European Rail Freight Line System (ERFLS)

Final report

M.11 – Final report
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ERFLS
European Rail Freight Line System
Rhine-Alpine Corridor

CEF-Transport Action
(INEA/CEF/TRAN/A2014/1041829)

Co-financed by the Connecting Europe Facility of the European Union

Project Partners

provincie
Gelderland

STI
Istituto Superiore sui
Sistemi Territoriali per l'innovazione

Stadt **Lahr**

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Authors

Andrea Rosa (technical coordinator ERFLS-project) with input directly achieved from all partners and from the previously delivered Milestones of the study Activities.

Milestones (Sub-Activity) and Title		Author	Date
M1 (SA1)	Smart Terminal Handbook	- Matthias Hofer (EBP Schweiz AG on behalf of the Province of Gelderland) - Nicolaas de Vries, ed. (EBP Schweiz AG on behalf of the Province of Gelderland) - Iolanda Conte (Uniontrasporti) - Luca Zanetta (Uniontrasporti)	December 2017
M2 (SA1 and SA2)	Country specific measure catalogues	- Matthias Hofer, editor (EBP Schweiz, on behalf of the city of Lahr) - Tobias Fumasoli (EBP Schweiz, on behalf of the city of Lahr) - Luca Zanetta (Uniontrasporti) - Iolanda Conte (Uniontrasporti)	July 2018
M3 (SA1 and SA2)	Terminal specific investment plan	- Matthias Hofer, ed. (EBP Schweiz, on behalf of the city of Lahr) - Tobias Fumasoli (EBP Schweiz, on behalf of the city of Lahr), - Nicolaas De Vries (EBP Schweiz, on behalf of the city of Lahr) - Luca Zanetta (Uniontrasporti) - Iolanda Conte (Uniontrasporti)	November 2018
M4 (SA3)	Guidelines for stakeholders for the establishment of an exchange platform on intermodal interc-onnection possibilities on the Rhine-Alpine Corridor	University of Duisburg-Essen - Jana Koppe - Sven Meyhoefer	August 2018
M5 (SA3)	Railway Traffic Study	University of Duisburg-Essen - Jana Koppe - Sven Meyhoefer	November 2018
M6 (SA3)	Implementation Plan	University of Duisburg-Essen - Jana Koppe - Sven Meyhoefer - Ulrike Overbeck	November 2018
M7 (SA4)	Telematics Handbook	- Maurizio Arnone, ed. (SiTI) - Andrea Rosa, ed. (SiTI), Chapters 1-4, 5, 8 - Massimo Arnese (CrossTec, on behalf of SiTI), chapters 4, 6, 7	December 2017
M8 (SA4) -	Telematics Action Plan	- Maurizio Arnone, ed. (SiTI) - Andrea Rosa, ed. (SiTI) Chapters 1 and 2 - Massimo Arnese (CrossTec, on behalf of SiTI) Chapters 3, 4, and 5	November 2018
M9 (SA5)	Socio-economic sustainability study	Uniontrasporti scarl - Antonello Fontanili, ed. - Iolanda Conte - Luca Zanetta	November 2018
M10 (SA5)	Environmental study	SiTI - Maurizio Arnone, ed. - Alessandro Musco - Cristiana Botta - Stefano Pensa - Tiziana Delmastro - Valentina Dolci	November 2018

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1 Introduction and structure of the present report

1.1 The ERFLS partnership and how the work was developed

ERFLS (European Rail Freight Line System) is an Action successfully put forward for co-financing under the 2014 Transport call of the Connecting Europe Facility by a partnership led by the Province of Gelderland (NL) and including the University of Duisburg-Essen (DE), the City of Lahr (DE), Uniontrasporti (IT), SiTI (IT).

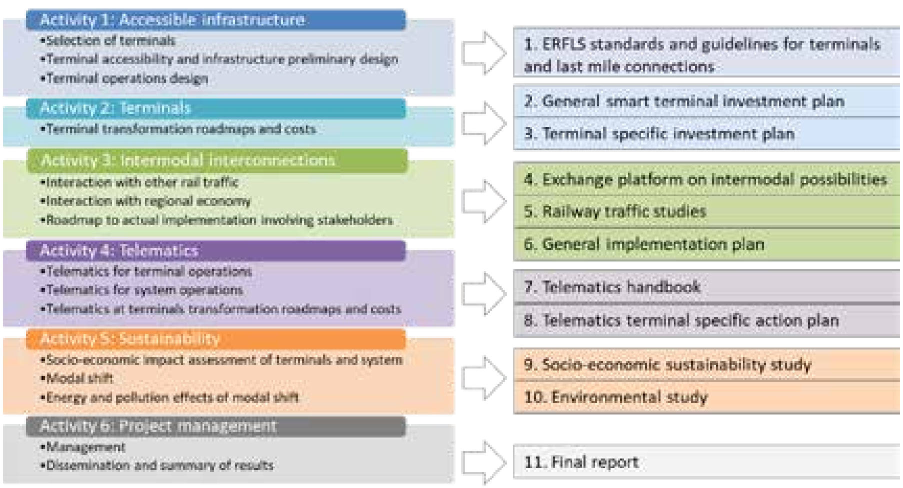
A Grant Agreement awarding the co-financing was signed in November 2015 by INEA, for the European Commission, and by the Province of Gelderland, on behalf of the partnership, to develop the ERFLS Action starting 1 December 2016. The work was finalised by 30 November 2018. According to the Grant Agreement, the ERFLS Action consists of 6 activities, each led by one of the Action's partners, as recalled in Table 1.1.

Table 1.1 The Activities of the ERFLS action and the Activity leaders

Activity	Activity leader (Action partner)
1. Accessible Infrastructure	Province of Gelderland
2. Terminals	City of Lahr
3. Intermodal interconnections	Universität Duisburg-Essen
4. Telematics	SiTI
5. Sustainability and socio-economic impact assessment	Uniontrasporti
6. Project Management, dissemination and communication	Province of Gelderland

The results of the study Action are reported in 11 Milestones as illustrated in Figure 1.1. The first 10 Milestones presented the detailed results of the Activities while the summary of the work is presented in this report, Milestone 11 "Final report".

Figure 1.1 Activities, their objects, and the Milestones reporting the work



At the outset of the Action the partnership felt the need to detail the work content consistently with the description of the Grant Agreement but in more operational terms. The result of that work was included in a Starting Document that the partnership used as a guidance throughout the duration of the Action.

The work was carried out under the supervision of a Technical Coordination Group composed by the leaders of each Study Activity and by a technical coordinator.

1.2 Structure of the report

This report is organised in eight chapters. Following the present introductory chapter, the concept of the European Rail Freight Line System (ERFLS) is explained in chapter 2, also detailing the technical factors enabling it. The Study Action was based on six terminals along the Rhine Alpine Corridor that were selected in the way briefly described in Chapter 3.

Chapter 4 offers further details of the technical elements to implement ERFLS: smart terminals with measures to reduce dwell time, and telematics. It also discusses the use of freight exchange platforms in connection with ERFLS.

Chapter 5 deals with each of the selected terminals in turn, offering a set of base information on its current status before detailing the options to change its layout and operations to allow for efficient ERFLS implementation. The required telematics provision is also indicated, building on the general blueprint described in Chapter 4. Furthermore, Chapter 5 reports the results of the regional economics investigations and of the socio-economic analyses carried out for each terminal. The outline of the necessary steps for the implementation of ERFLS are closed by illustrating the tentative timetables for ERFLS services along the whole corridor.

The transport and environmental effects of ERFLS are summarised in Chapter 6 of the present report, which includes also a discussion of the freight traffic that could be shifted to ERFLS rail services.

Finally, Chapter 7 reports some summary conclusions reached with the study Action and Chapter 8 mentions recommendations for implementation developed by the partnership at the end of the study Activities to complete the work.

A list of abbreviations used in the report is provided after the final chapter for the convenience of the reader.

2 The European Rail Freight Line System (ERFLS) concept

2.1 ERFLS and how it differs from current services

The European Rail Freight Line System (ERFLS) is an intermodal freight transport concept based on block freight trains travelling according to a regular timetable along a corridor, picking up or leaving intermodal units at intermediate points between their departure and arrival terminals. Both the working of the trains and the way intermodal units are loaded and unloaded aim to resemble the operations of intercity trains for passengers.

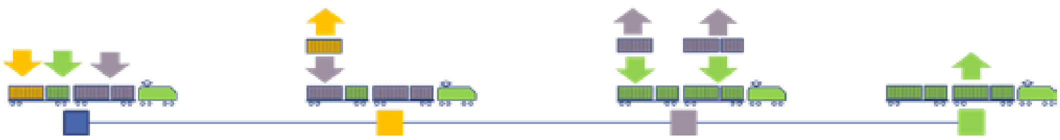
The difference between ERFLS and a conventional intermodal service is illustrated by contrasting Figure 2.1 and Figure 2.2. Figure 2.1 shows a conventional intermodal service concept, which involves a block train loaded completely at origin, and unloaded completely at destination.

Figure 2.1 The working of a conventional intermodal transport service

Figure 2.2 exemplifies an ERFLS service along a corridor which entails trains running to a regular timetable and calling at several terminals where intermodal units are unloaded, and intermodal units for downstream destinations replace them on the wagons. In Figure 2.2, the ERFLS train departs from the origin terminal (on the left) loaded with containers destined to all the different terminals it will call at. To ease the reading of the picture, containers and destination terminals are in the same colour. So in the picture, at the origin terminal the train is loaded with two containers for the Grey terminal, one for the Green terminal and one for the Orange terminal. Moreover, an arrow towards the train indicates the loading of the containers pictured in the same colour as the arrow (and the terminal). An arrow pointing away from the train symbolises an unloading operation.

Each time the train calls at a terminal, containers destined there are unloaded whereas containers for terminals further along the way are loaded on the free slots. For instance, in the picture, at the Orange terminal a container is unloaded and a container destined for the next terminal along the way is loaded using the slot just freed.

Figure 2.2 The working of a ERFLS intermodal transport service



The ERFLS services are intended to work on long distances calling at several terminals, and may or may not cover the whole distance of the railway corridor, depending on the demand for the service detected when the timetable is set up. Moreover, ERFLS is intended to make intermodal services available also at terminals where a limited number of intermodal transport units (ITUs) origin or are destined.

An important element of the concept is that it is intended to be operationalised already building on current practices and current terminals, introducing a set of modifications as limited as possible. This is so also to ensure that the ERFLS terminals or smart terminals may be used also by conventional intermodal traffic.

Finally, ERFLS is a concept that applies to trains carrying any kind of intermodal transport units: containers, swap bodies, semi-trailers.

2.2 Objectives of ERFLS

The introduction of ERFLS as a new intermodal concept is intended towards the following objectives:

- Make intermodal transport by rail more responsive to customer needs and therefore advance the shift of freight transport to rail;
- Serve regions with a high-quality freight transport solution on tracks so as to further encourage the use of intermodal transport along the Rhine-Alpine Corridor and, as a prospect, along any other Corridor or trade lane equipped with railways;
- Provide the core of an integrated intermodal service with road-legs interfaced with the rail segment in an optimised way;
- Develop a new concept for intermodal freight trains with slots sold even shortly before loading;
- Improve the use of capacity of rail infrastructure, intermodal trains, and terminals.

2.3 Technical enabling factors

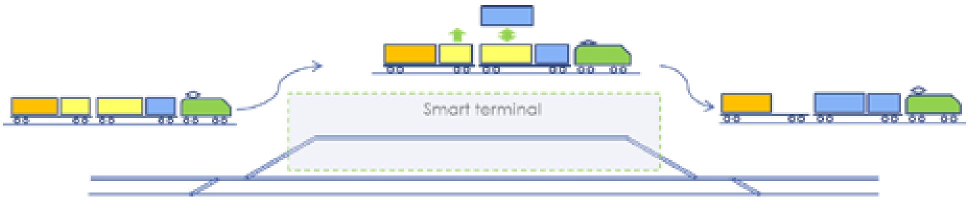
2.3.1 Smart terminals

There are some technical enabling factors for ERFLS that were identified before the beginning of the Action and were investigated in the work summarised in the present report: short (optimised) stays at terminals and a telematics layer linking ERFLS objects and operations. Both can be made possible with the implementation of smart terminals. At smart terminals the layout, the operations and the telematics are designed in a way that ERFLS trains can get in and out and load/unload intermodal transport units just like passenger trains have passengers getting on and off at stations. Smart terminals should not be terminals dedicated to ERFLS trains, but rather sections of terminals where ERFLS operations may take place.

