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Improving European Railways
retrack
An Integrated EU-Project

Retrack

REorganization of Transport networks by advanced RAil freight Concepts

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Author(s)	Dewan Islam
Co-author(s)	Tom Zunder and Phil Mortimer
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1 INTRODUCTION

The European Commission (EC) aspires to achieve a sustainable modal shift of freight traffic from road to rail to achieve a market share of 15% by 2020. This aspiration is also supported by the European Rail Research Advisory Council's (ERRAC) declared aim of bolstering rail's market share of freight to a similar level. Along with this aspiration the main objective of the RETRACK project is to develop, demonstrate and implement an innovative and market-tested rail freight service along the East-West trans-European corridor of Constanza in Romania to Rotterdam in the Netherlands through Hungary, Austria and Germany. Subsequently, this corridor may be extended to the Bratislava—Budapest logistical hub located at the new Central European industrial cluster which covers Poland, Czech Republic, and Slovakia. New service lines connecting Bratislava-Budapest with Nordic and Baltic States may be opened, followed by establishment of South-East corridor linking this new European powerhouse with important trade partners in the Black Sea region such as Turkey and Ukraine.

The rail freight ventures in the RETRACK project exploits business opportunities created by EC rail liberalisation and the ongoing work on removal of operational, institutional and technical fragmentation between the national railway systems through standardisation of infrastructure, IT systems and rolling stock {e.g., Technical Specifications for Interoperability (TSI)} carried out by the EIFF, ERRAC and the European Railway Agency. In this project rail entrepreneurs will invest their proprietary managerial and financial resources in the establishment of new rail ventures offering high-quality/customised rail services targeted at the until-now-truck-served market segments. Ultimately the RETRACK operators should provide evidence that the new EC railway policy is gaining ground in Europe.

Work package 2 identifies the problems and opportunities for the RETRACK rail freight service. The state-of-the-art of European rail freight services is identified through an in-depth literature review and field survey among the stakeholders. The state-of-the-art analysis was conducted based on best practice, technology developed through EU, member state and private research, and mature developments in the fields of transhipment techniques; information and communication techniques; terminal technology and systems; security and safety issues; vehicle technology, legislative and regulatory requirements; human resources and operations; infrastructure management and use issues; and corridor control systems.

This report summarises the findings and conclusions of the 9 tasks within Work package 2. For fuller material the individual task reports are available from the RETRACK project.

2 FINDINGS OF THE WP2 TASKS

2.1 Findings on Transhipment techniques

2.1.1 Transhipment techniques

The role of a terminal is crucial for inter-modal door-to-door transport (details can be found in RETRACK D2.1). Due to extra handling time and costs in a terminal compared to unimodal road transport, this is the big challenge for inter-modal transport. The terminal must be time and cost effective and routinely reliable. To get a reliable service from a terminal it is important that the most appropriate transhipment technique is used. Another important feature of inter-modal transport is unitised or containerised cargo. If the containerised cargo is using a standard module (i.e. ISO containers) then the terminal operator can use a standard technique. It is true that increasingly non-ISO cargo units such as swap bodies and longer dry van containers are being used in Europe as well as in the US. This is an extra issue that has to be taken into consideration for assessing a terminal transhipment technique. The problems of non-ISO modules such as swap bodies include non-stack-ability as its superstructure is soft compared to ISO containers or the designation of storage stacks for the longer units which cannot be freely stored in the same area. This then requires extra care in handling and extra space in storing. In contrast, the ISO containers can be stacked up to 10 units high when empty and requires less space and specialised consideration for storage. On the other hand, swap bodies have some advantages over ISO containers. The dimensions of swap bodies suit the standard pallets (ISO type 1), thus the total space of a swap body is fully utilised, which is the main cause of its popularity in Europe for continental transport. But, the ISO containers do not offer as great a volume when loaded with standard pallets and thus are less used Europe for domestic traffic. So, the importance of swap bodies cannot be denied. On the other hand, ISO containers are dominantly used in maritime and inland shipping and the vessels are built to fit ISO containers to the full extent and the terminals in worldwide ports are equipped with a standard handling technique. So, for international trade the ISO containers will predominantly be used in Europe.

Apart from these two types of cargo units there are (semi) trailers with different dimensions (size and weight) in Europe as well as in the US. Inter-modal train wagons are built according to national and international railway directives. Thus, an agreement between the national companies has to be agreed. Modalohr is a proven and patented concept that allows quicker and low cost horizontal transhipment between road and rail. To date it operates on a very restricted line of operations and has not yet achieved a wider acceptance outside its original area of application.

Efficient terminal operation can be achieved through the integrated efforts of main three actors: the terminal operators themselves, the rail operators and the road transport operators. The terminal operation must be a part of total integrated transport chain, not just a cargo transfer station. A single optimal terminal design, layout and configuration cannot be suggested as there are many options each being effective in certain specific cargo transfer situations. The terminal's capacity limitations are mainly imposed by the capacity limitations of the rail sidings that is by the transhipment track sub-system rather than by the handling (sub-system) i.e. equipment capabilities, at least for the majority of terminal configurations with limited rail-rail transhipment An effective utilisation of terminal rail tracks can dramatically improve the performance on the rail side, but it may imply additional costs, which vary according to the handling technologies adopted. The choice of alternative technology and terminal design, layout and configuration is linked to rail operations and operators. On the other hand, the improvements of the rail operation are achieved through the complementary and comprehensive use of all operating forms (direct trains, feeder systems, shuttle-shuttle forms, liner trains, hub-and-spoke systems, full-load traffic). The terminal efficiency through road transport operations can be achieved in two ways: time savings at the gate and improved service quality. Most modern terminals are now achieving time savings at the gate. Thus the main thrust should be the continued improvement of service quality including minimal dwell times and manoeuvring in the terminal area.

The key issue of terminal transhipment is to guarantee a timely and safe treatment of the cargo modules. It is therefore necessary to develop rules for the sequence of operations and strategies for the direct or indirect loading. The transhipment functions can be broadly two types: inland and port terminal. In the port terminals mainly ISO containers are transhipped (between rail/road/water and the berth). However, a mixed port terminal can handle other cargo units as well. In the inland continental terminals all types of cargo units are transhipped.

The transhipment functions in a typical rail terminal can be divided into four:

- railway operation,
- internal transport/buffer/storage,
- rail-side transhipment
- roadside transhipment

Railway operation in the terminal includes functions such as:

- entering into reception sidings and/or direct transfer to transhipment track by locomotive,
- (manual and/ auto) identification of train, wagon and/ITU, and lastly
- exit from the transhipment track by the mainline locomotive.

The rail-side transhipment option includes:

- from/to rail,
- to/from buffer/internal means of transport,
- to/from storage place(s),
- to/from road vehicle, and
- direct rail-to-rail transhipment can be foreseen.

Option 5 (direct rail-to-rail transhipment can be foreseen) could be of interest and value in the context of intersecting corridors. In most terminals the “direct” transhipment is seen as advantageous, to avoid additional expenditure. However, the type of transhipment depends on the requirements of the network modes (clients) and is not a rule of the terminal. Flexibility is recommended in the face of varying shipper/receiver requirements and cargo imperatives.

Internal transport and buffer operations may be required in complex terminals in case the operation procedures of rail wagon and trucks cannot be synchronised or the customers demand the terminal to work as buffer place or short term inventory holding point. The internal transport can be performed by crane, conveyors, “sorting tables” or mobile equipment. Parallel to the rail-side transhipment, some functions may have to be carried out on the terminal yard area. The lorries can be linked with buffer or storage places and trains in either direction. Also, the road traffic has to be organised as:

- Pre gate inspection of transport ability,
- The gate procedure itself,
- The movement on driving paths and parking areas
- The procedures in the driving and loading lane.

The transfer of loading units between different modes, through an improved system, must be less costly with improved reliability. With this objective there have been many projects funded by the EC. The INHOTRA project promoted specific horizontal transfer technologies for inter-modal transport. Terminal operation demands on-line real time optimisation and decision. The ITESIC project was implemented to develop and demonstrate a one-stop-shop for inter-modal freight transport in short and medium distance corridors by developing a working environment capable of covering the requirements of the logistic planners and operators. It attempted to fill up the gap between existing information systems that do not communicate to each other effectively, re-engineering the process of sending cargo to the corridors, eliminating for instance multiple efforts to send the same information to many parties including the maritime leg, the railway leg and the customs, and replacing it by a single procedure capable of delivering the information to all interested parties regardless of the mode of transport that they operate.

The IRIS project investigated Rail, Road and Short sea modes on the basis of the three demonstrators of how trucks dominate the field of transport on short and medium distances and whether it can be exploited by inter-modal rail transport. The Italian IT platform, as part of the IRIS project demonstrated at the Bologna inland terminal set out options to use an open architecture to integrate and facilitate the movement of information between various actors on site to improve efficiency and reduce delays, information loss and re-entry requirements.

The project 'Improvement of transfer facilities of the Port Bou terminal' was implemented to upgrade the capacity of the terminal by acquiring some handling equipment. The feasibility study project 'CargoSpeed' is an innovative concept for the faster transfer of semi-trailers permitting rail freight to operate as a sustainable inter-modal transport system with high-throughput and efficiency. It brings in Roll-On-Roll-Off efficiency to the road-rail sector and aims to halve the economic break-even distance to around 300 km or less. The whole transhipment functions at rail-road terminals can be performed through four types of techniques: i) transhipment devices, ii) transhipment and transfer devices, iii) internal transport equipment, and iv) stacking devices.

The transhipments device list includes the Fast Transfer Techicatome Commutor Handling Device and the KRUPP Fast Handling Device. The Fast Transfer Techicatome Commutor Handling Device is composed of transhipment equipment that is designed and developed as loading units (container and swap body), rolling stock (wagon or truck) and the spreader. The Krupp Fast Handling Device is an automatic loading and unloading device for flat wagons. Its operating range spans one loading track, one empty track and one service position. The terminal trucks with hydraulic lifting devices are used for transhipment and transport of swap bodies, containers and trailers. O The self-loading AGV Robot is used for transfer and transport of containers from one place to another. It navigates by reference to passive beacons set in the ground. Moreover, there are other internal transport equipments such as the shuttle wagon, and the multi-trailer system. Stacking devices include portal crane, one-arm crane, and high rack handling devices.

2.1.2 Transhipment techniques on the RETRACK corridor

In relation to sea-rail transfer RETRACK will have little or no direct bearing on the selection of transhipment technology. The main ports at Rotterdam use the full panoply of lifting and transfer equipment including gantry cranes working in multiple, automated guided vehicles for movement within terminals, front end loaders, straddle carriers and fork lift trucks. All of these are used in combination within the marine-rail interface. The high level of automation already achieved in Rotterdam is notable as this sort of technology is probably going to be deployed in further terminal developments planned within the port. In Constanza a similar position applies in that the port and proposed extensions already have a mix of terminal equipment (gantry cranes, front end loaders etc.) in place and for the proposed extension at this end of the corridor.

At some inland terminals inspected along the corridor the option of tri-modal interchange is in place for the movement of containers between trains, trucks and inland shipping. This is the case in Düsseldorf, Duisburg, Worms, Mannheim, Ludwigshaven, Nuremberg, Vienna and Budapest. Ironically the exchange of containers between water and other modes, whilst provided for with cranes in Nuremberg and Vienna has been less heavily used than anticipated, so the tri-modal option may be less attractive than originally planned or envisaged.

In all of the terminals visited along the corridor the operators of the terminal have elected to deploy a range of transhipment technologies and not confined their operation to any specific option. The mix of gantry and reach stackers is the most common model based on individual terminal throughput, configuration, equipment weight footprint and terminal foundation strength as well as the usual acquisition and operational choices.

For road to rail a similar situation applies. In Rotterdam the terminals inspected also deployed a mix of gantry cranes and reach stackers to service the inter-modal traffic (ISO containers, 45' high cubes, trailers and swap bodies). Similar situations are applied in most of the other terminals. Only one smaller terminal, Worms, relied completely on reach-stackers. This was a function of the terminal layout and size constraints. In none of the terminals was there any immediate interest in horizontal transfer technologies as this appears to be still largely undeveloped and untested in front line commercial service.

Cost related issues

In terms of the cost analysis of container handling systems the following general considerations apply:

- Definition of terminal productivity targets/production rates per hour or per day.
- Required stack size, stack handling capacity and location of stacks in relation to train loading/unloading pad areas
- Terminal configuration and point load weight limits
- Alternative equipment performance capabilities in terms of cost and physical performance to manage a planned/targeted production level
- Possible growth and expansion options
- Terminal command, control and communications systems (C3)
- Terminal IT and planning methods.

Planning models for terminal equipment need to reflect

- The estimated number of cranes and other lifting equipment forecast for up to 30 years forward from commissioning with possible mid-life refurbishment and upgrading.
- Total terminal investment costs including infrastructure, yard pavement areas, rail tracks, maintenance and renewal costs
- Operating costs including fuel/energy consumption, maintenance, replacement and upgrade costs, weather related activity such as snow clearance etc.
- Number of hours per year for actual cargo operations, maintenance and any infrastructure modifications.
- Actual cargo throughput planned and achieved
- Recognition of applicable hours of operation per day/week.

