design of an European Driver's desk for cross-border traffic. *Proceedings of the International Ergonomics Association*, 3, 185-188.
- Sachidow, R. (2003): Die Usbekische Eisenbahn auf dem Weg der Umgestaltung. *Rail International*, November 2003, 28-35.
- Schafer II, D.H., Barkan, C.P.L. (2008). Relationship Between Train Length and Accident Causes and Rates. *Transportation Research Record: Journal of the Transportation Research Board*, 2043, 73-82.
- Schiefelbusch, M. (2010). Rational planning for emotional mobility? The case of public transport development. *Planning Theory*, 9, 3, 200-222.
- Schiefelbusch, M., Diemel, H.L. (2014) (eds.). *Linking networks: The formation of common standards and visions for infrastructure development*. Aldershot: Ashgate (Transport+Society series).
- Tschaidse, A. et al (2001). Beschleunigung des Güterverkehrs über den TRASEKA-Korridor. *Rail International*, Mai 2001, 16-23.
- Tschaidse, A. (2003). Die Eisenbahn Georgiens. *Rail International*, November 2003, 17-27.
- Usatova, J., Hansmann, A., Rüger, H. (2008). Eurasische Verkehrskorridore erfordern multimodale Logistikzentren. *Internationales Verkehrswesen*, 60, 12/2008, 513-515.
- Wickens, C.D., Gordon, S.E., Liu, Y. (1998). *An introduction to human factors engineering*. New York: Longman
- Wilson, J.R. et al (2001). On the Right Track: Systematic Implementation of Ergonomics in Railway Network Control. *Cognition, Technology & Work*, 3, 238-252.
- Wilson, J.R, Norris, B.J. (2005). Rail human factors: Past, present and future. *Applied Ergonomics*, 36, 649-660.
- Zhangaskin, K.K. (2004). Trans-Kazakhstan link will complete standard-gauge transcontinental artery. *Railway Gazette International*, 486-488.