2.3.2 Layout and operations at smart terminals

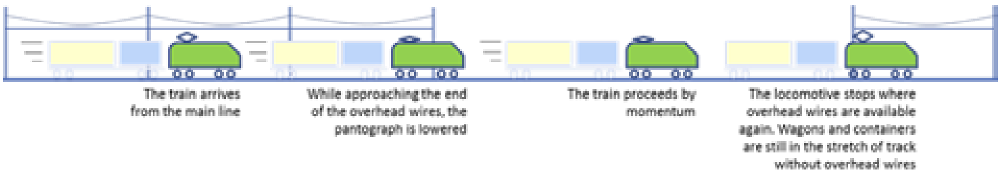
Ideally the layout of a smart terminal is similar to that of a passenger station: it is a through station so that trains can arrive and leave without changing direction and without shunting. There should be direct access from the main line to the sidings where loading and unloading of the ERFLS train takes place, and direct exit from that track to the main line. This is depicted in Figure 2.3 where the loading tracks for the ERFLS trains are in their ideal position: parallel and close to the main line. Figure 2.3 also illustrates the resemblance of smart terminals and through passenger trains stations where tracks to receive trains are accessible from either side from main line tracks. No shunting should be required and train dwell time at each terminal is reduced to 2 hours, as compared to 4-8 hours common today.

Figure 2.3 Ideally a smart terminal provides through sidings, and handling allows the main line locomotive to remain in the train composition



Since the preparation of the Action, momentum access of the loading/unloading sidings was characterised as a suitable procedure to enter and leave terminals thus avoiding shunting, and keeping the locomotive with the train, while handling intermodal transport units with cranes. In fact, together with avoiding shunting, keeping the locomotive with the train is one of the elements to optimise terminal dwell time. Momentum access is the procedure whereby a train hauled by an electric locomotive proceeds along a track with no overhead wires thanks to the momentum gained as it travelled until electric power was available. The train eventually stops at a target point where only the locomotive is again under overhead wires. The procedure is illustrated in Figure 2.4 which shows that, when momentum access is used at a terminal, the train travels normally off the main line, enters the smart terminal, reaches the end of electrified tracks without stopping, and places itself on a track with no overhead wires. The absence of overhead wires allows for safe operation of gantry cranes or reach stackers on the ERFLS train. Therefore, to enable momentum access the tracks served by the cranes need to have overhead wires at either ends but not in the crane working area. The momentum access is in operation in Wien Freudenau (Austria) and in the KTL terminal in Ludwigshafen (Germany).

Figure 2.4 The momentum access procedure



Keeping the locomotive with the train should enable partial brake testing procedures at departure so that, as soon as the loading operations are completed, the train is ready to go.

2.3.3 Telematics as a connecting layer

ERFLS telematics will enable information sharing and transactions among stakeholders. Each ERFLS train service will offer a set of on-board spaces for intermodal units. The telematics system will support real time sale of slots on trains between any pair of smart terminals, much in the same way as tickets for intercity trains are sold to passengers at ticket desks and via the internet. It will also possible to rent slots for ITUs on trains while they are travelling as long as there is time for the ITUs to enter the terminals and be loaded onto the trains. Information on operations at terminals and about intermodal units actually travelling or about to travel on trains, as well as trains' actual departure time will enable optimising operations at terminals, for road hauliers. Ultimately it will make intermodal transport more transparent and will improve the use of capacity provided on trains.

To make this possible all terminals, trains, ITUs and stakeholders need to be interconnected and share information in real time. Also, this exchange of information should be obtained with changes to existing practice and IT systems that are as limited as feasible, so that each stakeholder keeps their own system, suitable and tailored for their own needs. ERFLS will thus be supported by a communication tool that tracks all that happens on the system and is able to interact with the systems of each stakeholder without replacing them.

2.4 Corridors and network

The ERFLS Action was set-up along the Rhine-Alpine corridor since its design stage. Moreover, a liner freight train running to a regular timetable lends itself to implementation along a freight corridor. By extending the concept of ERFLS to more than a single corridor and including stops at gateway terminals, where ITUs may be moved from an ERFLS train along a corridor to an ERFLS train along other corridors, the concept may be readily extended to a network.

3 A selection of terminals along the Rhine-Alpine Corridor

The Action started by the initiative of several partners (see 1.1) among which two public bodies interested to develop their planned terminal in the form of a smart terminal. These planned terminals, RTG Valburg and Lahr, were therefore included in the case studies. However, to study the development of an actual system, also terminals entailing transformations were required along the Corridor.

A number of terminals were selected based on a set of criteria set by the technical coordination group of the Action and listed in Table 3.1. It was deemed important that terminals should have a minimum distance of 150-300 km between them to account for the typical economic distance of road haulage. The criteria served as guidelines and were not always fully met. A subjective estimation of the feasibility of terminals becoming smart terminals was required as part of decision making process.

Table 3.1 Selection criteria for case study terminals

Distance to corridor	Be nearby to the main railway tracks of the Rhine Alpine Corridor (suggestion: max 1 km perpendicular to the main tracks)
Drive-through possibility	Preferably have the possibility to drive through it, at least with limited adjustments only (small measures)
Track Length	Have appropriate track lengths for the line trains to load and unload. (suggestion: min 650 meter, preferably 750+; direct entry from the main railway track to the tracks under the crane)
Road-side connection	Have solid road-side connections, where extra traffic will not have large emission impacts on residents: high-capacity road access to the next motorway junction, without passing through residential areas
Spare capacity	Have spare capacity for the handling of the erfls trains
Potential space for growth	Have potential space for growth for container storage, etc. to allow the erfls to develop in a terminal
Handling time potential	Have potential for quick handling times made possible by cranes or multiple reach-stackers with short displacement distances
Multi-modality	A terminal should preferably be as multi-modal as possible (tri-modal, bi-modal) to allow for synergies in the freight transport network
Number of Corridors	A terminal should preferably be positioned on, or near, as many corridors as possible. A terminal with many corridor connections provides a good foundation for the long-term future erfls on multiple corridors (erfls network).

Based on the selection work and on availability by the terminals, the six terminals listed in Table 3.2 were finally chosen and are discussed in the deliverables of the Action. Terminals were involved in the Action by carrying out technical visits and interviewing the managers with the support of a questionnaire, and by getting back to them later on to ask for feedback on work developed during the Action. However, conclusions in this report are those of the Action's partnership and not necessarily those of the management of the terminals interviewed.

The two main ports at either end of the Corridor, Rotterdam and Genoa, are also very important in the ERFLS system. However, they are at the end of the line, and dwell times are not as important as they are at the terminals along the corridor. The train does not have to continue and resume its journey quickly, and shunting is inevitable as it must change direction. All freight will be offloaded at these dead-end terminals and later the empty train will be loaded for the other direction. The work was therefore focused on terminals along the Corridor. All the same, contacts with stakeholders in the ports were also established since their participation is necessary for the implementation of the ERFLS system.

Table 3.2 ERFLS case study terminals

Terminal	Corridors served
Valburg – RTG Valburg	Rhine-Alpine, North Sea-Baltic
Duisburg – Hohenbudberg Logport III	Rhine-Alpine, North Sea-Baltic
Ludwigshafen – KTL Kombiterminal	Rhine-Alpine, Atlantic
Lahr	Rhine-Alpine
Basel – Weil am Rhein	Rhine-Alpine
Novara	Rhine-Alpine, Mediterranean

Figure 3.1 Intermodal Terminal Structure on Corridor Rhine-Alpine (northern part of the Corridor) with the nodes selected as case studies

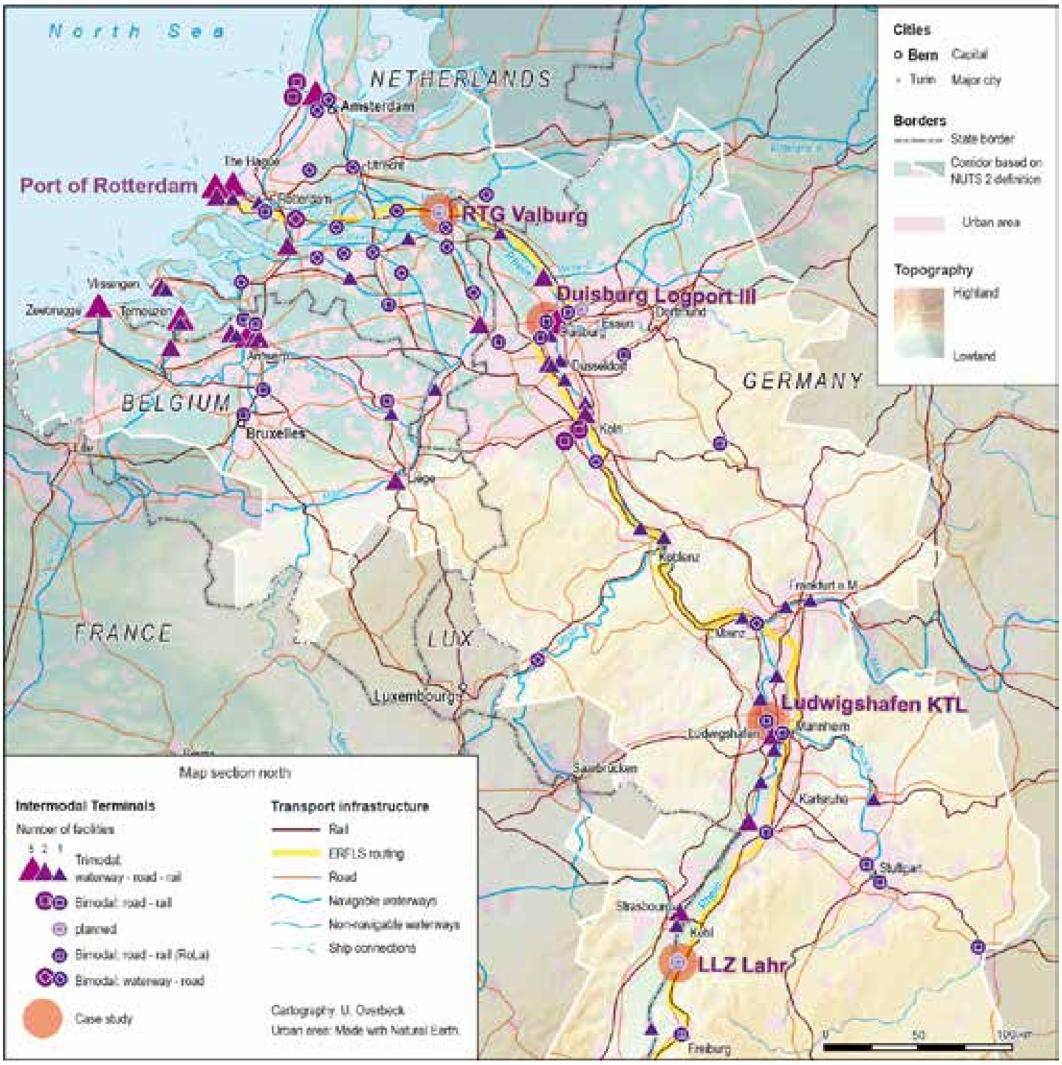
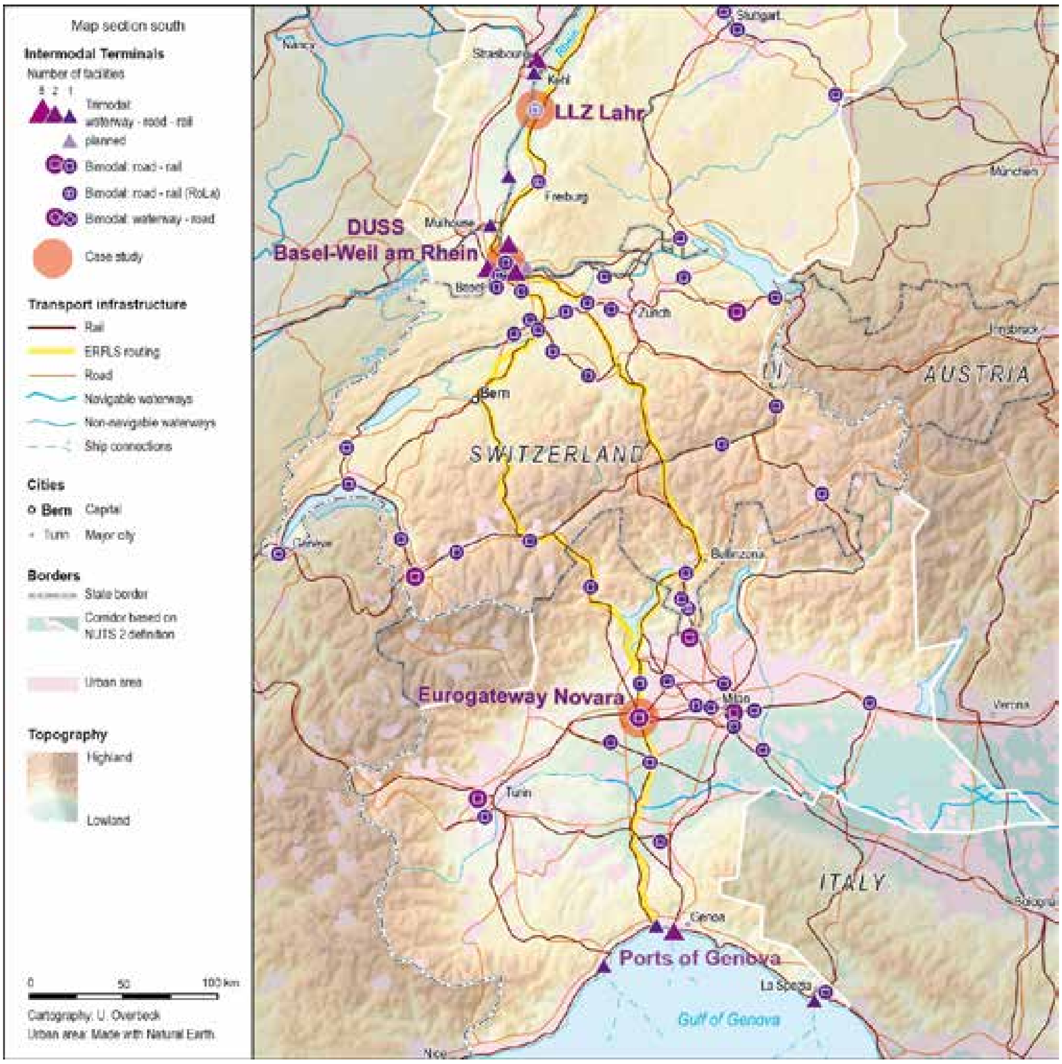