The cost per move will be a function of all of the above plus the financial criteria the terminal owners/investors are required to respond to in terms of the cost of capital, sources of funds (private or state support), any operating subsidies and grants and possibly some nonaccountable issues such as environmental cost measures and noise abatement. In relation to the terminals inspected the cost per container movement is directly linked to terminal throughput but no commercial tariffs were made available except in Vienna.

Noise related issues

Noise related issues were not identified as a key item in discussions with terminal operators along the corridor except in one terminal located deep within the urban area of Vienna. This terminal was previously an old style goods shed for the inter-modal transfer of goods & parcels between rail and local city delivery vehicles. The terminal has been modified to act as a container base for road-rail container, trailer and swap body traffic but still retains the cargo sheds on site for container stuffing and stripping. There is a heavy flow of HGV traffic in and out of the terminal during the hours of operation in addition to the container handling activity (a mix of gantry cranes and front end loaders). The cranes are electrically powered and rail mounted so do not generate a significant amount of noise when moving. The major noise generation is from containers being grounded, lifted on and off stacks (container reverberation and engine noise from mobile lifting equipment) and loaded on and off rail vehicles. HGV circulation is also a significant source of noise generation. There is also some noise from the flanges of rail vehicle wheels whilst being propelled in and out of the terminal.

As the terminal function has changed and has over time become surrounded by residential dwellings the terminal has been constrained in terms of hours of operation with no over night working and restricted hours of operation over the weekend. This constraint will, with others rule out the use of the older terminal in Vienna on the grounds of inflexibility and the noise constraints. All the other terminals inspected were in designated industrial areas or port areas well away from residential areas and no noise constraints applied.

2.1.3 ITESIC implications for RETRACK

The primary objective of ITESIC was to develop and demonstrate a one stop shop for inter-modal freight transport in short and medium distance corridors capable of fulfilling the requirements of logistics planners (forwarders) and operators. The project applied IT technology and telematics support, re-engineered processes to satisfy users requirements and maintained a unified user interface and standards to facilitate harmonization at a European scale. The overarching part of the concept has been to consider the corridors as a unified transport system rather than a set of separate transport and logistics activities that occasionally come into contact. The ITESIC concept has been tested by users using simulation techniques to compare the approach with other models. It was also tested using demonstration methods in a laboratory environment. It is not known whether it was ever deployed into live commercial demonstration activities during the life of the project or subsequently.

The ITESIC system effectively acted as an umbrella and became a single point of entry to all information required to manage the information flow associated with cargo in the corridors used during the project life. The project claims to have brought together:

- Shipping line and port interests,
- Logistics operators/forwarders
- Maritime agents
- Truckers
- Rail operators
- Depots/warehouses and terminals.

The system claims to fill the gap between existing systems that do not or cannot readily communicate. It recognises the whole logistics chain irrespective of direction (import/export/domestic). All players are able to communicate and the system claims to be able to forecast demand patterns. Replication into other corridors is also claimed as it eliminates the need to connect disparate systems.

The project is believed to have been completed in 2000. Evidence of adoption by a wider community of potential user has been elusive. In terms of corridor application the overwhelming need is to recognise that the corridors will have lateral links with cargo flows originating/terminating away from the corridor whilst using it for part of the cargo movement. The corridors are not surrounded by a cordon sanitaire and will need to reflect the requirement of remote users to connect and exchange information with actors along the principal line of route.

The IRIS project also developed a communications platform for use within terminals and cargo villages as a means of overcoming problems with different systems using different technologies, interfaces, protocols and technologies. It had similar objectives to the ITESIC initiative but has also had only limited application away from the demonstration point.

2.2 Information and Communication Techniques

Information and communication technique is vital for freight services. Details can be seen in RETRACK D2.2. Architectural support is of increasing importance in information system development. Many standards and frameworks for architecture-based development have been proposed in the past. An architectural framework divides a complex model into several model layers, each specified according to a meta-model. To manage complexity, views are defined on each model layer. Most of the frameworks distinguish between (platform-independent) functional views and (platform-specific) operational views of an application.

2.2.1 Architectural frameworks, standards and languages

The primary goal of architectural frameworks is to indicate what information regarding architecture should be captured in architecture descriptions and to provide means for capturing this information. Two well-known, representative examples of such frameworks are described:

- Zachman's "Framework for Enterprise Architecture" provides a logical structure for classifying and organising the descriptive representations of an enterprise that are significant to the management of the enterprise as well as to the development of the enterprise's systems.
- The Reference Model for Open Distributed Processing (RM-ODP) is an ISO/ITU Standard which defines a framework for architecture specification of large distributed systems. The standard aims to provide support for inter-working, interoperability, portability and distribution.

2.2.2 Architectural Description Techniques

- Under the name "architectural description techniques" a number of architectural approaches can be grouped which go beyond the definition of an architectural framework, by providing notations for architecture descriptions, by indicating modelling and analysis techniques, and possibly implementation examples. With "architectural description techniques" we refer to architectural approaches that go beyond the definition of an architectural framework, by providing notations for architecture descriptions, by indicating modelling/analysis techniques, and possibly implementation examples. Techniques and standards are:

- The Architecture Description Standard (ADS), published by IBM, provides the definition of a formal metamodel, the semantic descriptions to support it, and a glossary.
- The Model Driven Architecture (MDA) of the Object Management Group (OMG) aims to provide an open, vendor-neutral approach to interoperability.
- The International Standard ISO 15704 provides a set of terms and definitions, a set of requirements for enterprise reference architectures and methodologies, and requirements for such architectures.
- The Generalised Enterprise Reference Architecture (GERA), which identifies a set of basic concepts to be used in enterprise engineering and integration, is the basis for the GERA Methodology (GERAM).
- The Open Group Architectural Framework (TOGAF) originated as a generic framework and methodology for development of technical architectures, but evolved into an enterprise architecture framework and method.
- The Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Architecture Framework was developed in 1997 for the US Department of Defence
- Cap Gemini's Integrated Architecture Framework (IAF) divides a business system into an integral viewpoint and an information viewpoint, and an IT support into information systems and technical infrastructure.

2.2.3 Tools for architecture support

Tools to support an architecture-based software development approach tools can be classified according to their functionality, positioning in the Zachman framework and their openness. The overview includes, among others, (enterprise and system) modelling tools, management tools and repositories.

- Aris Toolset (IDS SCHEER)
- ASG-Rochade (ASG software solutions)
- Enterprise Architect (Sparx Systems)
- Front Arena Enterprise (Front Capital Systems AB)
- IBMS (Rensselaer Polytechnic Institute)
- METIS (Computas AS)
- Microsoft Visio (Microsoft)
- Ptech Framework (Ptech Inc.)
- Rational Rose (Rational)
- Select Enterprise (Aonix)
- System Architect (Popkin Software)
- TestBed Studio (Bizzdesign)
- Tivoli Enterprise (IBM)

2.2.4 Modelling Techniques

Models are used in the representation of a problem under investigation to abstract from unnecessary details and to provide a better understanding of the problem as a whole. A modelling language includes model elements, notation and guidelines. Model elements are the fundamental modelling concepts and their semantics, while a notation is a (graphical) representation of the model elements. Guidelines provide support for how to use the model elements.

A huge number of modelling techniques are currently in use to support application development, both to represent organisational aspects and system aspects. We concentrate here on techniques that are supported by multiple tools, or for which tool support does not yet exist.

In the late 1980's and early 1990's the object-oriented community witnessed the appearance of a large number of design languages. Many of these languages were similar but still had their differences. Besides, none of these languages appeared to be complete enough. By the mid 1990's these languages evolved and began to incorporate each other's techniques. The most prominent design language, the Unified Modelling Language (UML), is actually a collection of various modelling techniques. It is very widely used to model systems, and also offers techniques for organisational and process modelling. It is used as a basis for several software development methodologies and tools, and can be considered the de-facto standard in system modelling. Because of the importance of UML in application development, we will present its main features below. In all of the current modelling approaches, including the UML, there are still hardly any possibilities to represent relationships between organisational models and system model.

2.2.5 UML 2.0

In the field of software engineering, the Unified Modelling Language (UML) is a standardized specification language for object modelling UML is a general-purpose modelling language that includes a graphical notation used to create an abstract model of a system, referred to as a UML model. UML has been standardised by the UML Partners Consortium, led by Rational Software Corporation, under the auspices of the Object Management Group (OMG).

The primary goal of UML was to unify the different methodologies and to integrate the best practices present in industry. The design of UML also aimed at:

- providing users with a ready-to-use and expressive visual modelling language;
- providing extensibility and specialisation mechanisms to extend the core concepts;
- being independent of particular programming languages and development processes;
- providing a formal basis for understanding the modelling language; and finally;
- bringing some stability to the object-oriented (OO) tools marketplace, encouraging its growth.

UML has been a catalyst for the evolution of model-driven technologies, which include Model Driven Development (MDD), Model Driven Engineering (MDE), and Model Driven Architecture (MDA). By establishing an industry consensus on a graphic notation to represent common concepts like classes, components, generalization, aggregation, and behaviours, UML has allowed software developers to concentrate more on design and architecture.

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2.2.6 Application Server

Application servers, whatever their function, occupy a large chunk of computing territory between database servers and the end user. An application server is a software engine that delivers applications to client computers or devices. Moreover, an application server handles most, if not all, of the business logic and data access of the application (a.k.a. centralization). The main benefit of an application server is the ease of application development, since applications need not be programmed; instead, they are assembled from building blocks provided by the application server.

Although the term application server applies to all platforms, it has become heavily identified with the Sun Microsystems J2EE platform; however, it has also come to encompass servers of Web-based applications, such as integrated platforms for e-commerce, content management systems, and Web-site builders.

Application server products typically bundle middleware to enable applications to intercommunicate with dependent applications, like Web servers, database management systems, and chart programs. Some application servers also provide an API, making them operating system independent. Portals are a common application server mechanism by which a single point of entry is provided to multiple devices.

Following the success of the Java platform, the term application server sometimes refers to a Java Platform--Enterprise Edition (J2EE) or Java EE 5 application server.

Microsoft's contribution to application servers is the .NET Framework. This technology includes the Windows Communication Foundation, .NET Remoting, MSMQ, ASP.NET, ADO.NET, and IIS.

2.2.7 Workflow Management and Process Definition Languages

Workflow can be described simply as the movement of documents and tasks through a business process. Workflow can be a sequential progression of work activities or a complex set of processes each taking place concurrently, eventually impacting each other according to a set of rules, routes, and roles. A number of process-modelling techniques are available to define the detailed routing and processing requirements of a typical workflow. Listed below are some typical features associated with many Workflow Management Systems:

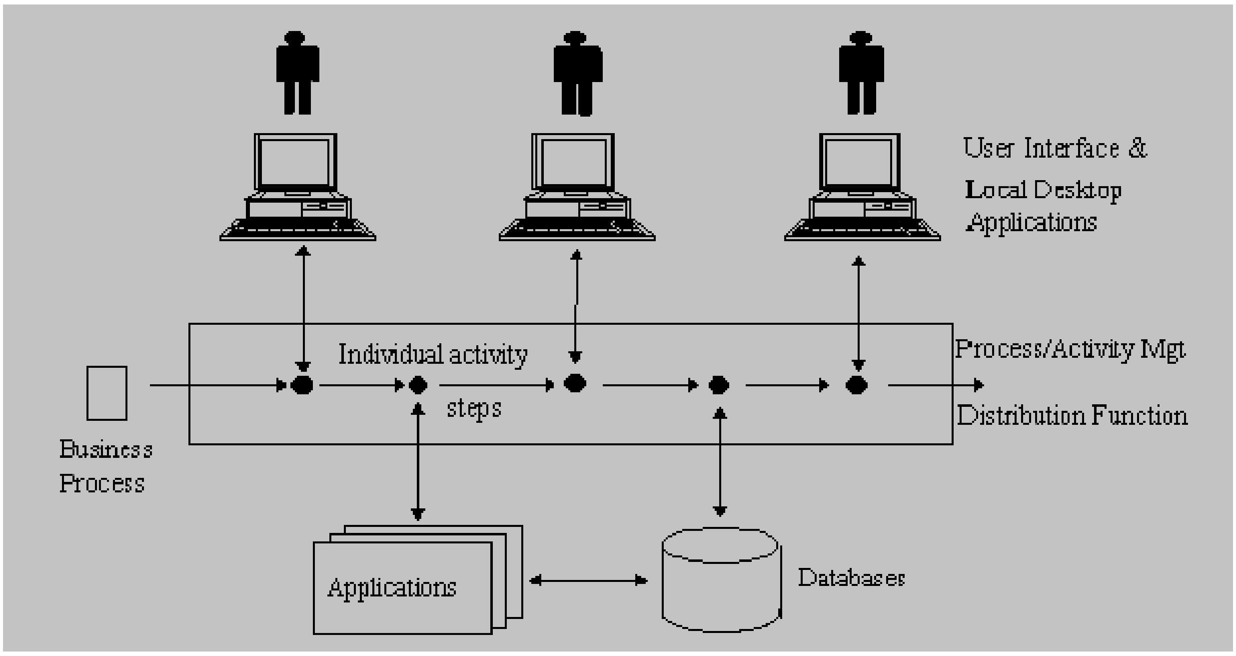
- Process Definition Tool: A graphical or textual tool for defining the business process.
- Simulation, Prototyping and Piloting: Some systems allow workflow simulation or create prototype and/or pilot versions of a particular workflow.
- Task Initiation & Control: The business process defined above is initiated and the appropriate human and IT resources are scheduled and/or engaged to complete each activity as the process progresses.
- Rules Based Decision Making: Rules are created for each step to determine how workflow-related data is to be processed, routed, tracked, and controlled.
- Document Routing: In simple systems, this might be accomplished by passing a file or folder from one recipient to another. In more sophisticated systems, it would be accomplished by checking the documents in an out of a central repository. Both allow document versioning and control.
- Invocation of Applications to View and Manipulate Data: Word-processors, spreadsheets, GIS systems, production applications, etc. can be invoked to allow workers to create, update, and view data and documents.