Figure 3.2 Intermodal Terminal Structure on Corridor Rhine-Alpine (southern part of the Corridor) with the nodes selected as case studies



4 Infrastructure, operations and telematics for ERFLS implementation

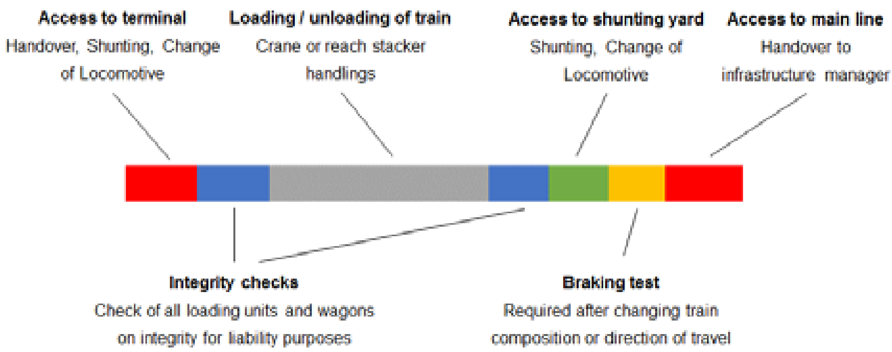
4.1 ERFLS infrastructure and operations

4.1.1 Optimisations to reduce dwell times

A smart terminal, as mentioned in chapter 2, provides infrastructure and operations to enable the operations of liner intermodal trains that, ideally, go in and out of the terminal within 2 hours. In more detail, the main characteristics of a smart terminal are:
- It provides access to the ERFLS;
- It has full conventional terminal functionality;
- It enables short dwell times of preferably 2 hours, and efficient handling of ERFLS trains;
- It provides for efficient handling of other (conventional) trains;
- It saves time and costs for terminal managers to make itself an attractive concept to invest in.

The basic concept of smart terminals is to shorten the dwell times of trains being unloaded and loaded. Therefore, the investigations carried out during the Action focused on the dwell time elements of an intermodal train stopping at a terminal as visible in Figure 4.1.

Figure 4.1 Dwell time elements of an intermodal train stopping at a terminal



During the technical visits to the case study terminals, lessons were learned about how to shorten dwell times using existing technology. The following key aspects can shorten dwell times significantly:
- Drive through terminals (not dead end);
- Momentum access both one-sided (as in Ludwigshafen) and two-sided (as in Vienna - Freudenau), allowing to reduce the access times and shunting to zero;
- Flowing-principle, optimization of track usage in terminals;
- Train gates (already planned at multiple terminals), which eliminate almost all manual checks in the terminal;
- Crane usage, since cranes are almost twice as fast as reach stackers;
- Automated Truck-Gates, to accommodate peak flows of trucks, which can occur due to the service pattern of ERFLS;
- Braking test not required or simplified when neither shunting nor a change of direction takes place.

It follows that an ideal smart terminal, required to accommodate ERFLS line trains, must optimise several elements. The following infrastructural and operational elements (sorted by dwell time components) are required for an optimal short dwell time smart terminal:

Reduction of access times:
- the possibility to drive through a terminal;
- the momentum access from both directions;
- no shunting for ERFLS line trains;
- train protection system on crane tracks and gantry crane;
- ownership of crane tracks by the infrastructure manager;
- electrified tracks from the main line to the terminal.

Reduction of times for checks and tests:
- train gates for automated checks;
- no or simplified braking test (due to train and locomotive remaining in the same composition and driving direction).

Reduction of loading and unloading times:
- use of gantry cranes;
- optimized handling algorithms.

Road-side adaptations due to peaks in truck flows:
- quick entry facilities;
- enough space for loading / unloading next to the crane tracks;
- accessibility of the terminal (capacity of access roads).

Further remarks:
- storage of loading units;
- capability of handling broken wagons;
- capability of handling shuttle trains with change of direction.

Existing terminals are likely not able to implement all of the elements above because of local preconditions, but they can still carry out optimisations to reduce dwell times by implementing only selected elements. In Chapter 5 of this summary report and in Milestone 3, the individual and suitable measures for each case study terminal are determined with their costs.

A terminal handling ERFLS line trains must also be capable of handling regular shuttle trains. Therefore, it is not necessary to adapt all terminal infrastructure and operations to function in the ERFLS system. It is also not recommended to reduce infrastructure in a way that specific functionalities of a terminal are eliminated. For example, a shuttle train needs to change direction in a terminal, this requires the possibility to shunt, which requires a diesel locomotive. Another issue is handling broken rolling stock (damaged wagons). To remove these from line trains, shunting and spare capacity on a track are required, just like in conventional terminals. It is imaginable that terminals only adapt a certain amount of the crane tracks for ERFLS use and leave existing facilities and infrastructure as they are. Such a hybrid terminal allows to have the benefits from both smart and conventional terminals.

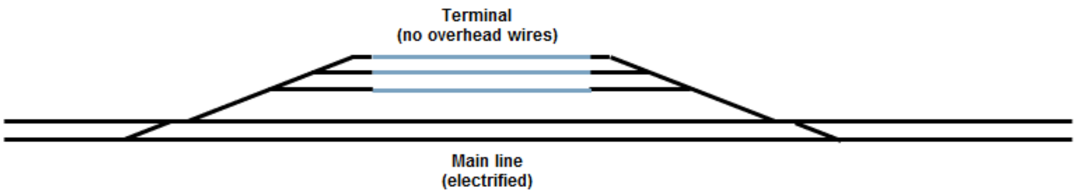
4.1.2 Focus on momentum access

The conventional way for a combined transport train to enter a terminal is by several shunting moves. Also, leaving the terminal requires the same process in reverse and the same amount of time. Momentum access and direct exit would obviate time consuming shunting movements. Also, since the composition of the train does not change (though its weight might change) a braking test is not required or is required only in a simplified form.

Momentum access was described in section 2.3.2 of the present report. It should be added that with momentum access it is crucial for the train driver to stop at exactly the right point, where the overhead wires start, at the end of the crane track. If the train drives too far, the first loading units cannot be unloaded by the crane or reach stacker. This can easily be corrected by the train driver, by driving the train backwards until the right position is reached. In case the train stops too early, problems arise, as the train stands still without a power source. Here assistance from an external power source in the form of a diesel locomotive from a nearby yard is necessary.

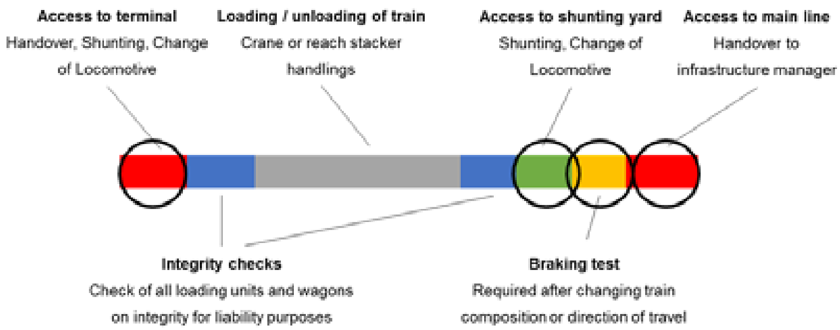
With the layout in Figure 4.2 the momentum access may be used from both directions and, similarly, direct exit is possible in both directions. The terminal can therefore be quickly accessed and left from both sides.

Figure 4.2 Drive-through momentum access. The blue track segments are non-electrified as they should be accessible by a crane. The black track segments are electrified (main lines, and access to the terminal)



With a terminal layout such as the one in Figure 4.2, the dwell time elements circled in black in Figure 4.3 can be eliminated by implementing a fully functional drive-through momentum access.

Figure 4.3 Dwell time elements eliminated by a fully functional momentum access



In Ludwigshafen (KTL), the momentum access is used in daily operations, but the terminal cannot be operated as a drive through one, due to restrictions of the local chemical plant. This form of momentum access only reduces the access time to the terminal. To leave the terminal, shunting movements are required, just as in the conventional terminals. This system is still beneficial for terminals which are not able to become a drive through terminal. This form of momentum access has the same benefits for both shuttle trains and ERFLS trains as both train types require to change driving direction. This means they still need a braking test before driving on the main line.

Figure 4.4 Dead-end terminal with shunting possibility. The blue track segments are non-electrified as they should be accessible with a crane. The black track segments are electrified (main lines, and access to the terminal)

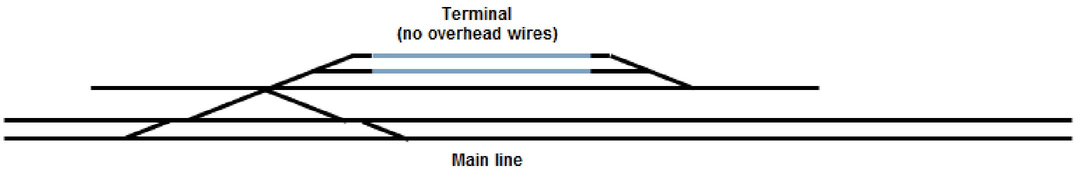
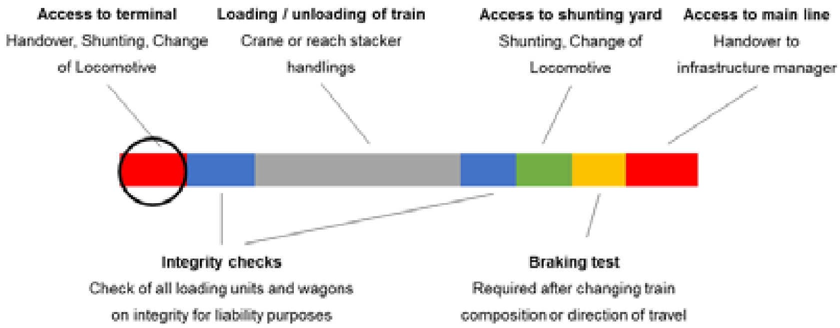


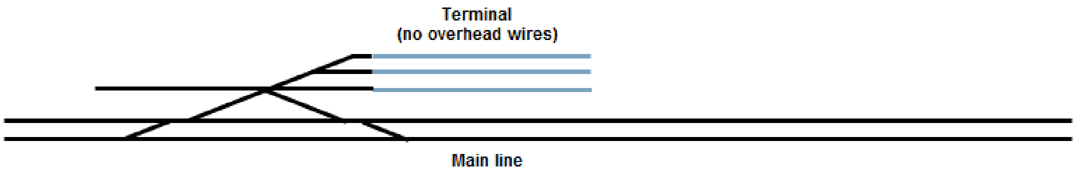
Figure 4.5 Dwell time elements which can be eliminated by implementing a one directional momentum access in a dead-end terminal



A third possibility for the use of momentum access is in a full dead-end terminal without any shunting possibilities. Entering the terminal would still require the same time as the two options described above. A large disadvantage, however, is the fact that the locomotive is now locked in the terminal by its own wagons. Whilst loading and unloading, the locomotive cannot be used and remains attached to the rest of the train. After loading and unloading, the entire train needs to be pulled out of the terminal, before continuing its journey.

For some terminal layouts (also for those with shunting possibilities) the process described above is even more favorable than driving the locomotive to the other side of the train. This is so especially when the train continues in the same direction. Since the train composition stays intact, at departure only a reduced braking test is required. The dwell time benefits are similar to the previous variant.

Figure 4.6 Dead-end terminal without shunting possibilities. The blue track segments are non-electrified as they should be accessible with a crane. The black track segments are electrified (main lines, and access to the terminal)



For the use of the momentum access several requirements must be met:

- **The terminal tracks need to be protected by a train protection system**
  Trains do not enter the terminal as a shunting movement but as a train movement. This prohibits train drivers to drive on sight which means train protection in the terminal is required.
- **Also the crane must be part of interlocking system, to protect trains in the terminal**
  Because the crane can handle loading units on places where trains drive with a train movement, the movements can theoretically interfere. This means that also the crane must be embedded in local interlocking systems.
- **Tracks must be owned by the infrastructure manager**
  Because of the direct access between main line and terminal, combined with the fact that train protection is in place within the terminal, the infrastructure must be owned by the infrastructure manager.
- **An intensive relation between the infrastructure manager and terminal manager is required.**
  As the tracks are owned by the infrastructure manager and the terminal is operated by the terminal manager.
- **Full benefits concerning dwell times are achieved with a drive through terminal**
  Because whilst leaving a terminal, the most important time savings can be realized both by eliminating shunting and by eliminating or simplifying the braking test.

Electro-Diesel locomotives may be indicated as an alternative to momentum access. However, there is no last-mile-diesel version available on the market with the capability to drive in all the Countries of the Rhine-Alpine Corridor. Only for the German, Swiss and for the dedicated freight tracks in the Netherlands such a locomotive is currently available.

Moreover, it is important to highlight that the momentum access is not a standard feature of terminals nowadays and is only known in Germany and Austria. Rules and regulations for direct access into terminals in other systems and with ERTMS level 2 equipped lines need to be developed.

4.2 ERFLS telematics

From the outset of the Action it was clear that the IT tool should be a key element enabling the ERFLS concept. Telematics is intended to link all pieces of information on the elements of the ERFLS chain: intermodal units, slots they occupy, trains, cranes, terminals, trucks, as well as managers, commercial departments and customers.

There is a large number of stakeholders directly involved in ERFLS. Those closer to the transport operations such as MTOs, combined transport operators, railway undertakings, terminal operators -and, when needed, shunting operators- should all have direct access to the ERFLS IT tool, each working only on the part of the information that is directly relevant to them (i.e. on a need-to-know basis). The key point of the IT tool is to track trains, slots, and intermodal units (be they ITUs on trains, on terminal yards, or booked for arrival) and do so in real time, sharing the information across stakeholders. In that way, the whole ERFLS system comprising its stakeholders, may know about operations occurring in each part of the system, as long as that information is part of what concerns and is useful to each stakeholder. Operations at terminals become more efficient with early visibility of what is arriving or of what may actually depart and when. Moreover, tracking availability of slots and situation of ITUs enables booking slots in times as tight as terminal gate-in and loading operations allow. This supports booking of transports also while a train is already travelling, provided it is still far enough from the next terminal to allow for admission and loading of the ITUs to be organised.

Visibility of ITUs managed by MTOs and intermodal operators may also be passed on to their clients (shippers or consignees) thus enhancing transparency and reliability of intermodal rail.

Different types of stakeholders were asked about present operations and telematics in intermodal rail, and the key requirements for ERFLS telematics resulted:

- Enable real-time bookings of slots on trains.
- Ensure real-time and reliable visibility of trains, slots, ITUs on trains, in smart terminals as they are handled or are in the yards, at entrance and exit of terminals.
- Ensure real-time and reliable visibility of bookings.
- Continuously interact with the local TOS at terminals to exchange information about the items above.
- Enable visibility of the items listed at 1, 2, and 3 only to authorised parties.
- Enable authorised parties to obtain detailed and summary performance data.
- Where there is no TOS able to exchange the information listed at 1, 2, and 3, enable the sharing of such information.
- Be fully customisable at any time in terms of local procedures, local organisational structure, local access to different operators, data exchange, display, and reporting, so as to meet the possibly changing needs of the different stakeholders.

The system will not replace terminals' TOS: it will be integrated with them thanks to a continuous information exchange manager.

ERFLS requires relaying and storing data across several stakeholders at several locations, far apart from one another. To ensure constant, fast and secure data flows, ERFLS has been defined as an enterprise system based on actual intermodal terminals divided IT-wise in Control Towers and Satellites. Those are defined as follows:

- Two control towers, where the ERFLS IT system will interact with the local TOS and with the central ERFLS system. The central ERFLS system will be hosted at control towers that will also host the databases (a main one and two back up ones, considering six smart terminals). Equipment and data will be perfectly replicated and aligned across control towers. Moreover, from control towers, ERFLS will exchange messages with the TOS at the terminals and monitor system's performance, triggering alerts in case of need.
- Satellites, where the ERFLS IT system only interacts with the local TOS and with the central ERFLS system located at control towers.

Selected control towers are Duisburg (main control tower) and Novara (back up control tower) and were characterised based on connectivity, existence of an internal ICT service, their location in different countries so that telecommunications providers are different as well as elaboration speed, storage capacity, safety and security.

In order to identify precisely data location and responsibilities about their integrity and security the system will not rely on the cloud. Data will travel via fibre optics backbones and will be stored at control towers. Operational and service data flows will work autonomously and separately. The development of connectivity requirements for each terminal indicated, among other elements, the need for two separate connections with the fibre optics infrastructure, a main one and a back-up one (with different specified speeds), managed by different companies (Table 4.1).

Table 4.1 Requirements for the connectivity of smart terminals along the Corridor

Type	Description	Required standard
Backbone	Fibre optic availability in the area	Max 20 km from the terminal
	Maximum available speed	Up to 1 Gb
	Minimum available speed	100 Mbs
	Minimum dedicated ERFLS speed	50 Mbs

The ERFLS IT has been envisaged as working on a set of databases (with the registries of all the items forming the system) and relying on exchanging status messages of the type developed for EDIGES. EDIGES was developed by HUPAC S.A. and has been characterised by the UIRR (International Rail Road combined transport Union) as the European standard for messages to obtain EDI integration among intermodal transport operators.

Status messages are xml messages intended for EDI and containing all the information required to describe the completion of an operation, the sender, and the consignee of the message. The following status messages have been considered for use in ERFLS, thus will be exchanged in ERFLS and made available via its interface:
- Booking
- Gate-in
- Check-in
- Loading forecast
- Train loading
- Closing of train loading
- Train departure
- Consignment note
- Request transport status
- Transport information
- Time collection
- Train/Wagon transit control
- Train arrival
- ITU Ready for pickup
- ITU Pickup, Gate-out

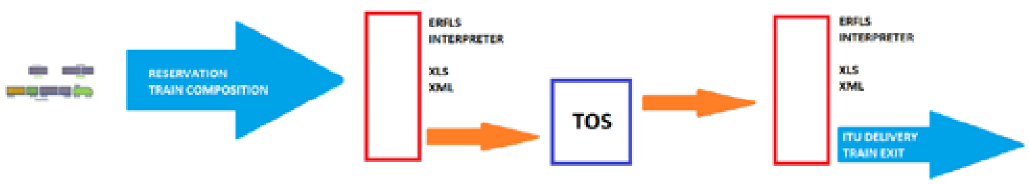
As an example, the closing of a train loading is a precious pre-information for downstream terminals to organise their operations, while the train departure status (and the consignment note) enables the user to have the certainty that their ITUs are actually on a train, and to do so in real time.

The ERFLS IT system is to be web-based and hosted on machines that are separate from those already at the participating terminal and will be adapted to exchange information with the different TOS by using the EDI features of each.

Linking with terminals own TOS, an ERFLS tool supplied to the terminal will transform the information supplied by the TOS into files with a format usable by ERFLS and the other way around, so that information may be exchanged between terminals and control towers. The ERFLS local tool will therefore be an interpreter between the ERFLS format and that of the TOS used by each terminal. In this way terminals will not need to use a new software and will be able to include the ERFLS information in their existing terminal software platforms (Figure 4.7).

External operators (hauliers, MTOs, forwarders) will see the ERFLS system as a platform allowing them to access the services supplied by the ERFLS terminals as shown in Figure 4.8.

Figure 4.7 The ERFLS tool supplied to the terminals will act as an interpreter between the status messages used by ERFLS and the format used by the local TOS so that terminals will not need additional software to be part of the system except for the ERFLS tool



Work on the ERFLS tool was also carried out by using mock-up GUI screenshots as exemplified here in Figure 4.9 which depicts the ERFLS dashboard with the ERFLS drop-down menu open. This allows to monitor or carry out directly the function immediately relevant to the operations of ERFLS. Not all functions are visible in the picture: for instance the "operation monitor" allows opening the gate-in/gate-out menu and the tracker/launcher of the tasks to place ITUs on yards or directly on trains. Further, the "planning" item opens an interface to monitor the progress of different activities according to sequences of statuses, which may be: booked / launched / ongoing / finalised / on hold / cancelled. The "train monitor" allows visualising arriving and departing trains and operations planned on them, or plan them directly. The "interactive map" shows all ITUs and equipment in terminals.

Moreover, looking at the other drop-down menus, the "records" menu is to set up the users and their operating rights. The "objects" menu allows showing, populating and amending the databases on which the system works. The "set up" menu is for the system administrator to customise the interface to the operations at each terminal. The "support functions" menu is for the system administrator to configure the visualisation of the system and some of its features.