- Worklists: These allow each worker to quickly identify their current tasks along with such things as due date, goal date, priority, etc.
- Task Automation: Computerized tasks can be automatically invoked. Task automation often requires customization of the basic workflow product.
- Event Notification: Staff and/or managers can be notified when certain milestones occur, when workload increases, etc.
- Process Monitoring: The system can provide valuable information on current workload, future workload, bottlenecks (current or potential), turn-around time, missed deadlines, etc.
- Access to Information over the World Wide Web (WWW).
- Tracking and Logging of Activities: Information about each step can be logged. This might include such things as start and completion times, person(s) assigned to the task, and key status fields.
- Administration and Security: A number of functions are usually provided to identify the participants and their respective privileges as well as to administer routines associated with any application.

This integration of workflow management systems provides structures to a process which employs a number of otherwise independent systems. It can also provide a method for organizing documents from diverse sources.

In the field of RETRACK workflow management systems can be used to organise and to structure business processes and communication flows along the value chain and across the partners and their customers. For the integration of a workflow management engine in the IT systems, to be developed in WP4, it is necessary to discuss existing standards.

Figure 1: The Workflow Management Coalition Diagram of Process Flow Across Applications



2.2.8 Workflow Management Coalition

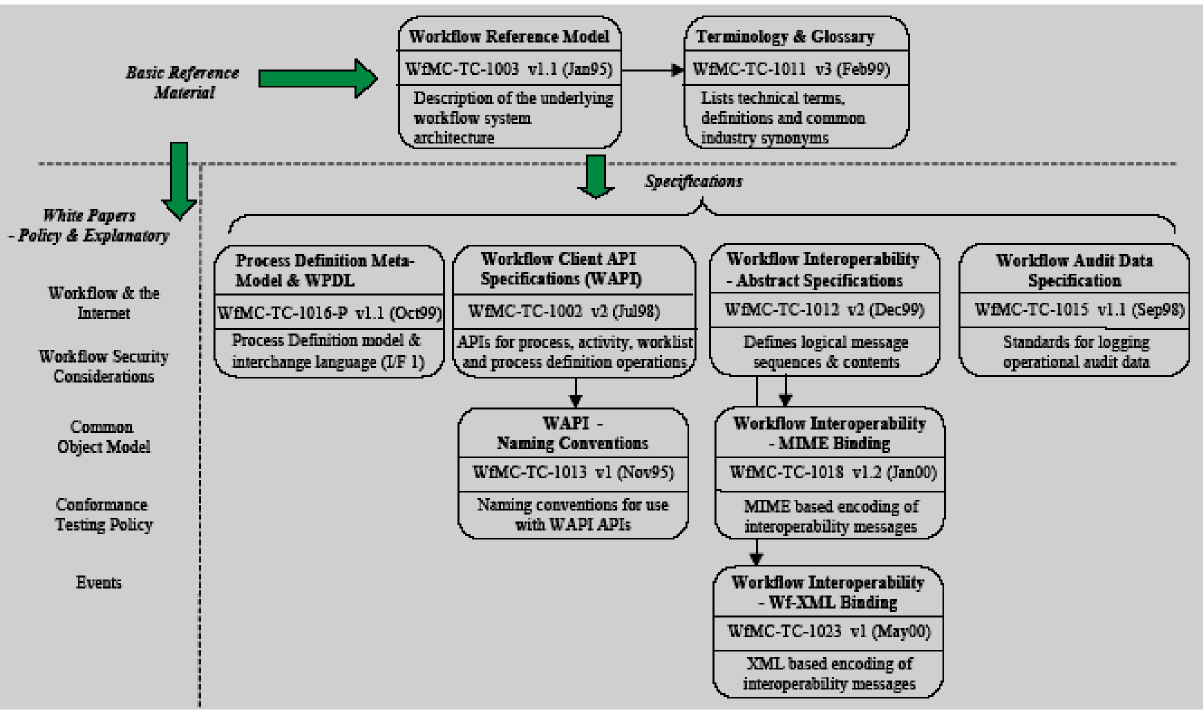
Founded in 1993, the Workflow Management Coalition (WfMC) is a global organization. The WfMC creates and contributes to process related standards, educates the market on related issues, and is the only standards organization that concentrates purely on process. The Workflow Management Coalition (WfMC's) Reference Model defines a generalized target architecture driving the development of most production workflow solutions (see figure 1). The goal of the model is to provide a standard for interoperability among the major workflow subsystems (see figure 2).

The Workflow Reference Model describes FIVE Interfaces.

- Interface 1 Definition deals with passing Process Definitions from external tools to the workflow engine where there are enacted.
- The new wave of interest in using the intelligent messaging language, XML, has swept through all areas of IT—including workflow. Interface 1 has recently been rewritten to use Wf-XML. The goal of Interface 1 tools with each workflow engine deployed.
- Workflow API APIs (Interface 2 & 3)
- These interfaces have been combined and cover the WAPIs (Workflow API's). The support of these interfaces in workflow management products allows the implementation of front-end applications that need to access workflow management engine functions (workflow services).
- Inter Inter-Engine Workflow (Interface 4)
- Interface 4 defines the mechanisms that workflow product vendors are required to implement in order that one workflow engine may make requests of another workflow engine to effect the selection, instantiation, and enactment of known process definitions by that other engine.

Figure 2: Workflow Standards and Associated Documents

(Source: http://www.wfmc.org/standards/docs/Stds_diagram.pdf



2.2.9 XML Process Definition Language

The XML Process Definition Language (XPDL) is a format standardized by the Workflow Management Coalition to interchange Business Process definitions between different workflow products like modelling tools and workflow engines. XPDL defines a XML schema for specifying the declarative part of workflow. XPDL is the leading standard for workflow management systems XPDL is the optimal technology for business process definitions (and communication flows) to secure interoperability between systems.

2.2.10 Electronic Data Interchange

To enable companies to exchange information, data must be structured by using a common standard (grammar). Electronic Data Interchange (EDI) is the computer-to-computer exchange of structured information, by agreed message standards, from one computer application to another by electronic means and with a minimum of human intervention.

Architecture for EDI

The Electronic Data Interchange (EDI) standards were designed from the beginning to be independent of lower-level technologies and can be transmitted using Internet protocols as well as private networks. It is important to differentiate between the EDI documents and the methods for transmitting them. Older transmission methods are being replaced by Internet Protocols such as FTP, telnet and email, but the EDI documents themselves, as well as the EDI service providers or Value-added network, remain.

EDI documents contain the same data that would normally be found in a paper document used for the same organisational function. For example an EDI 940 ship-from-warehouse order is used by a manufacturer to tell a warehouse to ship product to a retailer. It typically has a ship to address, bill to address, a list of product numbers (usually a UPC code) and quantities. It may have other information if the parties agree to include it. However, EDI is not confined to just business data related to trade but encompasses all fields including transport, such as container and modal information. The essential elements of EDI are:

- the use of an electronic transmission medium;
- the use of structured, formatted messages based on agreed standards;
- relatively fast delivery of electronic documents from sender to receiver; and
- direct communication between applications.

EDI depends on a moderately sophisticated information technology infrastructure. This must include data processing, data management and networking capabilities, to enable the efficient capture of data into electronic form, the processing and retention of data, controlled access to it, and efficient and reliable data transmission between remote sites.

EDI Standards

There are three major sets of EDI standards. UN/EDIFACT is the only international standard predominant in all areas outside of North America. ANSI ASC X12 and Uniform Communication Standard (UCS) are popular in North America and are very similar to each other. The standard says which pieces of information are mandatory for a particular document, which pieces are optional and give the rules for the structure of the document. The standards are like building codes. Just as two kitchens can be built "to code" but look completely different, two EDI documents can follow the same standard and contain different sets of information. Larger companies have existing specification sheets and are usually unwilling to negotiate. Because of that translation from one “standard” to another is necessary. This is typically done by using EDI translation software such as XLATE Evolution

2.3 Terminal Technology and Systems

This section identifies issues related to terminal technology and systems. Details on this aspect can be seen in RETRACK D2.3. For this, different terminals are reviewed along the corridor.

2.3.1 The Netherlands

ECT Terminal: Rotterdam

Currently a number of container trains moving from the port terminal on a point to point basis, not on a multi-stop service basis. This point to point operation focuses on a number of needs:

- Speed to match road based competition into Germany and other neighbouring countries;
- Rapid clearance from the port for imports;
- Maximise the use of wagon and traction assets.

The key requirement is seen as schedule reliability. The use of a “turntable option” with the movement of cargo from shuttles onto a longer haul formation was discussed as a possibility with the RETRACK service (possibly originating in the Ruhr area). This would avoid the complication of moving the RETRACK train into an already densely occupied railway territory around Rotterdam.

The ECT terminal is at the extreme end of the Dutch railway system served with new infrastructure and electrified lines. It is remote from the RCS terminal so traffic to/from each location would need to be considered and managed if a merged train option was to be offered. The planning of train movements, schedules, locomotive holding areas and the option to split and merge wagon formations to RSC & ECT will need to be planned.

The RETRACK train could be of interest to key shippers and forwarders. Finding the potential users amongst the major deep sea lines, global forwarders or the actual shippers and cargo interests is likely to be a major task given the diversity of control over cargo movement, freight payment conventions and terms of trade used.

Within ECT rail handling is charged to the shipper or the party paying the freight charges. The importance of the pre-release document routine was further emphasised to synchronise with train movements. Accurate and updated ETA information was identified as the key competitive component. There are various options to accommodate changes in booking and container availability in response to operational circumstances. The use of open list type services is constrained by the customs cut-off time. The option of moving cargo away from the port and for boxes to be cleared inland was reviewed as a potential option to accelerate the movement of boxes through the port. The whole issue of customs release, train scheduling and other constraints on the development of a routine/regular service in and out of ECT needs to be defined in more detail as the project develops.

ECT operate with a 6-weekly rolling forecast governing train schedules for main train moves, shunting, loco holding areas etc. As part of the start up process RETRACK will need to be engaged with the terminal and port authorities to ensure the preferred options can be serviced. The terminal operates 24/7 on Mondays through to Saturday 23.00 but with closure for port rail maintenance on Sundays until Monday 07.00. This pattern of working may change in response to increasing levels of traffic through the terminal and port in total.

Container flat wagons are available on a 9-month lead time so the position on wagon supply for any demonstration in 2008 will need to be managed by the end of 2007.

The terminal is highly automated and uses a mix of cranes, automated stacking cranes (90) and automated guided vehicles (185) to sustain the high level of terminal productivity. The automated stacking cranes (ASC) operate in a portal solution and as an overhead bridge crane. The ASC spans nine containers in a 1 over 5 solutions and allows economical high density stacking arranged for rapid access and retrieval. It forms a link between the quayside and landside equipment such as ship to shore cranes , terminals transport and road vehicles.

The AGV is an unmanned remote controlled transporter capable of moving 20', 40' and 45' containers and are used to move containers from the quayside to the stack yards. 2 x 20' containers with a total gross weight are permissible with the AGV. The ECT Delta terminal has chosen to adopt an integrated terminal management and process control system to unite its gate, vessel, rail, yard and berth operations at six facilities inside the overall terminal complex. The system is designed to optimise the use of terminal handling equipment, lower costs and raise productivity.

Rail Service Centre (RSC) Rotterdam

The option of a train serving the Rotterdam-Constanza corridor was welcomed as a useful potential addition to the existing array of train services to/from the terminal. Any new service would be required to use the Betuwe Line (BL).

RSC was developed as a response to falling rail share in inter-modal traffic activity through Rotterdam, extensive and expensive shunting, poor reliability, slow services and low equipment utilization. These collection and delivery operations were replaced by road transport with rail being used for the long haul movement. There was formerly only one traction service provider. There are now at least eight traction providers and independent rail has a high share (80%) of the inter-modal traffic through the port. The intention behind RSC was to stem the decline of rail's participation in freight traffic by massively improving quality, capacity, capability and competitive costs. The RSC at Rotterdam lies just to the West of Kijfhoek marshalling yard. The RSC is integrated into the Eastern docks complex where containers from barges and smaller ships are landed. The container trains are owned and operated by many rail companies call at the terminal in transit to or from the Maasvlakte Delta terminal.

RSC (like ECT) use shuttle train formations operating on a point to point basis, fixed schedules and at higher transit speeds (120kph) with options to swap cargo and/or wagon blocks. On time performance and any variance is monitored and analysed for intervention and improvement. EDI & IT initiatives have been developed to facilitate operational asset management and tight control of the crane and front end loader assets in the terminal. Systems such as PortInfo link are used to monitor vehicle arrivals and to integrate terminal movements for the movement of containers in and out. There are presently 12 primary rail customers using the terminal and these are linked for the exchange of information (>90%)

covering the container I/D number, cargo details including weight, any hazardous commodity details. For rail movements to the terminal from inland the operator advises the terminal of the train consist, wagon numbers, container numbers and other relevant details again to facilitate the efficient movement and handling operations within the terminal.

All train services in/out of the terminal are diesel hauled with traction currently provided by Railion. The terminal is operational for 6 days per week. The restriction of train services for line maintenance on Saturdays & Sundays needs to be recognised as a constraint for the development of the train master schedule.

The terminal is relatively small but is highly productive with the whole operation based on a minimum of planned movement. Office and site staff exchange roles and secure familiarization with each groups tasks and concerns leading to ongoing operational enhancements. Activity levels have increased from 250K movements in 1994 to a forecast level of >1.0 million in 2008/9. The terminal has two parallel cargo handling modules, hazardous cargo areas and holding bunds. Hazardous cargo makes up 20% of the current cargo volume on the terminal. The terminal can handle container traffic, swap bodies and trailers which offers flexibility for marketing the RETRACK service option. The terminal uses 4 gantry cranes, 6 reach stackers, 5 terminal trekkers and a variety of multi-chassis trailers for internal container transfers.

Generic changes that are also having a compound impact in the market include the increase in the number of new traction and train service providers, the use of company owned block trains, the introduction of very large ships and increasing participation by deep sea lines in the shore side transport and logistics. Slow levels of market liberalization of rail in France and Belgium have been something of a constraint on further rail service development despite pressure to adopt market liberalization.

Conclusions for The Netherlands

Both terminals could be a useful point for traffic aggregation and dispersal in Rotterdam's port area:

- They will provide access to deep sea container traffic seeking access to central and Eastern Europe. The likelihood of through container traffic being moved needs further commercial exploration but may be an option for lines which have maritime services into Rotterdam and Constanza;
- Their ability to handle ISO containers, swap bodies and trailers is potentially advantageous;
- Currently there is capacity to accommodate additional train services to/from the terminal, although there are concerns that forecast future levels of traffic activity could become a constraint. The forecast traffic will require additional rail infrastructure and shunting services.
- There are existing train shuttles operating to/from the terminal which could act as a feeder to the RETRACK train if it is to be operated from the Ruhr area.

2.3.2 Germany

TriCon Container Terminal, Nuremberg

The terminal is one of several owned and operated within the area of Nuremberg. The terminal is already used as a hub for services to/from Hamburg and also to Regensburg. Current train activity is six trains per day in and out. The terminal operates 5.5 days per week Monday through to Saturday noon but could go to 24/7 operation if required.

The terminal is a modern development and will be expanded in 2008/9 to accommodate already identified growth. The existing terminal has two portal cranes of 40 tonnes capacity with an 83m span. These are the primary cargo handling equipment on the terminal. There are three loading tracks of 700m length plus two storage tracks also of 700m. The terminal is to be expanded as traffic moves from an existing terminal in Nuremberg to the new location. RETRACK would be an incremental addition to the forecast levels of traffic and train activity. Access options will be improved by the electrification of the lines into the terminal perimeter as the terminal expansion plan proceeds. This could make the Nuremberg terminal a more attractive option.

The ability to re-group cargo on the train was explored as an option in addition to the actual load and discharge of cargo originating or terminating in Nuremberg. This could be a useful reinforcement point for RETRACK and make best use of rapid load on/load off options between Rotterdam and Nuremberg. There is a cargo/LCL facility on site that could be useful for stripping and stuffing of containers originating or terminating locally. The tri-modal terminal area is not heavily used and there may be potential to exploit the available space for storage if needed. There is an adequate hazardous cargo area within the site with bunds to prevent leakage. Container repair facilities are also available on a mobile/rapid response basis within the terminal area. The whole site is secure and has no problems with noise and access issues. Customs facilities are also on site which may be an advantage for clearance issues being removed from the port areas where this may become an issue and constraint of service times.

Conclusions for Germany

- This is a modern facility with expansion plans already in place and scheduled to proceed in 2008/9 which could tie in usefully with the demonstration phase and subsequent moves into commercial service.
- The access position will be markedly improved with the expansion of the terminal and allow main line power close into the actual crane areas.
- The array of facilities on site is impressive and would fit all the commercial and operational requirements if this terminal is selected as a node on the corridor.
- Several other terminals in Germany on or close to the corridor were inspected and all could be potential points for traffic as the service patterns evolve.

2.3.3 Austria

Terminal Vienna Northwest

This terminal is a hybrid site served through a single point of entry from the main electrified running lines and requires a separate shunting operation with any lengthy wagon formation being split into the yard/pad area. Maximum train length is approximately 300 metres. There are three operating rail tracks under the two portal gantry cranes and four road alleys. Reach-stackers are used for container, swap body and trailer movements. Turning space is severely limited. Extensive container storage activities are available on site and facilities for running repairs also available. Customs clearance facilities are available on site. The terminal has the capability to load/of load swap bodies and tri-axle trailers for those traffic flows that require this type of equipment. Reefer points are available but there is limited capability for hazardous cargo and response to any leakages occurring on site. High cube traffic is handled through the terminal.

The terminal also acts as a major logistics terminal for loading and stripping containers. Road access is very constrained and the whole road transport access to and from the pad area remained very congested during the whole of the inspection period with little by way of evident sequencing, control and planning of access and security. There is little room for manoeuvring and positioning on/off the pad area and this is a cause for concern about the efficient functioning of the terminal. In effect this is an older city site highly constrained by external development and other limitations. The terminal is constrained in terms of hours of operation (Mon-Friday 06.00-19.20, Saturday 06.00-11.00) and any ability to expand realistically to absorb additional traffic on a reliable basis. There are existing long distance trains operations through the terminal into Germany, North Sea ports and to Budapest.

Loading additional two trains per week is probably feasible, two additional trains per day may be more problematic in terms of sustained reliability and productivity. It may be possible to begin RETRACK operations using the existing terminal as a trial but as a long term option the obvious physical and organizational limitations are a real constraint to competitiveness. There are recognised problems of interface links between train operations and terminal operations. Trains routinely lose paths and schedules in and out. The impact of disruption and the ability to accommodate off-schedule trains could be a significant mark against the use of this terminal to serve the Austrian market.

The long-term future of this site is uncertain as closure has been predicted for some years. There is limited scope for upgrading and enhancement given the confined site and the likely impact of the new tri-modal terminal (Viennaer Hafen) which will remove significant heavy traffic volumes from an inner city zone.

New Tri-modal terminal – Vienna-Freudenau

This is a modern terminal, owned by the Port of Vienna with two other minority shareholders, which is being expanded to accommodate future growth in international container traffic. The existing terminal is heavily used and evidently busy and is focused entirely on deep-sea traffic (ISO containers) activity. But it is unlikely that continental non-ISO traffic (e.g. swap body) can be accommodated. A significant upgrading of terminal space and access arrangements is under way targeting operation in 2008/9. This will include direct electrically hauled trains to and from the rail terminal area with no intermediate shunting.

The terminal already handles block train operations to German, Dutch and Italian ports with intermediate loading/discharge of traffic linked to the Vienna conurbation including traffic to/from Budapest. The option to load to/from river traffic exists but appears less heavily used than predicted. Most of the existing terminal traffic is road/rail and serviced using a fleet of reach stackers. Annual traffic activity is 300,000 TEUs. Approximately 15% of this is transhipment activity between the existing network of rail services. Other activity on the site includes local haulage, customs services, container stuffing and stripping, container repair, storage, cleaning and plug in facilities for reefer traffic. The present expansion programme will lift terminal throughput to 400,000 teu per year with up to seven trains being serviced simultaneously in the combined new and existing terminal areas. A gantry crane will be installed on the existing terminal to reinforce and substitute for reach stacker operations. Reachstackers are the primary transfer technology used on the existing terminal. The new pad area will incorporate four new cranes, improvements in terms of road access and circulation area and improved links to the national motorway net. The enhanced rail access will incorporate increases in rail axle loads to 22.5 tonnes and increased speeds to/from the site using electric traction.

A key improvement is the introduction of a terminal planning and communications system for the manipulation of equipment inside the terminal and the expediting of documentation interchange between all parties using the site. This could be a significant and useful benefit to RETRACK if such a measure allows the trains to be serviced more rapidly. Customs clearance is available on site in addition to container stuffing and stripping services. The absence of hazardous cargo handling capabilities is a serious limitation.

The existing terminal is served by a mix of OBB/RCA and private rail operators for shunting and main line operations. Current operating hours are Monday to Thursday 06.00-19.00, Friday 06.00-16.00 with the option for requested service at the weekend. The site is less constrained than the Vienna North-West terminal in terms of noise and traffic activity and is firmly located inside the port area. The three existing train lines are all over 650m long and thus could be accommodated without a train being split.

Conclusion for Austria

- For inter-modal traffic to/from Vienna the Freudenau terminal appears to be a preferred option when compared to the alternative Northwest option. Its capacity is already at a premium in the terminal and the new capacity being developed is also likely to be used up by other rail services. The development of capacity beyond the current programme is already being considered.
- The use of this terminal will require rapid action by RETRACK consortium operator to fix schedules and terminal times and to declare this requirement within the next 8-10 months. The benefit of direct rail access to and from the site plus the road links will be an advantage.
- Two other sites in Upper Austria were also visited and could be used as required.

2.3.4 Hungary

Bilk Container Terminal

This is the most modern inter-modal and logistics facility in Budapest. It acts as a central point within Hungary for international services for inter-modal block train services and has extensive logistics facilities (Hungaro-Camion) adjacent to the terminal area. Water links are a further option not far removed from the site. Bilk is linked to other terminals functionally in terms of transport links and commercial/managerial activities.

The site currently has only one rail lead but is electrified up to the terminal boundary. Trains are normally shunted in/out by the terminal switch engine. A second lead into the terminal is planned as part of the next phase of expansion which will make access and manoeuvring across and to running lines less complex. There are holding positions for the main line locomotives.

The terminal was developed as public private partnership (PPP) with a mix of private and state investment, where 60% of the investment has come from MAV Cargo, 4% from the Hungarian State Railway Authority, 12% from MAV Combi and the balance from private investors. The high proportion owned by MAV may be an issue on privatisation. The public investment included the rail links in/out and the electrification and signalling links.

The combined site has customs facilities, warehousing, truck parking and a major logistics centre. Reefer points and hazardous cargo sumps for any leaking boxes or tanks are also available. Container repair and storage facilities are also available. Access to the national road network is good as is access to the city road network.

The terminal is currently handling 130,000 (85,000 in 2005) teu per annum of which 95% are deep sea services in and out from a range of ports. The terminal also handles RoLa services at a current activity rate of 20, 000 trucks per annum. Two specialised tracks with ramps are available for this type of special cargo. The terminal is also able to handle swap-bodies.

Rail services currently operate to Rotterdam, Bremerhaven, Hamburg, Munich, Wells, Emms, Prague, Vienna, Trieste and Bologna. Train services are planned (excluding RETRACK) to Constanza and to Kiev. There is an existing service from Rotterdam to Budapest which may be seen as a potential competitor if this was to be linked to any other new service connection to Constanza ahead of RETRACK. The possibility of piggybacking on this might be investigated as a means of spreading investment and operational risk until market potential can justify a separate RETRACK product or service.

The terminal is well placed strategically to serve traffic to many parts of Europe and act as an interchange between services and corridors. The Black sea ports are known to be interested in the development of regional feeder services and the ability to switch cargo amongst corridor operations. It may be possible for RETRACK to exploit these links, traffic demands and developing corridor connections as part of the wider marketing strategy. Much will depend on the train formation to be operated, call patterns and type of services (inter-modal/conventional) offered.

The main terminal has 4X 750m rail lines under two gantry cranes supported by two reach stackers. The whole terminal is paved, well lit and in excellent condition. The terminal can be made available for 24/7 working as required and responses to disruption and delay as required. Additional investment is being made and will include three additional 750m tracks, additional container storage (950 teu) and the procurement of a shunting locomotive. Current train activity is 7-10 trains per day but is likely to increase to 20 when the new investment phase is commissioned.