Figure 4.8 Access to the ERFLS system by external users via web portal and functions available

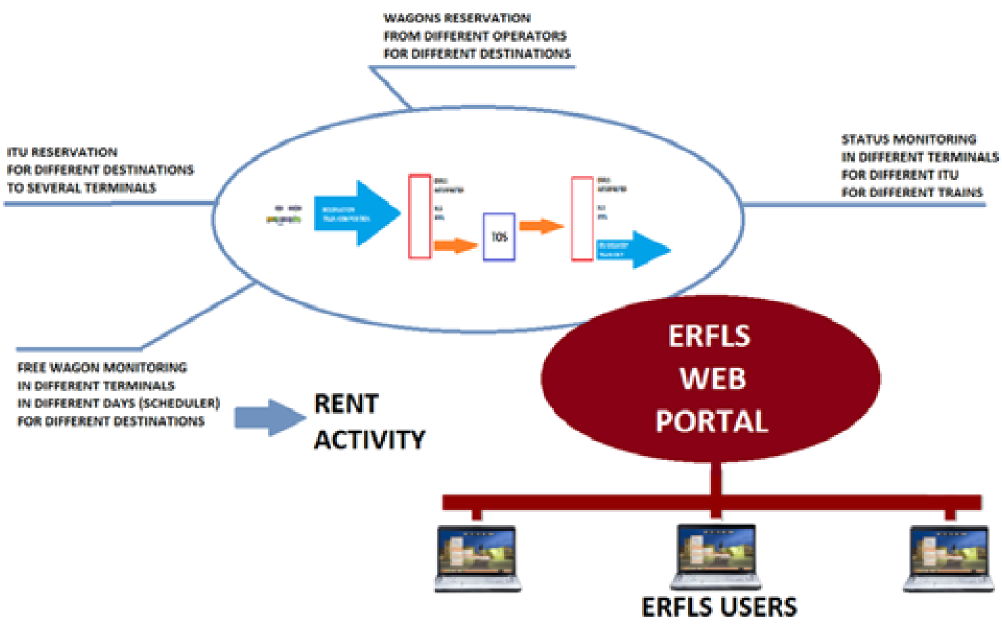
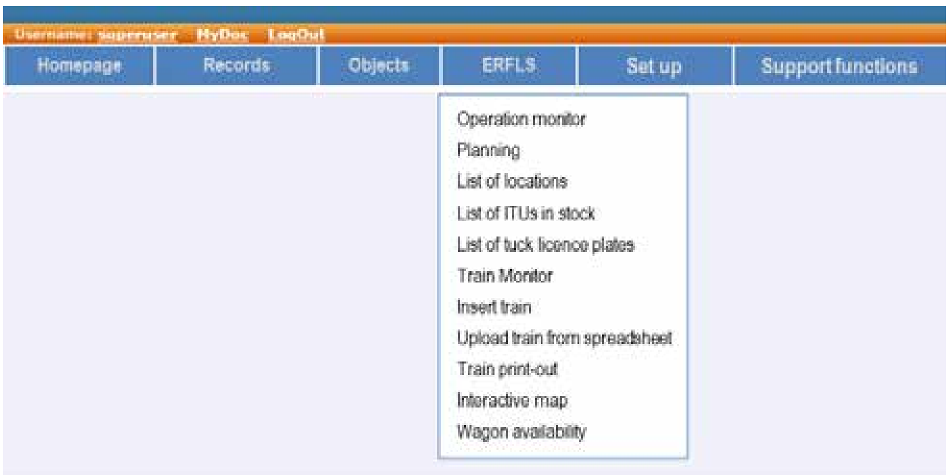


Figure 4.9 The ERFLS menu on the ERFLS mock up GUI



In chapter 5 the times and costs for the implementation of the ERFLS system have been estimated with actual commercial products in mind, so as to provide relevant figures, that will possibly need updating at time of implementation. It is noteworthy that there are limited differences between the costs to set up the telematics system at control towers and at smart terminals, since the equipment is very similar, the main difference being the presence of a second host and of disaster recovery system at the control towers.

4.2.1 The slot rental platform

A note is in order concerning the slot rental platform, which would be used to sell slots for ITUs on ERFLS services. The Action is mostly devoted to the technical design and the evaluation of ERFLS and does not elaborate on the issue of the governance of the ERFLS system. One of the points left open is about whether the ERFLS IT platform should relay the data that enable the sale of slots or carry out slot sale transactions directly.

The approach taken is that the actual transactions should occur via the commercial platform of the operator or operators running ERFLS, while the ERFLS IT platform carries out a neutral role distributing information to suitable stakeholders and enabling transactions much in the same way as the CESAR platform does with success for conventional intermodal traffic.

4.2.2 Benefits of the ERFLS telematics component

Table 4.2 contrasts the overall aims that each stakeholder has when choosing a transport system and the functionalities provided by ERFLS so as to characterise the benefits that each stakeholder may obtain from the ERFLS telematics system.

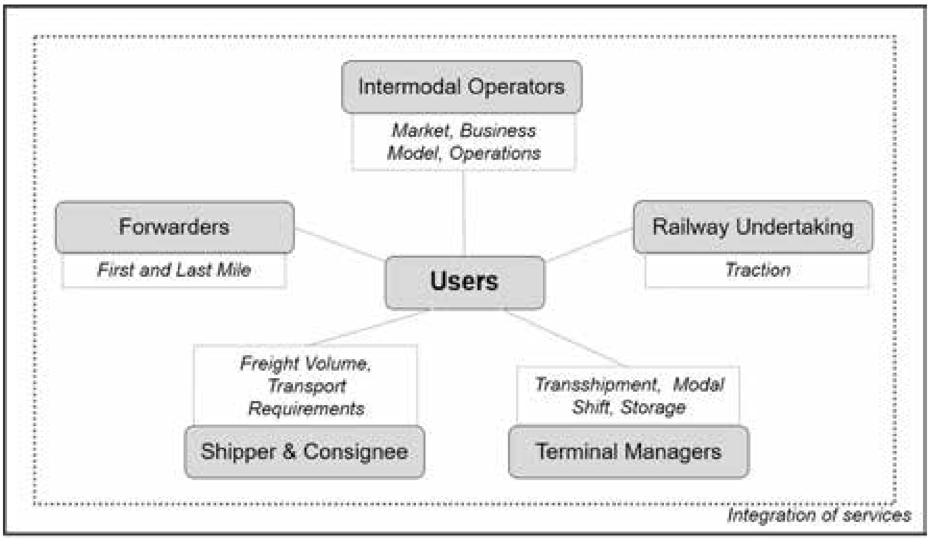
Table 4.2 Key features of the ERFSL system contrasted with the aims of stakeholders so as to show which features allow the stakeholders to reach which aim

ERFLS features	Visibility to shipper and consignee	Provide reactive service	Improve transport reliability	Favour exchange market among operators	Improve load factor of consists	Efficient road ops as for trucks time occupations	Improve utilisation of trucks	Improve adherence to train timetable	Reactive work in terminals	Optimise terminal work - Rail side	Optimise terminal work – cranes	Optimise terminal work – yard	Opt imise terminal work - Entry/exit management	Close comms gaps	Advance info to Customs
Real time tracking of slot availability on trains		•		•	•						•	•			
Real time slot sale enabling				•	•										
Advance transmission of train composition (wagons+ITUs)		•				•	•				•				
Transmission of e-consignment notes														•	•
Real time transmission of ITU status	•	•	•		•		•		•		•	•	•		
Real time tracking of train status	•						•	•	•	•	•	•		•	
Real time terminal activity monitoring		•						•		•	•	•	•		
Interactive terminal map										•	•	•	•		
Interface customisable on terminal layout/ organisation/management			•						•		•	•			
Compatibility with third party software (e.g. info upload from spreadsheet)					•									•	

4.3 ERFLS exchange platform

The study of the ERFLS concept included a review and an evaluation of freight exchange platforms. The work was carried out referring to existing platforms that derived from the Interreg CoDe24 project, located on the Rhine-Alpine Corridor as well. The aim was to understand how the market adapted to the platforms and what guidelines could be provided to stakeholders to establish intermodal interconnection possibilities on the Rhine-Alpine Corridor. Users that would benefit from a freight exchange platform are illustrated in Figure 4.10, along with their roles. The final customers (consignors, consignee) are not involved. The work in the Action noted that the traditional actors' structure is changing with actors taking up roles previously supplied by others.

Figure 4.10 User groups of ERFLS freight exchange platforms



Online freight exchange platforms are meant to avoid empty rides by facilitating better utilisation of existing capacities (less empty wagons). Communication flows between -for example- forwarders and railway undertakings are made easier.

Once ERFLS has reached market maturity it can be integrated into an online freight exchange platform. As a first step, a uniform erfls sales channel should be established. It could resemble a passenger train platform with booking functions:

- booking shortly before transport;
- offer of door-to-door transport (pre- and post- haulage trucking);
- all ERFLS relations are available;
- information about prices;
- information on General Conditions;
- exchange or cancellation of slots or reservations;
- load status, tracking & tracing and information on back-up transport solutions in case of unforeseen events e.g. delay.

In a later phase of the implementation, additional services could be added to produce synergies and foster modal shift. For example, with the help of algorithms, matchmaking between geographically near customers with small transport volumes could be made to bundle their cargo.

CESAR is an example of a platform close to the one indicated by the findings. Results warned about platforms that refer to rail transport only, where rail would be the main part of intermodal transport. Instead, they should be presenting users with options over whole transport chains. In fact, the two intermodal platforms set up following the CoDe24 project had limited success, and did not reach a critical mass of transactions, so that one was recently shut. The sustained success of a platform concerned with barge transport linked to one of those just mentioned highlighted the dissimilarities between markets that make the difference to the success of a platform to match transport capacity and goods requiring transport. Barge transport includes thousands of operators that pressed their customers to take up the platform and keep using it. Rail transport is characterised by a limited number of operators, that do not aim to publicise cost structures, operations and clients, and typically finalise large contracts off the platform.

Building on the willingness of terminals to increase their capacity utilisation and relieve congestion (both possible with the ERFLS concept), and urging them to collaborate with other terminals, the platform should include rules and regulations to coordinate the bookings per relation and per customer. This aims also to avoid that highly frequented relations will be overbooked thus preventing to load further consignments because the train is already full. This is also in the direction to allow small and medium enterprises (with small quantities to ship) to benefit from intermodal transport instead of using truck only transport.

5 Preparing the implementation of ERFLS along the Rhine-Alpine Corridor

5.1 Introduction

This chapter summarises work on the infrastructural and operational changes required for the implementation of ERFLS that were detailed in Milestone 1, Milestone 2, Milestone 3 along with a concise account of the results of the work on the implementation of the telematics component of ERFLS, developed in detail in Milestone 7 and Milestone 8. The sum-up of the technical results is completed by the summary of the results of the regional market evaluations reported in Milestone 6 and of the socio-economic evaluations elaborated in Milestone 9.

The next sections of this introduction report the base information on the methods employed to obtain the results summarised in this chapter, which are then reported organising the discussion by terminal.

A final section of the chapter illustrates the key results of the work towards Milestone 5, which discussed the possible timetabling of an ERFLS train covering the whole Rhine-Alpine Corridor.

5.1.1 Method for the cost estimates of infrastructural changes

Infrastructural change options described for each terminal were developed based on a set of possible measures characterised after the technical visits and detailed in Milestone 1. The Action carried out a wide survey to obtain Country-specific cost rates for each possible element used to implement the measures which is reported in Milestone 2. As a basis for estimating the costs of infrastructure measures per terminal, a "country-specific measures-catalogue" was compiled. In this catalogue, cost rates were compiled specifically for various measures and differentiated for the countries Netherlands, Germany, Switzerland and Italy. The following Table 5.1 shows an overview of the infrastructure measures at which cost rates were given for the four countries. In addition, unit cost rates for estimation of changes of operational processes have been compiled (shunting costs, traction costs, wagon costs and terminal operating costs).

The costing of the infrastructural options mentioned in the following is obtained using those cost rates, but it should be remarked that, at this stage, they are rough cost estimates since they have an accuracy of ± 50%. They are therefore to be understood as an initial assessment of the order of magnitude of the costs.

Table 5.1 Overview of measures for which Country specific cost rates were collected

Property / Parcel

Value of the property

Agriculture zone

Commerce and industry zone

Residential zone

Preparation

Demolition measures
- tracks
- switches / points

Remediation of contaminated sites
- inert or reactor materials

Preparation of ground surface
- Clearing of bushes
- Clearing of single trees

Ground construction

Embankment
- construct an embankment, including slope stabilisation

Terrain cut
- dig a terrain cut, including slope stabilisation

Drainage
- Drainage including collector tube and stand-pipe

Sub-layer / grade protection layer

Superstructure

Tracks
- Track including sleeper, rail, fastening and ballast

Switches / points / turnout
- Single turnout (radius 190...500m, speed 40...60 km/h)
- Single turnout (radius 760m, speed 80 km/h)
- Diamond crossing with a single slip (radius 190...500m)
- Diamond crossing with double slip (radius 190...500m)

Buffer stop

Supporting structure

Supporting structure (height 1m)

Supporting structure (height 2m)

Supporting structure (height 4m)

Supporting structure (height 6m)

Supporting structure (height 8m)

Bridges

Overpass rail bridge

Overpass road bridge

Culvert for small river

Control command and signalling technology

Signals
- Signal unit
- Signal unit: Integration in signal box

Switches / points / turnout (integration in signal box)
- Turnout unit (singe turnout 190-500)
- Turnout unit (singe turnout 760, diamond crossing)

Automatic train control
- Automatic train control, main line

Level crossing
- level crossing with barriers
- level crossing with flashing lights (no barriers)

Gantry crane
- mIntegration gantry crane in signal box

Contact line / catenary

Contact line/catenary on open track

Contact line/catenary in stations

Sectioning point

Ground surface

Planting (at slopes)

Paved surface

Pavement for shunting staff

Roads
- asphaltic surface (normal requirements)
- concrete surface (increased requirements)

Square
- asphaltic surface (normal requirements)
- concrete surface (increased requirements)
- concrete surface for reach stackers (mobile cranes)

Surface for leakage

Storing position for containers/swap bodies

Technical installations

Air technology systems
- Installation for brake test

Installations for high current-circuit
- Electric cable conduit and cables
- Illumination system (lamp pole etc.)
- Points heating

Telecommunication facility
- Electric cable conduit and cables
- Installations for radio communication
- Installations for video surveillance

Other installations
- Train Gate (detection of wagon no. and container no.)

Conveying system

Gantry crane
- Crane runway (include two tracks)
- Gantry crane (40m)
- Gantry crane (50m)
- Gantry crane (60m)

Transfer table
- Transfer table (3-4 tracks)
- Transfer table (5-6 tracks)

Additional costs

Auxiliary costs

Unforeseen

Unforeseen

Planning costs

Planning costs

5.1.2 General IT activities and method for cost estimates for the telematics facilities

The development of the ERFLS IT system entails the development of the different parts of the software and the deployment of the system at the terminals.

Milestone 8 "Telematics Action plan" described the activities to develop the software, which can be summarised in three parts:

- Analysis of the project;
- Phase 1: comprising creation of a ERFLS SQL DB (tables, queries), development of the traffic management and the wagon rental user interfaces, and report creation.
- Phase 2: entailing ERFLS code development, development of XML messages, Development of connection rules and control monitor, development of the EDI software.

The development activity requires about 270 calendar days and a first estimate of its costs amounts to € 1,169,360. This cost as well as those of the deployment activities were obtained by considering average European costs of the professionals requested.

Once the development work is finalised, it will be possible to implement the ERFLS system at the terminals. The deployment of the ERFLS IT system entails some preliminary work to prepare the set-up. It is necessary to source and provide the necessary hardware, characterise the transmission protocols to enable the data flows as well as the software for the alignment between databases at control towers. Then, the software is installed and a first test period is performed only on internal operations, followed by a second test period focused on EDI transmission to external parties.

Once the tests are successfully completed, there will be a pre-production period during which the system will be tested with real data and with real external third parties. Only after the successful finalisation of the pre-production period will it be possible to proceed to the acceptance of the system and to its use in production. Those operations are illustrated in Figure 5.1 and will be carried out at each terminal.

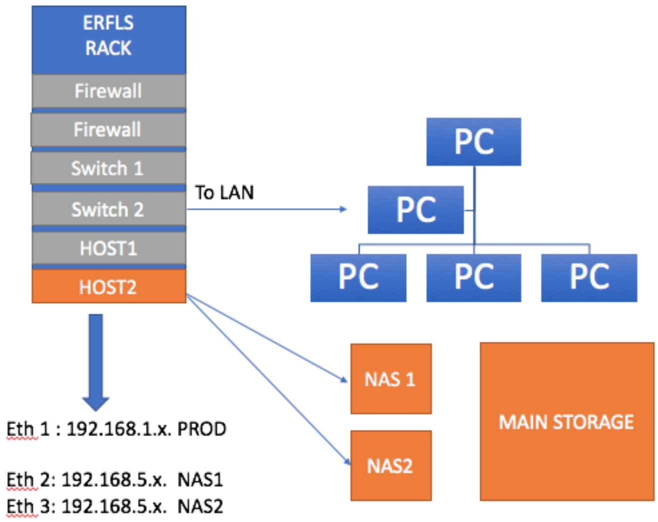
Figure 5.1 The sequence of steps for setting up the ERFLS telematics system at the terminals, from component installation to system commissioning

Once the IT at each terminal is accepted, local operational and IT staff will undergo the relevant training. Operational staff will be provided with the know-how required to manage the ERFLS traffic through the system (bookings, deliveries, trains, etc.). IT staff will be provided with training to keep the system efficient with planned maintenance operations and, in case of anomalies, with suitable prompt actions.

Control towers need to be equipped with two HOST machines on which the servers required for the ERFLS system may be virtualised. At satellite terminals the equipment will consist of a single physical host server. At each smart terminal, if at all possible, the ERFLS equipment will need to be accommodated in rack cabinets that are separate and independent from other IT equipment. The ERFLS rack cabinet will contain UPS, switches, firewalls and hosts. The data storage management foreseen is depicted in Figure 5.2. Actual components are specified and costed in M8 "Telematics Action Plan".

Software was characterised so that it is stable and offers the possibility to manage the whole system from a single dashboard, also as for concerns regularity of back-ups. The "Telematics Action Plan" (M8) characterises the operations system, the back-up system, the antivirus system and provides their estimated costs. The same report provides details and costs of the operation system for the virtual machines to be set up on the hosts, comprising production and test servers for the ERFLS application, production and test database server, security server and market server (the latter to enable operations on the platform to rent slots/wagons). The following sections report summary aggregate information on such systems.

Figure 5.2 Data storage management



5.1.3 Regional market analysis

The regional-economic evaluation for each terminal was based on characterising their catchment areas. Data were obtained from Work package 3 of the German Federal Transport Plan (2014) where transport volumes of all modes except for pipelines were modelled on NUTS3 level in Germany and NUTS2, NUTS1 in other European countries. Local statistics and sources were additionally used. The modelled data were aggregated at Corridor level to project transport volumes in the supra-regional terminal catchment areas.

The regional market analysis is reported in detail in Milestone 6 and was finalised with an assessment of the market quality for each terminal and of the effects at the local and regional level whose summaries are reported in the following paragraphs for the relevant terminals.

5.1.4 Socio-economic evaluation

The socio-economic evaluation was carried out by observing parameters describing the development of the areas around the ERFLS terminals and parameters describing the performance of the terminals, in either the current situation, the base scenario without ERFLS, and with the ERFLS in operation (ERFLS scenario).

By using methods pertaining to multicriteria analysis, the investigation developed for each terminal area and each scenario a Key Development Indicator (KDI) and a Key Performances Indicator (KPI). Each comprises a number of elements whose weights were derived from a desk analysis and from interviews with stakeholders.

Elements contributing to the Key Development Indicators (KDI) describe the geographical, social, economic and administrative context of a terminal's catchment area and are mainly statistics. Catchment areas used in this analysis are described in Table 5.2. Elements contributing to the Key Performance Indicators (KPI) were obtained from the "Smart Terminal Handbook" (Milestone 1) and from the terminal managers who provided information useful to define the clusters and the elements defining the two scenarios. The terminal managers also provided information on terminals' size and equipment, operations and dwell time, ICT as well as freight volumes; then the "Terminal specific investment plan" (Milestone 3) and the "Environmental study" (Milestone 10) allowed the definition of the value of some variables in the smart hub Scenario.

The findings of the socio-economic evaluation were also summarised in SWOT analyses which are reported in the following sections 5.2 to 5.7, each of them dedicated to a terminal.

Table 5.2 Planned terminals and their catchment areas considered for the socio-economic evaluation

Terminal	NUTS2	NUTS3 (catchment area)	Conventional name of catchment area
RTG Valburg	Gelderland (NL)	**Arnhem/Nijmegen**	Arnhem/Nijmegen
Intermodal terminal Logport III	Düsseldorf (DE)	**Duisburg**, Krefeld, Düsseldorf, Wesel, Oberhausen, Mülheim	Duisburg
KTL Kombi-Terminal Ludwigshafen	Rheinhessen–Pfalz (DE) Karlsruhe (DE)	**Ludwigshafen am Rhein**, Frankenthal, Speyer, Rhein – Pfalz Kreis, Mannheim	Ludwigshafen am Rhein
Lahr	Freiburg (DE) Alsace (FR)	**Ortenaukreis**, Rottweil, Emmendingen, Schwarzwald, Freudenstadt, Baden - Baden, Rastatt, Bas Rhin (FR)	Ortenaukreis
DUSS Terminal Basel - Weil am Rhein	Freiburg (DE) Alsace (FR) Nordwestschweiz (CH)	**Lörrach**, Waldshut, Breisgau – Hochschwarzwald, Freiburg in Breisgau, Haut Rhin (FR), Basel Stadt (CH), Basel Landschaft (CH), Aargau (CH)	Lörrach
CIM Novara	Piemonte (IT) Lombardia (IT)	**Novara**, Vercelli, Verbano Cusio Ossola, Milano, Varese, Pavia	Novara

5.2 RTG Valburg

5.2.1 Base information

Rail Terminal Gelderland (RTG) is to be developed from a section of a disused container train interchange point (Container Uitwisselpunt) located along the Betuwe line, near Valburg (see Figure 5.3). The Province of Gelderland and the intended terminal operator (DERT Dutch European Rail Terminals b.v.) are now planning a layout with 3 tracks north of track 721 of the container interchange point (see Figure 5.4). The new intermodal terminal will be connected on both sides to the sidings of the train interchange facility, which in turn is connected at both sides to the main line (the Betuwe line). The key data about RTG Valburg are summarised in Table 5.3.

According to current plans, direct entrance and direct exit of trains are not possible since the new terminal is not connected to the interlocking system and trains need to leave or re-enter ERTMS procedures as they approach or leave the new terminal. This needs to happen on the track of the present train interchange and brake tests are required. Tracks entering and leaving the terminal would be electrified and there will be train gates. Gantry cranes and optimised handling algorithms will be in place. Road-side, there will be quick entry facilities. RTG is very strategically placed near a major highway intersection and not far from an inland port.

According to the project management and the DERT consortium, RTG it shall go into operation in 2022.