Conclusion for Hungary

- The Blik terminal looks like the only realistic prospect to service the Hungarian market and others using the existing array of corridor services. The terminal is modern, well equipped and competent. Capacity is being expanded to accommodate identified growth and RETRACK could usefully sit inside this. As service levels grow there may be additional pressure on the site and further expansion may be constrained.
- In terms of rail access the existing single lead in/out will be reinforced by an additional link providing bi-directional access. The main line locomotive will be able to coast into the site or the train could be shunted by the terminals own switch engines.
- The terminal is fully capable of handling ISO containers, swap bodies, trailers and RoLa traffic.
- Terminal ownership might become an issue if the current owner is bought out by a strong regional competitor.

2.3.5 Romania

DPA Terminal

The Constanza port currently has 3x 600m rail tracks under the main terminal cranes. Four additional tracks are planned to be in operation within two years (2009). The largest ships calling at the port are 7000 TEU.

The port terminal is equipped with reefer plugs and has a hazardous cargo leakage pit zone. RETRACK will need to secure quality train paths to/from the port plus the associated shunting capability by early 2008. Reefer and tanker traffic could be significant components of both import and export traffic.

The port terminals operate on 24/7 basis.

UMEX: Constanza

UMEX is the smaller terminal area in the Constanza port complex and has access to container traffic, general cargo and the shipment of trucks and cars and the movement of locally produced goods. The terminal is subdivided by activity type. Most container traffic is regional within the Black Sea and Mediterranean area. The traffic activity is around 80,000 teu per year. Some deep sea operators use the terminal in preference to the larger newer terminal so this terminal could still act as a source of traffic activity for RETRACK. The key liner operators include K-Line, CMA-CGM, Yang Ming & Hapag Lloyd.

The terminal does not have direct contact with the train operators but is aware of the current constraints caused by the infrastructure enhancements in the port and approach lines. The condition of the rail infrastructure on this terminal was adequate but would need attention if routine high levels of traffic were to be operated. Siding length is 200m. The main lifting equipment is a small fleet of front end loaders and reachstackers. Reefer points are available and a hazardous cargo zone has been designated. The terminal configuration is congested and there was evidence of truck congestion at the gates of this terminal.

Train length maximum is 600m with a maximum single locomotive load of 1500 gross trailing tonnes. This can be boosted to 2600 tonnes with the use of a second locomotive but may be compromised if train sequencing is disrupted or passing loops are not available. Splitting and then re-forming the train may be an option but would compromise transit time. The line section North of Ploiesti is heavily graded and transit times will need to reflect this. An overall transit time between Constanza and the Hungarian border of 36 to 40 hours was proposed as being feasible. The option to service Bucharest as a shuttle is a possible service option.

Concerns over border crossing routines were expressed and there was interest in simplifying procedures (technical/operational) but these are governed by treaties and protocols that need to be unpicked to reflect new strategic circumstances. The department for the Interior is responsible for this. Transit inspections (take 20-30 minutes) are made at 300km intervals, although rationale for this is not clear.

Conclusion for Romania

The DPA terminal in Constanza is a world class facility and is a major potential target market for ISO import container traffic from the Far East and South Asia moving into South Central Europe. It is an obvious source of valuable inter-modal traffic on the RETRACK corridor. Equally export traffic from South Central Europe could be directed through the terminal to balance traffic and equipment flows. Most of the traffic through the DPA terminal is deep sea traffic moved by individual lines and consortia who also have services into North west Europe through Rotterdam and other North Sea ports. Lines may elect to use the RETRACK corridor as a conduit to direct cargo (imports and exports/ loads and empty equipment) in response to fluctuating cargo load factors and directional balance.

- The older part of the port (UMEX) is used by a mix of deep sea and services operating into the Black Sea and Mediterranean. The latter are wholly different markets but RETRACK could potentially service them. The terminal equipment in the UMEX port terminal area is less sophisticated than the DPA terminal and will require some upgrading in terms of configuration, mobile plant and IT systems.
- The key to serving both of these terminals adequately is to secure much improved access for import and export traffic. The market share held by rail has declined as

road transport has developed (new roads being built) and the inadequacies of the present lines into the port areas exposed.

- There is at present inadequate capacity to handle the traffic by the terminal, shipping lines and forwarders are pressing for.

2.4 Safety and Security

Details on the Safety and security issue can be found in RETRACK D2.4. Rail transport security faces new threats from international terrorism which are not well defined. Nevertheless new rail freight service launching makes mandatory, via an integrated approach, to address current security threats and to assess social as well as economic consequences. While providing reliable, cost-effective tools in assessing, preventing and combating the novel threats of international terrorism different framework conditions and regional disparities have to be regarded.

The objective of the safety and security system is to identify terrorist threats and consequences to new rail freight service with the potential to support the industries and transport operators' competitiveness, identifying and promoting threat-cost-benefit optimised solutions.

The security is dependent on efficient cooperation and coordination among Public Authorities (in charge of threat identification) of the States concerned by the new service, the EU Institutions and the relevant stakeholders. The threat posed by the criminals may use dangerous substances and thus the level of risk involved is dependent on this cooperation and coordination. Customs and border protection requirements are constantly evolving. Traditional fiscal roles continue (such as the collection of excise duties), but there is now additional emphasis on the identification of threats to local and national security – a first line of defence against possible insurgent attacks.

The priorities have moved from monitoring cross-border cargo and reducing international shipments of contraband, to screening for explosives, arms, dirty bombs and weapons of mass destruction. Identifying such threats is increasingly more difficult, hidden inside a vehicle or concealed in the middle of the shipment. The challenge is the rapid detection without disrupting the regular flow of goods.

A lot has already been achieved concerning the security of dangerous substances (HCDG like explosives, radioactive products, etc.) both at the national and EU level. It is clear, however, that more can be done in such areas as enhancing the exchange of information, disseminating best practices, establishing coordination mechanism and taking joint actions on particular issues.

The issues of cargo tampering, people and contraband smuggling and terrorism need to be assessed and solutions evaluated based on a realistic freight “Risk” assessment associated to transport mode and local threat scenarios. Tracking of cargoes, sensors to notify the operators of intrusion and performance of cargo control and protection must be evaluated to ensure security without harming transport chain activities fluidity, productivity and cost-effectiveness.

2.5 Railway Operations and Technical issues

This section discusses railway operations and technical issues. Details on this aspect can be found in RETRACK D2.5. The final routing and terminal stops of the train pilot depends mainly on potential customers, supply chain requirements, availability of track and terminal slots, etc., the described corridor routing could be posed as a blueprint concept:

The corridor line starts in Rotterdam, follows the new BETUWE line to the German border at Emmerich. In Germany the corridor follows the Rhine to Mainz via Duisburg and Cologne, passes Würzburg and Fürth and crosses the German/Austrian border in Passau. Due to operational obstacles different routing could be required between Mainz/Darmstadt and Würzburg. In Austria the route follows the main western-eastern line to Vienna via Wels and Linz, continues towards Hungary via Hegyeshalom. In Hungary the main route via Hegyeshalom and Budapest diverges into a line variant ”North” via Ujszasz and a line variant ”South” (via Cegléd). Both variants rejoin at Szolnok and crosses the Romanian border at Curticci. In Romania the main route runs along Arad, Brasov to Bucaresti and further on to Constanza.

The railway companies are using three electric (current) systems on the corridor:

- DC 1,5 kV and AC 25kV, 50 Hz on the Betuwe line in the Netherlands.
- AC 15 kV, 16.7 Hz in Germany and Austria
- AC 25 kV, 50 Hz in Slovakia, Hungary, and Romania.

The main routing of the corridor is completely electrified.

Common signalling systems are only used in Germany and Austria (PZB/LZB)

In each country a dedicated national signalling system is used.

The new European ETCS level 2 will be only established on Betuwe line.

Dedicated line sections within the corridor countries will be switched to the new European ETCS level 1 (Austria/Hungary, Romania).

A locomotive to operate on the complete corridor would have to be compatible with at least three current systems.

The maximum train capacity is limited by the eastern part of the corridor:

Line category C 2 (i.e. maximum wagon axle load = 21 to 57, maximum wagon length load = 6.4 t/m) and maximum train length of 600m and maximum train mass for single traction of 775 t in parts of Romania.

2.5.1 Technical equipment / rolling stock

A different variety of freight wagons are used. Universal wagons are used for many different objectives of transport. These are mainly the conventional covered wagons, high-sided gondola and flat cars. In contrast specialized wagons are matched with special needs of cargo and transports and with certain market requirements concerning load volumes, specific weight, transportation protection, loading technology and vehicle delimitation.

An overview and detailed technical description of the most important freight wagons has been made. Covered boxcars, inter-modal flat cars and tank wagons could be considered as the most important wagon categories concerning presumable and possible kind of transported goods of the RETRACK pilot.

In the context of interoperability of electric locomotives, existing barriers for border crossing operations in practice are still technical differences of railway network of each country e.g. different energy, signalling and protection systems.

Currently there is no electric locomotive on the market and available that is equipped with all required signal and energy systems and country modules to be able to operate the whole pilot routing from Rotterdam to Constanza.

At least one exchange of the locomotive on the complete routing is required at the moment due to the currently on the market available technical equipped locomotives. The most common possible solutions of multi-system electric locomotives that could be used on the pilot routing have been described and analysed.

2.5.2 Border crossing freight train concepts

At the moment there is no rail freight operator that offers a direct connection between Rotterdam with Constanza. The analysis of operated train concepts shows that there are an increasing number of border crossing rail freight transport concepts to and from East and South-East Europe, which have at least partly similar routing and origin/ destinations with the RETRACK pilot. The development of the described examples concerns additional offering of train departures and round trips, the increasing number of transported goods and containers, an increasing market demand for Trans-European freight train concepts that connects the western and eastern part of Europe can be concluded.

Based on the prior analyses of the operational requirements, commonly used and available rolling stock and locomotives on the routing from Rotterdam and Constanza and the experiences of border crossing rail freight transport concepts to and from East and South-East Europe, first draft considerations for an operating schedule, potential intermediate terminal stops on the routing and technical parameters of train has been made. A first draft recommendation on operational and technical parameters of the RETRACK train could be:

2.5.3 Description of routing and intermediate stops

Block train shuttle service for container and/or conventional goods from Rotterdam to Constanza via Terminals in Neuss (Germany), Worms (Germany), Nuremberg (Germany), Enns (Austria), Vienna (Austria), Bratislava (Slovakia) but not as a direct call, Budapest (Hungary), Brasov and Bucharest in Romania. A separate set of wagons from and to Bratislava could be connected with a shuttle service from and backwards to Vienna.

Operating Data

Train departures and timetables (details in table 20 in D.2.5)

Twice weekly to both directions:

Round trip 1:

Southbound: departure from Rotterdam on Sunday and arrival in Constanza on Thursday;

Northbound: departure from Constanza on Friday and arrival in Rotterdam on Wednesday.

Round trip 2:

Southbound: departure on Wednesday from Rotterdam and arrival in Constanza on Sunday;

Northbound: departure from Constanza on Monday and arrival in Rotterdam on Sunday.

Realistic transit time: 104 hours (A-E).

Train parameters

a) Maximum gross weight / maximum length:

- Rotterdam – Nuremberg: 1.800 t / 650 m
- Nuremberg – Brasov: 1.600 t / 650 m
- Brasov – Bucharest: 1.425 t / 560 m
- Bucharest – Constanza: 1.075 t / 420 m

- Vienna – Bratislava: 800 t / 300 m

b) Maximum operational speed:

100 km/h in the Netherlands; Germany; Austria and Hungary and 80 km/h in Romania

c) Maximum axle load is 20t along the RETRACK corridor.

Equipment- Rolling stock

a) Container wagons: 8 units 60´ Sggmrs, 90´ Sggmrs and 3 units 104´pocket wagons Sdggmrs

b) Conventional train: 29 units covered wagons Habins

c) Defined number of wagon sets due to substitution for maintenance and ability for flexible usage

d) Usage of Locomotives for both weekly round trips:

Traction with one Bombardier TRAXX F140 AC or Siemens ES64F4 between Rotterdam via Betuwe line and Nuremberg. Continuously locomotive traction with two ES64U2 "Dispolok Bosporus Sprinter" between Nuremberg and Constanza.

Shuttle service for separate set of wagons between Vienna and Bratislava. Additional operation of a banking locomotive (basic locomotive in Romania: Electroputere EA060) between Brasov and Predeal (Romania) due to the restriction of 775 t for single traction.

e) Estimation of operational performance (kilometric):

Wagons: 140.000 – 180.000 km/a

Locomotives: 180.000 – 220.000 km/a.

2.6 Legislative Structure Analysis

This section reviews the legislative structure and issues for railways along the corridor. Details on Legislative analysis can be found in RETRACK D2.7. There does not seem to be any difficulties regarding open access and transparency in The Netherlands. The main problem in the proposed corridor seems to be the dominating position of incumbent in Austria (in particular), Hungary, Romania and Germany. This is often due to either company ownership structure or the possible existence of informal relationships between stakeholders. Furthermore, it is also possible that there are problems regarding access to terminals due to ownership by incumbent operator.

2.6.1 The Netherlands

No major obstacles for new entrants have been observed.

2.6.2 Germany

When it comes to the relations between key actors, the situation is still characterized by separation of accounting and responsibilities, but all major functions are still within one holding company. The consequences of such a situation for new entrants are unclear. But there are no clear indications that this may cause problems, as procedures seem transparent and non-discriminatory.

2.6.3 Austria

There is a holding company structure comprising IM and RU in both passenger transport and freight. RCA has a dominant position in the freight market and there are some concerns that RCA will use its dominant position in the market against new entrants, e.g. by "creative" or aggressive pricing policies. There are also some concerns that the linkage back to the parent company may be used to reduce competition.

2.6.4 Hungary

Also in this country there is lack of organizational separation, although all formal changes have been made. The data gathered in autumn 2005, indicated obstacles for new entrants in several areas, e.g. in terms of pricing structure, train path allocation, no transparent pricing of access to terminals. Hence, both ownership to terminals, opaque relations between IM and incumbent can cause problems for new entrants in to this market.

2.6.5 Romania

The situation in this country is similar to that in Austria and Hungary. There may be problems for new entrant due to ownership to terminals, and it is not quite clear whether there is an established level playing ground for new entrants.

2.7 Human resources and training

This section reviews the human resources and trainings issues for railway operations along the corridor. The delivery of new competitive rail services along the RETRACK corridor sets a requirement for competent personnel to plan, operate, manage and sell the train services on a sustained basis to ensure competitiveness with competing road and water-borne services and with other competing rail services largely provided by the incumbent rail operators. Each national rail domain has its own idiosyncrasies and detailed specifications including issues relating to personnel and training, qualifications, experience, expertise and accreditation. The overlay of trade union issues also brings into play a further set of considerations to be managed to allow new train services to be developed successfully.

The new train services will cross four international borders, four language borders and involve five differently organized railway systems. To ensure any new service is able to operate credibly and be routinely reliable implies the need for a new multi-faceted skill set including languages, rail industry expertise (including marketing and sales) and detailed technical and operating knowledge that is able to be deployed across the whole corridor. The availability of the new freedoms for train crews to operate across international and rail industry borders opens up a competitive advantage for rail but there has been some initial hesitancy and resistance to its wide scale implementation. Crew training to overcome this issue is being developed as part of the research work on the project to allow traction to cross borders without the requirement for a crew change. The use of simulators to accrue route knowledge rather than the lengthy and often futile methods requiring multiple transits of route or line sections is proposed. The use of multi-voltage traction also implies another level of crew competence to be confirmed.

One of the key parts of the RETRACK project is the integration of the commercial and operational components of the service. This brings together activities that have previously been independent and implies the requirement for a different skills set bridging the two domains. Customer contact and the refreshment of information on train status, condition and the identification of delays also sets out a requirement for new (to the rail sector) skills for which training is required.

The initial train services are likely to be operated on an initial constrained frequency as part of the demonstration. Even under these conditions there is an implied requirement to have in place crew rostering mechanisms to allow the trains to operate to the specified schedule and routing and accommodate issues such as driver hours/working time limits, short term replacement of crews to cover sickness, holidays, traction type accreditation etc. This will need to be in place across the complete corridor route to ensure the trains are able to be operated routinely without crew shortages.

2.8 Railway Infrastructure Issues

This section reviews the railway infrastructure issues along the corridor. Details on this aspect can be found in RETRACK D2.8. The RETRACK corridor from Rotterdam to Constanza traverses five national railway networks all of which differ in their response to the Railway packages and also in detail in terms of their individual national rail infrastructure characteristics. The generic features of the entire corridor are:

- Standard 1435mm rail gauge is used throughout;
- The loading gauge varies on the route;
- The route operates under differing power supply systems for electric locomotive operation;
- Electric traction operations are feasible over the main routes over the principal lines;
- There are varying speed, axle weight and total trailing train weight limits in force;
- Train control and signalling systems (see in section 2.9) are based on individual national methods and patterns; and
- All the railways along the RETRACK corridor are UIC members and work within its rulings and objectives.

Country specific comments on national railway infrastructure and management are provided below.

2.8.1 The Netherlands Railway Infrastructure

The rail infrastructure in The Netherlands extends over 2600 km of which 200km is electrified. The rail network is one of the most densely operated rail systems in Europe with a mix of international, inter-city, regional and stopping/commuter trains all operating on the network. The entire network is governed by signal operations controlling train movement. Much of the network has multiple lines with bi-directional signalling multi-aspect colour light signalling. Line capacity has been enhanced to accommodate the aggregate high levels of train activity and to accommodate peak travel. The maximum train speed on the main network is 160kph for passenger trains. Freight trains operate to a maximum speed of 100-120kph. Maximum vehicle gauges are specified by route sections and are the maximum permissible vehicle gauges using UIC combined traffic coding. Maximum train length for freight is 750m. A significant part of the network is able to accommodate container traffic (2.6m width) and with a height of 4.43m (ToR).

In addition to the existing national network new freight only line capacity has been developed and commissioned between Rotterdam and Emmerich on the German border to accommodate the already high levels and predicted rapid growth of inter-modal traffic. It is intended that this route will become the primary rail freight corridor between The Netherlands and Germany. The line is double tracked with an axle load of 25 tonnes per axle and has no level crossings. The theoretical design limit on the line is ten trains per hour per direction. The line formally opened in June 2007 but is still being commissioned. Linkage into the German rail infrastructure and power supply system is still not fully completed and may be subject to further operational and budget induced delay.

The line is operated by Keyrail which was specifically established for this purpose with participation by ProRail, the current infrastructure operator/manager and the port authorities of Amsterdam & Rotterdam. Keyrail is responsible for traffic control, capacity management as well as the operational management and maintenance of the new line. It also plans traffic activity for a variety of cargo interests including national and international parties, other infrastructure managers, forwarders and train operators intending to operate over this section of the corridor.

The main railway system is electrified at 1500v d.c. although some specialised sections are now being adapted to 25kv a.c. as part of a move towards European standardised power technology, notably the High Speed lines and the Betuwe line and the linkages to Amsterdam (via ‘s-Hertogensboch-Utrecht) and Ijmuiden. The 1500v d.c. system poses limitations on the capability of traction using this power input and there is a strategic national plan to convert the network to the European standard voltage but over a very long transition period (2022-2032) including the use of mixed voltage operation under the slowest conversion option. Reinforcement of the existing 1500v system has been undertaken to prevent power losses and the knock on effect this has on train performance.

The primary freight capacity enhancement has been the Betuwe line which is now in the process of being commissioned. This will be the primary freight line serving Germany and other parts of Central and Eastern Europe. It should be able to accommodate over 200 trains per day. The Rotterdam area is a very busy traffic zone for rail and there are issues identified during interviews with terminal operators relating to the maintenance of the railway infrastructure (track, signals and power supply) that constrain the ability to run trains on a 24/7 basis. The planned maintenance intentions of the infrastructure operator are advised to train operators in advance or embedded in the Network Statement. The development of further maritime container terminals in the Rotterdam area will inevitably place additional pressure on rail. No details have been made available on intentions with respect to these types of terminal development. In the short to medium term the operation of RETRACK rail freight services building possibly towards at least one train per day may become a problem for the infrastructure manager (ProRail). Congestion statements have been issued covering rail yards in Maasvlakte, Europoort, Botlek and Waalhaven for 2007.

The majority of lines are governed by multi-aspect colour light signals governing train movements and speeds. A system of train protection is used (ATB) which intervenes automatically in the event of prescribed train speed limits being ignored and also failure to respond to warning signals to reduce speed. The system was developed after a serious traffic accident involving bi-directional train operations. New control protocols built around ERTMS Levels 2 & 3 (for details see deliverable D.2.9) are being developed and will cover issues such as train detection, interlocking and speed control without external signalling.

The rail infrastructure is managed by ProRail (a private company under national law where the Dutch government is the sole stakeholder) under a management concession granted by the Dutch Ministry of Transport. The concession governs the quality, reliability and availability of the infrastructure, a fair, transparent and non-discriminatory distribution of capacity on the network and executive control of the traffic on the network in accordance with provisions established in granting the concession. In addition to the above ProRail has to ensure:

- Adequate, reliable and safe infrastructure is available for rail operations which can be used safely without excessive attrition
- To make train paths available on an equable basis through allocation and traffic control

- Risk analysis and risk management.

ProRail operates its exclusive management concession under the Dutch Railways Act. The Network Statement 2008 is a document within the meaning of Section 58 of the Dutch railways Act and has been developed to ensure compliance with that act and with the EC directive 2001/14/EC. The statement lists the rights and obligations of both ProRail and titleholders/users. They contractually establish the rights and obligations in access agreements and procedures determined for capacity requests. By publishing the Network Statement 2008 ProRail has accepted its obligations as specified within the body of the statement.

Traffic monitoring is undertaken by the normal train signalling system with train operations governed by pre-planned routing, schedules, stopping points, recovery times etc. Any "out-of-course" schedule delays are resolved by individual signalling centres and the national infrastructure manager. Train schedules are developed in the form of representations to the infrastructure manager for train paths by a prescribed date (normally April but in June in Holland) to secure a scheduled path (see ProRail Network Management statement for full details). Requests made after this period are dealt with on an ad-hoc basis by the infrastructure manager. The option to apply for an international train path through RailNetEurope or to individual national infrastructure managers is available to train operators to determine the best way of securing their requirements. The capacity allocation process is described at a generic level in 2001/14/EC. In the event of routinely congested infrastructure this situation has to be declared invoking a capacity analysis and capacity enhancement measures. Train priority rules vary by country and apply after congestion has been declared and may not always reflect the importance of international freight. No initiative to harmonise priorities is known to exist.

The Dutch rail system is a modern well equipped network which supports high levels of traffic activity. RETRACK services operated by a new private rail entrant will have to be compliant with the requisite national and international technical, operational and managerial requirements before being allowed to deploy services. The position on cross border train driving operations by expatriate train crew is already addressed by the operation of locomotives by accredited and certificated train crew across national territorial borders within prescribed limits. The development of a position on an international driving licence is relevant to RETRACK in that a model of operation exists and this could be replicated. The use of a common or near common language (e.g. Dutch and German) facilitates the position. The change of power systems should be less of an issue as the Betuwe line becomes operational and the need for 1500v d.c. power is reduced.

No information has been developed in relation to train service disruption resulting from track damage (however caused) or bad weather. There are known to be eight train operators in the Dutch rail freight sector:

- ACTS Nederland BV
- ERS Railways BV
- Nederland BV (formerly NS Cargo)
- Rail4Chem Benelux BV.
- Dillon & Lejeune Cargo
- Rotterdam rail Feeding BV
- Hafen & Guterverker Kkoln AG

- Veolia Cargo Nederland BV

SNCF Fret and B-Cargo are also known to be intending to operate. The adoption and implementation of the package of reforms and liberalization measures has dovetailed with and positively reinforced changes taking place within the Dutch rail freight sector. The various agencies have combined and collaborated to adopt the strategic requirements of the EC's directives.

The Network Management Statement (NMS) is an object lesson for other countries to emulate. It underpins the method of working on the railway infrastructure manager in detail and at the strategic level.

The liberalization process and open access to the system has induced new operators into the market all of whom are compliant with the requirements of the NMS.

Infrastructure capacity issues are already in development and implementation. Further capacity enhancement in the Rotterdam area will be required as additional port capacity is developed for inter-modal traffic. International co-operation to maximise the potential of this will be needed.

2.8.2 German Railway Infrastructure

The German sector of the RETRACK corridor uses part of the national infrastructure (34000 km) controlled by DB Netz which is wholly owned by Deutsche Bahn. DB Netz was established in the second stage of railway reform in Germany. DB Netz acts as the provider and manager of the infrastructure covering track, power supply and signalling and communications. DB Netz operates through seven regional divisions with headquarters in Frankfurt. DB Netz is part of one of the three major subsidiaries of DB (Networks) and is a company in its own right but wholly owned by DB Holding. It is a part of the German model of liberalization and discrimination free access to the national infrastructure for domestic and international services.

DB Netz is responsible for the operation, maintenance and development of the national infrastructure (freight and passenger) and is required to publish a Network Management Statement describing its objectives and intentions and methods of working. DB Netz has developed and is implementing a programme (ProNetz) aimed at increasing capacity and reducing operational bottlenecks. The objective of the whole initiative is to adapt the infrastructure for rapid growth by significant investment in modern systems and hardware to support efficient train operations. The ProNetz programme is planned to extend for several years (unknown duration) for the existing rail network and aims to adapt the system to accommodate more traffic by technological improvements, the integration of investment and maintenance and to install developing train protection and control systems. Annual investment is projected at Euro 1.6 billion for 2007. Modernization funds (Euro 3.0 billion) are also planned for the entire network. RETRACK will be an indirect beneficiary through the systems enhancements. The main focus will be in maintaining the already high integrity and standards of the track structure (rail replacement, ballast & sleepers), power supply and signalling systems.

For RETRACK operations there have been expressions of concern over the capacity of the route along the Rhine and the risk of being allocated less than adequate quality train paths in terms of schedule. The rail network in Germany is intensively used by a mix of passenger services (international – day and night), national passenger services, regional and local/commuter services. The development of the high speed network as a separate entity has removed some traffic onto a completely separate infrastructure.