Figure 5.3 Planned intermodal terminal Valburg (near Arnhem and Nijmegen), location on the rail network

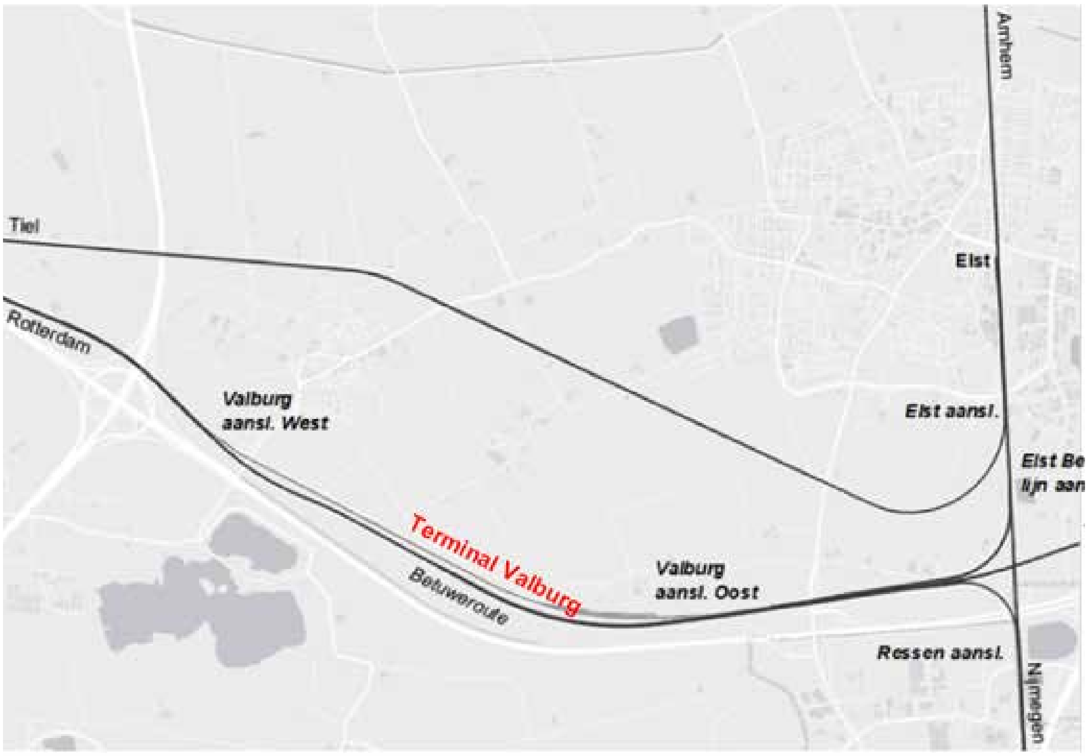


Table 5.3 Planned intermodal terminal Valburg, key figures

Area	80.000 m²
Expected volume	30.000 TEU/year in the first phase, 90.000 TEU/year when fully operational
Storage area	4.000 TEU
Crane tracks	3 tracks, 750 m each
Sidings	5 tracks, 750 m each (tracks 711, 712, 722, 731, 732)
Cranes	2 gantry cranes
Capacity	The following operations are assumed: - Shuttle trains Valburg – Duisburg (4 daily, each direction) - Shuttle trains Valburg – Rotterdam (2 daily, each direction) - Trains Valburg – European hinterland (6 daily)
Operational concept	Train remains on the crane track for the entire duration of its stay (unloading, loading) in the terminal (Standverfahren)
Operating times	n.a.
Electrification	It is currently being examined whether the access tracks (entry sidings <–> crane tracks) will be electrified.

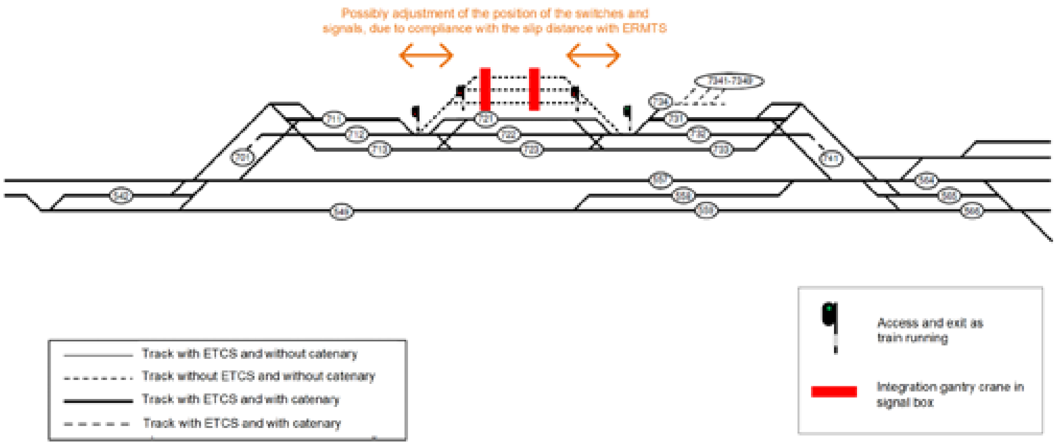
5.2.2 Smart terminal layout and operations

Single Option (cost estimate 2.0 M€ ±50%) (Figure 5.4)

The planned layout and operations of RTG are very similar to those of a smart terminal. Proposed changes imply making the momentum access and direct exit possible. At present there is no rail freight terminal protected with ERTMS so the case for RTG would require new developments by the infrastructure manager ProRail. Issues should be sorted by considering the similarity between a passenger railway station and a freight terminal. Momentum access would be made possible by integrating crane tracks and the gantry cranes in the safety system. This measure is currently being examined by the future terminal operator and by ProRail and might require adjustments of the positions of switches and signals beside the integration of the gantry crane and the crane tracks into the interlocking system.

Estimated ERFLS intermodal trains' dwell times in Valburg with the facility described will be 2-4 hours.

Figure 5.4 Planned intermodal terminal Valburg, infrastructural measures, single option



5.2.3 Telematics

RTG is planned as a satellite terminal. There is currently no IT for intermodal transport, but the prospective operator has characterised a choice for a TOS which will work with a SQL database and a fully web-oriented interface.

The set-up of the telematics system for ERFLS is planned to take 22 days of work involving project manager, system engineer, senior developer, electrician. The commissioning of the IT including tests of operations system, security, back-up, database, and ERFLS tests, training and beginning of production stage are expected to require 25 working days. A first estimate of the overall costs for setting up and commissioning the ERFLS system at RTG Valburg amounts to € 333.600.

5.2.4 Regional market analysis

Due to the direct connection by the dedicated rail freight line 'Betuwe line' RTG Valburg offers great market potential. In fact, in 2017, 70 per cent of more than 150 shuttle trains per day to and from Amsterdam and Rotterdam used the Betuwe line, although its capacity is not fully exploited because of a bottleneck at the German border. The 80-ha logistics centre Park 15 is located close to RTG, south of the Betuwe line. It targets retailers, logistics providers and shippers, that have already established there their distribution centres. The next barge-road connection (BCTN Nijmegen) is located within 15 minutes of truck driving time from RTG Valburg and Park15. From there, the ports of Rotterdam, Antwerp and the Ruhr Area can be reached daily.

There is no facility like RTG Valburg to date in the north-eastern hinterland of the Netherlands. RTG Valburg will be the only rail-road terminal within a radius of 20 km and could relieve traffic from the terminals in the sea ports. Expected market volumes are made up of maritime and, mostly, continental flows resulting from different catchment areas. DERT projects a catchment area north of Schiphol-Utrecht-Boxmeer, whereas an operating area of 10 to 25 km is generally assumed.

Intermodal traffic concerning Rotterdam is generally concentrated at RSC Rotterdam, discharging the port infrastructure with a daily, operator neutral rail Port Shuttle that connects all container terminals of the Maasvlakte. RTG Valburg could aim for a similar and complementary role, relieving traffic from the terminals in the seaports. Additionally, RTG could take advantage of the railway transport links to the east of Europe in combination with Chinese trade traffic.

From the perspective of regional policy, RTG Valburg is considered a positive contribution to multimodality, enhancing the economic development of the logistics sector in the region. The interview with an operator revealed that five to ten intermodal units would be enough to warrant a stop at RTG. This does not contrast with the recent finding of the STC Netherlands Expert Group for Sustainable Transport and Logistics (van Liere, Richard, 2017: p.9) which concluded that the market potential is only long-distance continental cargo to the hinterland, due to alternatives being cheaper.

5.2.5 Socio-economic points

The scenario assessments show a significant improvement of the indicator, which increases from 2.4 in the base scenario to 2.60 in the ERFLS Scenario.

The socio-economic analysis indicates that tonnes produced at the terminal with the implementation of ERFLS will entail about 400 new jobs, 9 M€ of taxes and 1.6 M€ income for the terminal.

The SWOT analysis in Table 5.4 summarises the other findings. Next to the many strengths of the location, it is noted that the main problems of RTG are linked to the current equipment and to the low capacity of the railway network, as also indicated in the last Work Plan for the Rhine-Alpine Corridor produced by the European coordinator.

Table 5.4 RTG Valburg SWOT Analysis

Strengths	Weaknesses
- Terminal's strategic location between The Netherlands and Germany - Strongly developed industrial area - Good overall infrastructural equipment in the whole province - Proximity to the port of Rotterdam - Entrepreneurial density of 7.9 companies per 100 inhabitants	- Low capacity of railway lines leading to the terminal
Opportunities	**Threats**
- The terminal still under construction allows the project to be modified to have a smart terminal - The Port of Rotterdam continues to perform well, and new investments are expected in the years to come - Crossing with other European corridors (e.g. North Sea-Baltic) - Development of a multi-modal logistic rail platform along the Betuwe line (Valburg/ Nijmegen), as part of a European Rail Freight Line System along the Rhine-Alpine Corridor.	- Delays in the construction of the terminal - Work on upgrading railway routes can become a bottleneck and create further delays on the works - Non-competitive prices of rail transport compared with road transport - Long times for the realization of the infrastructural intervention

5.3 Duisburg – Logport III

5.3.1 Base information

The Duisport-Hohenbudberg Logport III terminal is located on the Duisburg – Krefeld line between Rheinhausen and Krefeld-Uerdingen stations (see Figure 5.5). The connection to the line is at the goods yard of the latter station. The facility is owned by Duisport and operated by Samskip.

There is access only from one side, from Uerdingen, and the access line is not electrified. Entrance is by shunting and momentum access is not part of current operations. Gantry cranes are used as well as optimised handling algorithms. Road-side there are rapid entry facilities and the access to motorway A57 "Krefeld-Gartenstadt" is within 6.7 km. The main data about the terminal are summarised in Table 5.5.

Figure 5.5 Duisport-Hohenbudberg Logport III CT terminal, location on the rail network