Germany claims to be one of the most liberalised freight markets for rail in Europe. Since the market began to de-regulate nearly 300 companies have secured licenses to operate within the freight market. Of these over a third are active in the provision of traction for train haulage or shunting. Some operations are highly localised serving a specific location or enterprise. The market in terms of volume and production (tonne km) is still dominated by DB's rail arm, Railion, which has control over the infrastructure and the huge market presence.

Trains are monitored in transit on the rail network through the active signalling and train control mechanism based on scheduled access to train paths, routing and schedules granted through the formal bid process or ad-hoc arrangements which cannot always fulfil the path requests made by specific operators. Parts of the corridor are covered by the developing ERTMS implementation. Inter-modal trains have been monitored for performance quality under the CER Quality initiative to record train movement patterns in relation to prescribed schedules and to identify any underpinning reasons for delay. The train departure related delays had increased (based on 2004/5) marginally but arrival performance had improved with over 70% of international trains arriving within the performance parameters. The absence of common protocols on IT (for details see deliverable D.2.2) and reporting makes the present monitoring methods more expensive and disaggregated.

There is no uniform formal method of passing to shippers or cargo interests real time information on cargo location and condition or any revised schedule adjustments. Cargo trains operate within UIC agreed loading gauge limits for vehicle height and width. The maximum axle load on the German portion of the train corridor is 22.5 tonnes. Maximum train speed is 120kph.

In terms of inter-operability the German main line rail system which would be used by RETRACK operations is electrified at 15kv a.c. This differs from the Dutch national system (1.5kv d.c. and the Betuwe line operating at 25kv a.c.). Thus the train operation will require multi-voltage locomotives. Operations into Austria and Hungary are at 15kv. Crew changes are still largely made at the borders but the opportunity to operate across borders with competent certificated train crews is in prospect. Some cross border driving activity but on a localised basis is undertaken by competent “foreign” crews.

The German railway signalling system is, like most others, distinctly different from those of other countries on the corridor. ERTMS is being developed on the part of the route likely to be used. In the event of service disruption in terms of train priorities cross border traffic is most highly rated followed by passenger services and then national freight services.

Developing train path bids by train operators and the consolidation of these into an agreed schedule by DB Netz in a transparent process establishing schedules, routings, stopping points and related technical issues. Within the train operators key personnel are assigned for dispute resolution, related commercial negotiations and settlements. Slots not allocated by the process are available under short term rules. DB Netz has to reconcile all bids to minimise schedule and route conflicts under an established disputes/reconciliation process. Options to re-bid or pay a higher fee for a preferred path is available. The short term slots are available outside the main timetable/train path position and can include declared unused or redundant slots. This may be an advantage in that some short term or spot paths may offer faster transits than the regular path. International train paths can be fixed by the national operator or through RNE.

For the purposes of RETRACK the routes proposed are all double track. So there is an option with flexibility to loop around any obstruction. It is possible that a locomotive could be requisitioned to move a failed train out of the way under rules set by the network statement.

General power supply failures are rare in Germany. Some localised damage is caused by snow causing trees to fall onto power lines but these types of incident are easily repaired within a few hours. Point’s failures do occur and lead to local re-routing or train re-scheduling until rectification of the fault. Leaf fall in the autumn can result in train weights being lowered by about 10% to mitigate this problem. Locomotive or traction failures are rare with modern technology yielding 97% availability underpinned by lease contracts. Wagon defects are largely the result of brake valve failures. This can lead to an individual wagon or freight car being removed from the train formation to be repaired or isolated to allow it to complete the transit and then be repaired. This sort of defect is usually detected by “hot box” detectors at the line side responding to brakes dragging. Bearing lubrication failures resulting in overheating are also detected by the hot box equipment.

Maintenance and other construction work is a significant issue on German railways and significant construction work is planned into the annual timetable. Smaller projects are notified to train operators in advance (3 months) with a resolution process driven by the rail regulator.

DB Netz and OEBB Infrastructure have the same software (Alcatel), which enables them to see, what is going on in their respective network. It is called LeiDis-N (Leitsystem der Betriebsführung – Disposition Netz) (Leading system of the operation – Disposition of the network). Every station has at least one fixed point where trains are passing by are registered by there individual train number. Every movement (in Germany) is entered into the system as planned. Once the train has started to move, at the predetermined points, that the train is supposed to pass, the actual time of day is filled in, next to the scheduled time. The capturing of the actual times may happen by using ETCS data, static data, or manual key entry, where no automated system is in use. The difference between scheduled and actual is displayed and reasons for delays have to be entered by Netz personal.

Private rail companies can have access to the system, either to the Leidis – N mirror or via ARAMIS. LeiDis – N mirror is located in Frankfurt. The schedules are copied once per day from the live system LeiDis – N to the mirror system. The actual data is “real time”. As a central system, it shows only trains, that are “long-distance” and have been grouped to the code of long distance-trains manually. So, a locomotive movement only to get to a train is not visible in Leidis – N mirror. The customer is connected via direct line from a dedicated computer in his office to the server of DB Netz and due to a filter, he can only see trains moving, that were constructed using the customers account number.

ARAMIS (Advanced Railway Automatisation, Management and Information System) takes its info also from LeiDis – N. The difference is that it is accessed via Internet. The customer has the choice from which DB Netz server he wants his information. This choice can be altered at any time. So if information concerning a local movement is required, the customer can chose the regional server which has all movements within his region. By logging into ARAMIS, automatically the filter is activated to prevent the customer seeing trains of his competitors.

The reason codes for additional delays are used to determine which party has to pay the penalty charge created by the stimulation system. I.e. the delay code says, 5 minutes additional delay because of a defective switch, DB Netz will pay. If the code says, locomotive driver late, the railway company will pay.

2.8.3 Austrian Railway Infrastructure

Access to the national rail network (Betreib AG, a part of OBB) is governed by stipulations set out in the NMS including an operating licence, safety certificate, insurance and an allocation of infrastructure capacity. Various categories of train operators are allowed to apply for access including internationally based groups intending to serve the Austrian market or requiring transit.

Additional stipulations govern the transport of hazardous goods traffic. National laws apply in relation to environmental issues including noise.

Lines on the Austrian rail system are described in detail in the NMS in relation to line characteristics, operations methods, signalling and axle box counter/hot box detector location.

All primary routes are built to 1435mm track gauge and over 70% of the system is electrified at 15kv a.c. which permits through traction operations into Germany and Hungary. Power is supplied through a mix of railway owned or partner generating plant.

The infrastructure activities are split into those responsible for the operation and maintenance of the network and a separate section devoted to the development and enhancement of the network. Betreib AG is responsible for ensuring as much of the network is available for traffic as is possible commensurate with maintenance requirements and commitments to ensure safety and efficient train operation. Infrastructure maintenance is governed by scheduled planned activity intentions for up to three years forward.

Train paths are allocated to operators on the basis of requested route, operator details, train weight, length, speed and braking characteristics, any hazardous cargo intentions, traction unit capabilities, border processes for hand over and checks, crew changes, gauges for inter-modal traffic /combined transport and connections. Deadlines for the submission of train paths in the annual timetable planning process are required by April for the following year. Ad hoc train paths can be requested on a diminishing time basis but with the risk of not being able to satisfy the request on a shorter time span. In the event of an operating incident procedures have been developed to ensure contact is established with named personnel within train operator's organizations to advise intentions to restore stability.

Train path priorities have been identified in descending order from passenger/public transport to longer haul, long terms contracted operations over shorter distance short term operations. There is a let out provision for priority to be allocated to trains that "tie in with infrastructure operating conditions". There are train monitoring processes in place and response measures in the event of disruption of disturbance of a planned train sequence. A total of 24 railway undertakings have licences to operate although how many of these are active is not known in detail.

Line capacity for RETRACK services operating through Austria will be able to take advantage of the capacity enhancements in the West of Vienna between Linz and St Paulten. This section is classified as a high priority route with high passenger and freight volumes. Vienna is a busy conurbation with a major potential terminal stop to negotiate in transit to/from the Hungarian border. The route is governed by train monitoring system RZO/loop lines and train radio communications. Hot box and wheel "flat" detectors are installed on the route and over the most of the main line network. OBB Betreib has issued a forecast map of major engineering works including capacity enhancements as part of the NMS. The RETRACK route will be affected by some of these.

2.8.4 Hungarian Railway Infrastructure

The Hungarian railway network (7700km) is dominated by the infrastructure managed by MAV, the Hungarian State Railway Company. There is a small jointly owned (Hungarian and Austrian) cross border route in Western Hungary. About 40% of the network is electrified at 25kv a.c. which complicates cross border traction operations for RETRACK into Austria. The management of the infrastructure has been separated from train operations. There has been a back log of infrastructure maintenance leading to slower train operation. There are international container services operating to Budapest from Western Europe and rail has a high level of participation in inter-modal traffic.

Only 20% of the network is double track which may create concerns over capacity in the medium term. Traffic levels are however down significantly compared to levels under the communist regime. So there is in principle some capacity on the network to accommodate new traffic. The deterioration of the network due to maintenance backlogs will need to be addressed.

At least 20% of the TERFN annual line capacity in Hungary has been allocated to railway undertakings other than the incumbent and enjoy comparable journey times to the incumbent operator investment made by the EIB since the early 1990s in infrastructure upgrades and modernization has amounted to Euro 450 million. ECTS is already in operation on the route between Vienna and Budapest and was one of the first applications of this technology.

Parts of the RETRACK corridor routing in Hungary will allow freight train operations to a maximum line speed of 100-120 kph. Maximum axle loads are 22.5 tonnes. Maximum train length is 750 m.

Access to the rail network is granted under licence and in compliance with safety, competence and insurance credentials. Capacity is allocated by a capacity allocation office nominally separated from the infrastructure manger (MAV) although this separation is opaque. A fully independent Rail Regulator is in place. Market share held by the new train operators is very low and competition is still developing. There are only a few (4) players identified capable of operating competitive train services. MAV Cargo has been sold to Rail Cargo Austria.

Traffic control and monitoring is through a mix of signalling and train control mechanisms which reflect national systems that also incorporate train speed commands to train crew. ERTMS is in operation on parts of the RETRACK corridor. There is no independent monitoring of train location or cargo track and trace in place. In terms of train inter-operability rail vehicles have to be compliant with UIC loading gauge stipulations on dimensions, braking loading and speed characteristics.

2.8.5 Romanian Railway Infrastructure

The strategy for rail transport supported by the national government is to reorganize the activities of the incumbent railway operator in accordance with EU norms by splitting the functions, clarifying the financial position of the incumbent, privatising freight, removing speed restriction, enhancing technical and commercial speeds by 20%. Separate regulatory and safety inspectorates are to be fully developed.

The total national route network comprises 11,300km of which 40% is electrified at 25 kv which will allow through operation on the same power supply as the neighbouring Hungarian system. The railway is to standard European gauge (1435 mm). The dense network of lines offers multiple routing options for RETRACK corridor trains in the event of disruption or lengthy track possession for engineering work.

CFR Infrastructure manages and operates the railway infrastructure. It is also responsible for line modernization. The rail network has a high proportion claimed by the infrastructure manger to be inter-operable. The residual network is mainly low volume branch lines. The rail system to the North and West is in mountainous territory which constrains train performance. The network is being developed to allow an increase in train speed between Bucharest and Constanza. In addition significant infrastructure enhancements are being made in and around the port terminal area in Bucharest to allow additional trains to operate. These investments will enhance rail's competitive position in the port which has been eroded by the lack of adequate rail capacity .

Maximum train length is set at 620m and a gross trailing weight of 1500 tonnes. This can be raised to 2600 tonnes with additional traction resources added. Rolling stock and traction are governed by UIC stipulations on dimensions, weight and operating capabilities.

A network statement has been prepared by CFR to describe the services supplied by CFR for those customers wishing to operate trains on the railway infrastructure. It is for the guidance and advice only and not a contractual document. The network statement includes the general rules, deadlines, processes and criteria regarding the system of levying charges and of allocating railway infrastructure capacity which is also defined in the statement. It facilitates non-discriminatory access to information for existing and new market entrants.

The statement has evolved in accordance with EC directives transposed into national law. It describes the position for one timetable period only but will reflect changes and developments as these occur.

Traffic management on the network is undertaken by traffic regulators co-ordinated by regional regulators and centrally by the Central Office for Railway traffic control. An integrated rail information system is used for monitoring and control purposes. Disruption response is undertaken by increasing degrees of involvement of the hierarchy. Trains operate on allocated paths based on the annual timetable, average traffic programme (10-30 days forward) or on a spot basis with a lead time of 24 hours. There are 24 railway undertakings in Romania with sanctioned access to the network for freight traffic operations. Access is granted in accordance with government ordinances on the national rail transport policy objectives, the establishment of a national rail company, allocation and charging, safety rules and certification and licensing. The main railway system is invested in state ownership.

The public railway infrastructure is made available to railway undertakings in a non-discriminatory way based on licensing, safety certification and an access contract with CFR. This will set up the scope of rail services to be offered, access to infrastructure services and any supplied services, additional and auxiliary services. Capacity allocation is made by CFR as the independent railway infrastructure manger. There is no option to swap or trade capacity allocations by the train operators without recourse to CFR. Paths are allocated for one timetable period (normally one year) but may be extended by mutual consent. Rights and obligations are detailed in contracts. Allocated train paths are published. The lead time for the development of train path bids includes the operation of international trains.

CFR is required to analyse periodically the available infrastructure capacity to identify bottlenecks or potential bottlenecks. Congestion can be declared and remedial options identified within 6 months. Planned maintenance intentions are required to be made available by CFR to train operators.

2.9 Mapping Corridor Control System

This section reviews the railway traffic management systems along the corridor. Details on this aspect can be found in RETRACK D2.9. The single European Rail System is progressing, with increasing levels of harmonisation and interoperability being achieved by the introduction of an array of measures including Standards (TSIs) and technical developments such as the all important European Rail Traffic Management System (ERTMS) or European Train Control System (ECTS).

The Dutch rail Command Control (CC) system is known as ATB. It has two main versions, the first generation or ATB-EG and a modern version known as ATB-NG. While ATB-EG provides discrete (i.e. at signals) speed supervision, the ATG-NG provides continuous speed supervision. Both systems are incompatible, needing an additional interface (ATB-L). ATB-L is the on board ATB-NG system capable of managing ATB-EG information. The German CC system is known as PZB with a more advanced version of the system known as LZB for continuous speed supervision. The Austrian CC system uses the same systems as the German network, the PZB and the LZB. The Hungarian CC system is called EVM and is based on a technology very similar to the Dutch ATB-EG. However, EVM is not capable to stop the train before a reference point. Romania uses the PZB system, similar to the German and Austrian CC systems.

The RETRACK corridor is expected to run through the Netherlands using the dedicated freight line “Betuweroute”, which is fitted with ERTMS/ ECTS (discussed in next section) level 2 exclusively. Joining the Betuwe route, between Rotterdam and Kijfhoek, the line is equipped with ATB-EG although it is planned to be equipped with ERTMS/ETCS level 1 by spring 2008. The connection to the German network is made on track equipped with PZB changing to LZB for the German section. The Austrian section (Passau - Linz - Vienna-Hegyeshalom), is fitted with a combination of PZB, LZB and ERTMS/ECTS Level 1 systems, although ERTMS/ECTS Level 1 will be in service for the whole of the Austrian section by the end of 2008. Running across Hungary (Hegyeshalom-Budapest-Curtici), the route is fitted with ERTMS/ETCS level 1 from Hegyeshalom to Budapest, switching to EVM system from Budapest to Curtici on the Romanian border. Finally, the Romanian section (Curtici-Bucharest-Constanza) is fitted with PZB from Curtici to Campina. The section between Campina and Bucharest has ERTMS/ETCS level 1 already in commercial service running alongside PZB during the migration phase while the Bucharest-Constanza section currently uses PZB although ERTMS/ETCS Level 1 is already being fitted and will be fully operational by 2008.

The ERTMS systems consists of two main distinctive features, namely, GSM-R for data exchange between track side and on-board and ECTS in which a train-based computer controls the train speed according to the operational characteristics of the track. ECTS and GSM-R together form ERTMS.

ERTMS has three levels. ERTMS/ECTS Level 1 which can be used as an overlay to existing signalling systems. Track integrity and position is provided by track circuits and the movement authority is received via Eurobalise (track-mounted). ERTMS/ECTS Level 2 does not require track side signalling. The movement authority to the vehicle is now received via radio (GSM-R) from the control centre. This allows constant update of speed and position, making the track side signals redundant. This also allows an increase of the capacity of the network. With ERTMS/ECTS Level 3 the train can check its integrity and position by itself and it is becoming effectively a moving block system where trains constantly talk to each other and the control centre adapting their speed profiles to their surrounding convoys allowing more trains on the network.

A Memorandum of Understanding (MoU) signed in 2005 by the European Commission and all the rail stakeholders marked the start of the real implementation of ERTMS which has been planned and developed for the last two decades. To allow this implementation, a coordinated deployment of an ERTMS network of corridors has been defined. Six corridors have been selected and studied, namely:

- Corridor A: Rotterdam – Genoa;
- Corridor B: Stockholm-Naples;
- Corridor C: Antwerp-Basel-Lyon;
- Corridor D: Valencia-Lyon-Ljubljana-Budapest;
- Corridor E: Dresden-Prague-Budapest;
- Corridor F: Duisburg-Berlin-Warsaw

These six corridors represent 6% of the total Trans-European Network of Transport (TEN-T) but 20% of the total freight traffic. Each of the corridors has specific individual targets and objectives and often involves not only fitting ERTMS/ETCS equipment but also upgrading the existing infrastructure as well as harmonising the operational rules.

ERTMS is seen as an essential tool for realising the interoperability of the European railway system and improving the competitiveness of the European railway sector. However, it is encountering compatibility issues on its migration from existing systems. Technical compatibility issues between train borne and track borne equipment are also slowing some projects although this is something to be expected when introducing new technologies in such complicated environments as the railways and it should disappear after the initial stages.

3 SUMMARY

The findings of the different aspects of Rotterdam-Constanza railway corridor are summarised in the following sub-sections.

3.1 Trans-shipment techniques

This sub-section summaries the transhipment along the corridor:

- For unitised cargo the technology options to service RETRACK cargo requirements are available, credible and align with some RETRACK routing options.
- Terminals are available to handle ISO, non-ISO, swap body and trailer modules
- Need to ensure open access to terminals is available on equal terms with incumbent train operators
- Horizontal transfer technologies not in evidence and not seen as a mature technology to support the services.

3.2 Information and Communication Techniques

This sub-section summaries the information and communication techniques along the corridor:

- Complex mass of documentation, systems, technologies, protocols, methods, communications technologies and priorities in evidence
- Manual, electronic interface costs and delays with errors
- No existing systems fully support RETRACK requirements
- Need for a common platform for data entry, recording, transmission and receipt
- Need to integrate cargo documentation with track and trace, Command, control and communications issues (C3)
- Need to establish continuous traceability of high value time sensitive cargoes.

3.3 Terminal Technology and Systems

This sub-section summarises the terminal technology and systems related to rail freight transport along the corridor

- Review of terminals potentially to be used reveals the dominant use of LoLo technology and support systems (straddle carriers/front end lifters etc.)
- Individual terminal variances in technology mix reflecting local/national traffic characteristics.
- Some commonality and use of proprietary systems
- Complex management/planning/operations interfaces at national level need to be integrated
- Security and capacity issues evident in some locations but major terminals all have expansion and productivity plans in hand

3.4 Safety and Security Issues

This sub-section summarises the safety and security issues for railways along the corridor:

- Review only of the transport component and not infrastructure, power supply etc.
- Hazardous cargo assumed to be governed by international protocols with international standards and any national reinforcement
- Major threats are theft, damage in transit, smuggling (people and substances).
- Border points as high risk with delay and train vulnerability exposed on a routine basis
- Need for integration of check and clearance processes.

- Need for linkage to all involved national bodies with relevant interests/Customs/immigration/security
- US cargo issues and potential extra-territorial implications
- Work has exposed vulnerability and risks in the supply chain. Need for through transit traceability and condition monitoring with real time intervention
- Implied cost of security but could be used as a product “plus” point.
- Need to accept inspections beyond borders as an integral part of transit without need for national inspection. (Use the airline example)
- Need for driver integrity checks and access to train
- Use existing road borne security systems

3.5 Operational Issues

This sub-section identifies the summary of railway operational issues for railways along the corridor:

- Includes preliminary routing and equipment appraisal
- Border crossing concepts developed
- Train parameters and performance defined
- 3 power systems on route but the corridor is all electric (Green plus points)
- ETCS is to be implemented on the Austria/Hungary/Romania sections
- Need for bi-current (1.5kv d.c. and 15kv/15kv & 25kv)
- Train length issues - some uncertainty in results on weight and trailing length to be clarified
- A range of terminal stops identifies as potential stop points for unitised cargo
- Transit time of 104 hours end to end
- Wagon productivity 140-180 k km per annum
- Loco productivity 180-220 k km per annum

3.6 Driver Training and Certification

This sub-section summarises the diver training and certification issues for railways operations along the corridor:

- Key issues centre on the acceptance (or otherwise) of national certificates of competence to be used in other railway domains.
- National legislation and rules militate against the EC initiative of driver flexibility
- Issues of language, competence, certification, acceptance and familiarization and any liability from errors

3.7 Legislative Structure

This sub-section summarises the legislative structure and issues for railways along the corridor:

- Mixed array of implementation and structures in place with differing degrees of competence, involvement and effectiveness
- Measures are nominally in place along the corridor

- Need for a reality check with national RRs if required to intervene
- Evolving positions in Hungary & Romania
- German & NL railways have sophisticated structures and mechanisms in place. German RR to intervene on commercial issues, cross subsidization and predatory pricing below cost to fend off competition.
- Austrian RR concerns over effectiveness and willingness to intervene
- Potential role for EC to secure full and adequate compliance in line with directives by a common agree deadline to ensure a level playing field

3.8 Infrastructure Issues

This sub-section summaries the infrastructure issues for railways along the corridor:

- Port area congestion in and around Rotterdam and Constanza being addressed with infrastructure reinforcement and capacity additional
- Identified constrains in Germany with speed/weight issues in the Rhine section and lower quality train path allocation
- Flexible port/terminal infrastructure access required to accommodate train schedule performance divergence
- National signalling systems in place being partly overlaid with ETCS from Austria to Romania (Level 1)
- Power system variances require multi-voltage/multi-system locos
- Train length definition still to be confirmed in Romania
- Speed and axle load parameters known

3.9 Corridor Control Systems

This sub-section summaries the traffic management issues for railways along the corridor:

- Triple C (command/control/communication) varies by national practice
- ETRMS planned for Austria to Romania section
- ERTMS on Betuwe section
- National signal system variances
- Implications for crew cross bordering

4 CONCLUSION

Based upon the works (state-of-the-art literature reviews and field surveys) completed within the work package 2 (corridor assessment) the technical, commercial and operational case for the RETRACK train operations along the corridor appears to be sufficiently robust to suggest that it is feasible. There are adequate terminals for the operation and handling of inter-modal traffic at strategic points along the line of route fully capable of accepting the new traffic flows that RETRACK trains will induce. The ability to operate trains end to end or part way along the corridor as well as intersecting with other major links all appears to be feasible based upon the work so far undertaken. This will need to be converted into commercial positions between the train operators and the individual terminals and will be geared to the development of traffic activity patterns.

There are residual concerns that the incumbent rail operators could restrict access and operations in terminals as a defensive commercial measure. If these situations arise there are in most of the countries adequate defence measures through the regulator to constrain this. Austria remains a primary focus of concern together with Hungary given the recent take over of MAV cargo.

A number of terminals visited and inspected are world class terminals. Others are less well developed but could usefully allow access to markets less well served through the big terminals and also allow market testing without major commitments to the big operations.

Several of the larger terminals visited are being expanded or have expansion plans in development. All of the terminals visited are using established terminal transfer equipment with no evidence of the use of horizontal transfer systems. This is still largely novel technology and not appropriate to high volume terminal operations. Terminal management methods vary but not significantly.

There are some environmental issues arising from terminal activity largely focused on noise and traffic generation activities. Noise is an issue for terminals in or near city centres but some of the terminals pre-date the development of the urban areas. Other terminals are in port or industrial areas and are less constrained. The new terminals are fully compliant on hazardous cargo containment.

5 RECOMMENDATION

The findings from this work package 2 indicate that the development of a demonstration train service or services operating along the corridor will be feasible, competitive, and environmentally benign and will begin to achieve the modal re-positioning required on merit. The further development of the operational aspects of the development of a demonstration service in late 2008 or early 2009 should continue based upon the findings of this and earlier work packages.

6 Abbreviation

ADS Architecture Description Standard
ASC Automated Stacking Crane
EC European Commission
EDI Electronic Data Interchange
ERRAC European Rail Research Advisory Council's
ERTMS European Rail Traffic Management System
ECTS European Train Control System
ETA Expected Time of Arrival
HGV Heavy Goods Vehicle
GERA Generalised Enterprise Reference Architecture
INHOTRA Interoperable Inter-modal Horizontal Transfer
IAF Integrated Architecture Framework
IRIS Innovative Rail Intermodal Services
ITESIC Integration of Technologies for European Short Intermodal Corridor
ISO International Standardisation Organisation
IT Information Technology
LCL Less than Container Load
MDA Model Driven Architecture
NMS Network Management Statement
RETRACK Reorganisation of Transport networks by advanced Rail freight Concepts
RM-ODP Reference Model for Open Distributed Processing
TOGAF Open Group Architectural Framework
TEN-T Trans-European Network of Transport
TEU Twenty feet Equivalent Unit
TSI Technical Specifications for Interoperability
UCS Uniform Communication Standard
UML Unified Modelling Language
UN/EDIFACT United Nations EDI for Administration, Commerce and Transport
WfMC Workflow Management Coalition
XPDL XML Process Definition Language
WWW World Wide Web

7 References

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