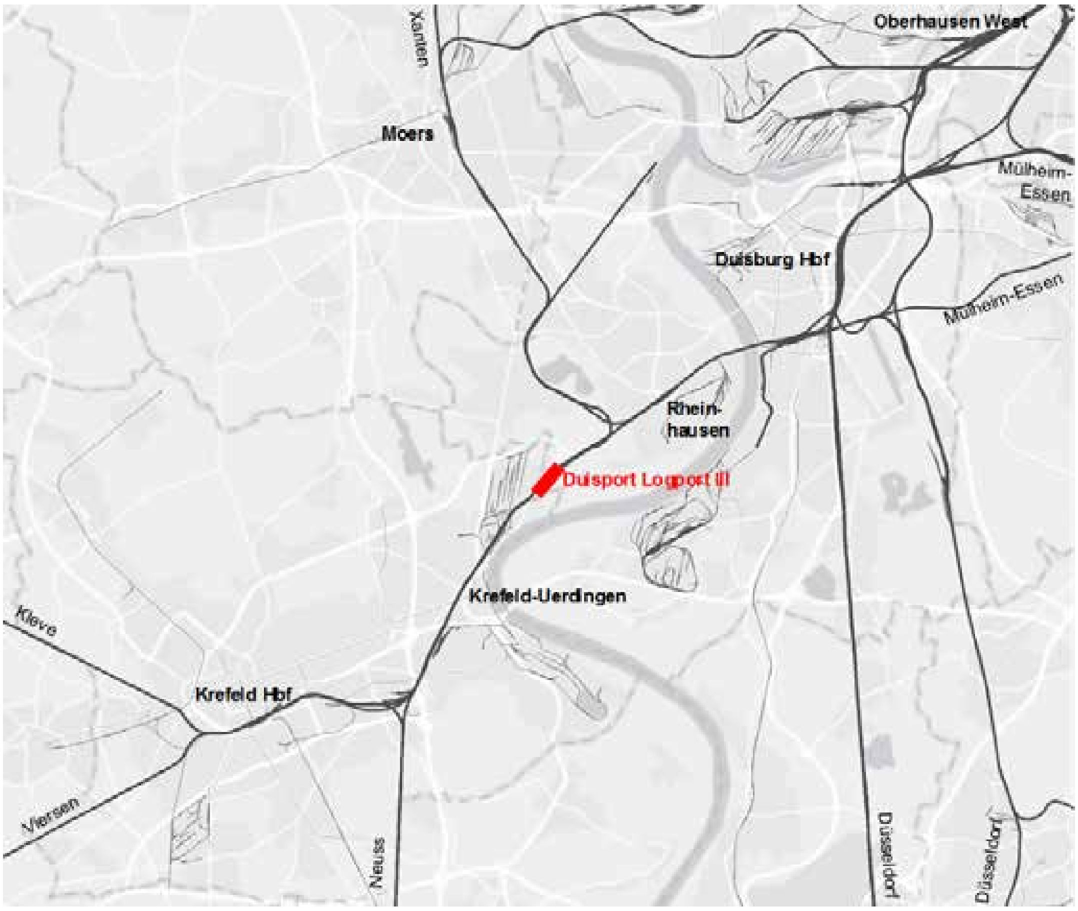


Table 5.5 Duisburg-Hohenbudberg Logport III CT terminal, key figures

Area	140,000 m²
Storage capacity	250 container parking spaces, 200 trailer parking spaces
Crane tracks	6 tracks of 740 m under gantry crane (effective length under crane approx. 700m)
Holding sidings	2 tracks of approx. 700 m and 1 track of approx. 780m (two of which are suitable for handling with a reach stacker)
Cranes	2 gantry cranes, 3 reach stackers Gantry crane performance capability: 30 transhipments per hour
Capacity	Handling of up to 200,000 loading units per year
Operating concept	No information is available as to whether all the trains will remain on the crane track during their entire stay in Duisburg-Hohenbudberg Logport III (*Standverfahren*) or whether, after rapid unloading, some of the trains will be parked on a siding and the loading process will be completed before departure (*Fliessverfahren*).
Opening hours	Monday – Friday 0:00-23:59, Saturday 0:00-12:00
Electrification	No
Traffic volume	130,000 moves in 2016, expected 150,000 moves in 2017 (traffic composition: 15% containers, 80% semitrailers, 5% swapbodies)
O/Ds of trains at time of survey	Melzo, Mortara, Trieste, Singen, Gothenburg, Katrineholm, Nassjö, Ålmhult, Helsingborg, Malmö, Taastrup (Copenhagen), Curtici, Munich

5.3.2 Smart terminal layout and operations

The two transformation options described in the following paragraphs aim to obtain ERFLS intermodal trains' dwell time limited to about 3-6 hours.

<u>Option 1 (cost estimate 6.2 M€ ±50%)</u> (Figure 5.6)

As the Logport III terminal is located directly parallel to the Krefeld – Trompet/Rheinhausen main lines, the basic idea of option 1 is to integrate the most westerly loading track, the one not under the gantry crane, into the parallel main running lines. Therefore, single cross-overs to the main line on the north-east and south-west side of the terminal have to be built. Due to height difference of the Hohenbudberg Logport III CT and the main line tracks only a link to the Krefeld – Moers line is possible, but not to the Krefeld – Rheinhausen line. Therefore, ERFLS trains have to run an approximately 10 km detour. They have to select the following route: Emmerich – Oberhausen West – Duisburg-Beeck – Moers – Hohenbudberg Logport III CT terminal – Krefeld-Uerdingen – Neuss – Cologne South – Bonn. Height conditions of the tracks require determining at the design stage the length of the new connecting track. It should be noted that the connection may only be realised for the track on which handling is not with gantry cranes but with reach stackers.

Further, option 1 entails the electrification of the access lines, the installation of train gates and the integration of the terminal and its equipment in the interlocking system. Momentum access as well as direct exit would be possible.

The time required for implementation, including planning and permissions, is estimated to be at least 4 years after a positive decision by the terminal operator.

Figure 5.6 Duisburg-Hohenbudberg Logport III, Infrastructural measures, option 1

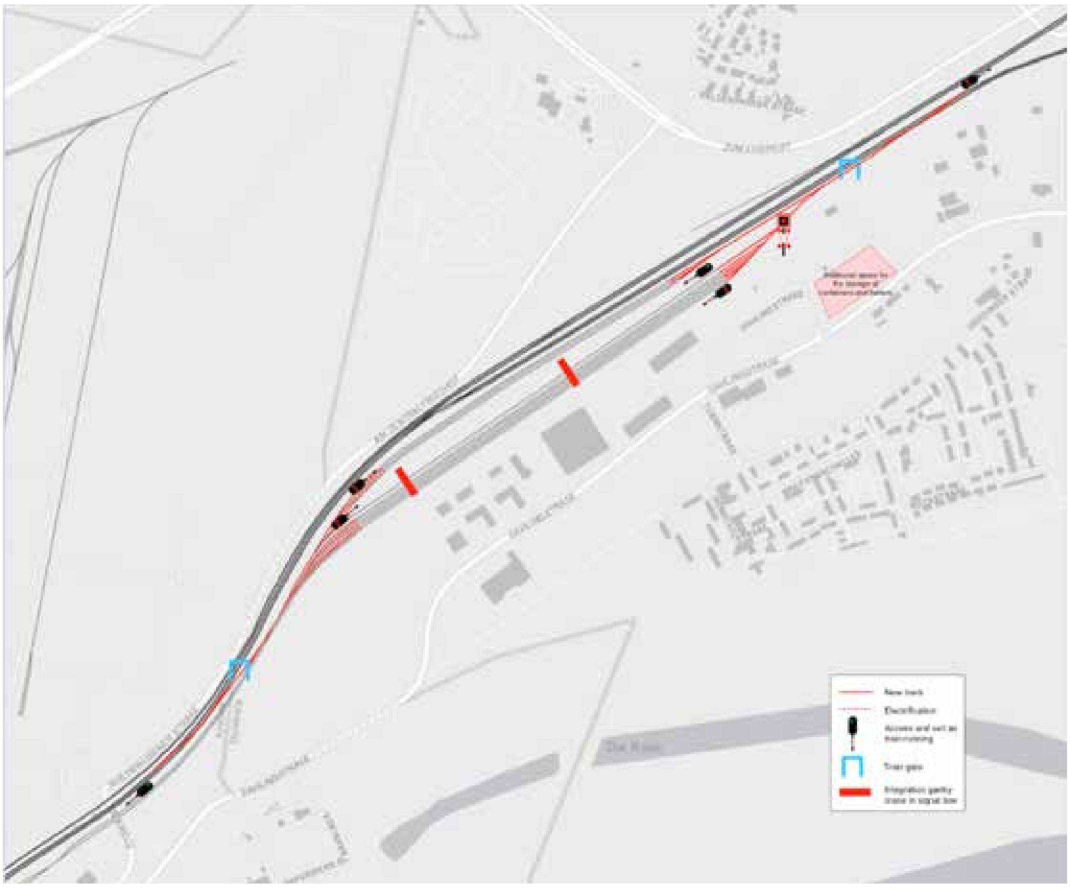
Option 2 (cost estimate 14.9 M€ ±50%) (Figure 5.7)

A second option extends the previous one by connecting to the main line also the tracks under the gantry cranes, and trains which approach and depart conventionally instead of using momentum access would continue to use the arrival/departure tracks in Krefeld-Uerdingen.

Works are similar to those for option 1 (switches and tracks to access the yard from the north, electrification of both accesses, cranes integrated in the interlocking) but extended to the tracks under the gantry crane. This would require using part of the of the storage area for trailers.

The time required for implementation, including planning and permissions, is estimated to be at least 6-7 years after a positive decision by the terminal operator.

Figure 5.7 Duisburg-Hohenbudberg Logport III, infrastructural measures, option 2



5.3.3 Telematics

The Duisburg Logport III terminal has an advanced ICT system developed by its own ICT service, able to manage all the operations required for intermodal units' loading and unloading and train circulation. Such system allows for high interaction with third parties and therefore it satisfies the requirements to fit into a wider system connecting nodes such as ERFLS. An important non-technical feature is the ownership of part of the system and therefore the ease to apply changes. The intermodal statuses of interest are all managed by the present system at Logport III which, therefore, may provide a continuous information flow in real time.

At present bookings for trucks delivering or picking up ITUs are received through Web services specifically developed in house (OCA gate). Admission to the terminal is supported by a set of cameras placed at the gate. The TOS communicates to the cranes which operations need to be carried out, their order and priority chosen by the operations office. The information is arranged by the central system (CMS crane system) and visualised on the on-board units of the cranes. Progress of operations is tracked. Work on trains and yards is optimised thanks to dedicated database and software (CID container).

Table 5.6 Duisburg-Hohenbudberg Logport III, summary technical information of the current IT

CONNECTIVITY: Optic fibre	DBs: SQL
BANDWIDTH: more than 10 mbs	PROTOCOLS: TCP/IP
TOS LANGUAGES: Visual c#, php, aspx, .net	METHODS: FTP/WEB/WS
INTERFACES: Client/Server – WEB	

Duisburg has been identified as suitable to become a control tower. The set-up of the telematics system for ERFLS is planned to take 22 days of work involving project manager, system, engineer, senior developer, electrician. The commissioning of the IT including tests of operations system, security, back-up, database, and ERFLS application tests, training and beginning of production stage are expected to require 25 working days. A first estimate of the overall costs for commissioning the ERFLS system at Duisburg Logport III amounts to € 379.600. That cost includes the software for the emergency recovery of the system that replicates the virtual machines both on a local device and on the cloud. Setting up this further device is expected to require 10 working days and will need to follow once the ERFLS system along the corridor has been set up.

5.3.4 Regional market analysis

Duisburg is a central transport node with the trimodal Port of Duisburg as largest inland container port worldwide and leading logistics hub in the Ruhr area. Logport III Hohenbudberg operated by Samskip Multimodal has a high number of continental semi-trailers in contrast to other terminals in the region. Logport III is located in a strong economic region with high transport demand for export goods which is home to numerous trimodal terminals, indicating high volumes of cargo transhipment and transport. Several international logistics companies operate terminals in Duisburg within their own intermodal network. However, this rapid increase in handling capacity is leading to further bottlenecks in the local transport infrastructure and some bottlenecks already exist.

A look at the region reveals that the facilities in Duisburg enjoy the central position of North Rhine-Westphalia (NRW) in Europe. Within half an hour driving time by truck, Düsseldorf as well as the Ruhr area can be reached. To the west, the Dutch border is 45 minutes away. The closest inland waterway terminals with barge connections to Rotterdam, Antwerp and Zeebrugge are located five kilometres away at Logport II, DIT Duisburg Intermodal Terminal and D3T Duisburg Trimodal Terminal. At the site of the former marshalling yard Duisburg-Meiderich, DUSS is constructing a large rail-rail hub to distribute incoming goods from the ports of Rotterdam, Antwerp and Zeebrugge by rail towards the hinterland.

The transport network is busy with transit and regional traffic. However, transit traffic -especially seaport hinterland traffic- outperforms regional traffic by number, and is forecast to increase. In fact, almost three quarters of Dutch sea freight is transported via the Betuweroute, a dedicated freight line between Rotterdam and the German border at Zevenaar-Emmerich, where a bottleneck exists. To obviate it, the double track rail line between Emmerich and Oberhausen will be expanded to three tracks.

Containerised cargo and not time-sensitive cargo with continental origin and destination has the largest potential for modal shift to ERFLS, e.g. from and to supplier industries. This type of cargo from the supra-regional catchment area (Ruhr Area) is projected to increase. However, it is questionable whether ERFLS can coexist with the many existing direct links at Duisport, thus adding value to the supra-regional catchment area and contributing to the main objective of the actual transfer of goods from road to rail.

5.3.5 Socio-economic points

The analysis of the scenario indicators has shown significant values in all the clusters measured. The indicator varies from 2.85 in the base scenario to 3.19 of the ERFLS Scenario. In particular, the increased traffic that the terminal will generate thanks to ERFLS will favour the creation of about 550 direct and indirect jobs and a greater income for the State thanks to the taxes paid, which can be translated in benefits for the surrounding area in terms of greater resources for investments.

The particular location of the terminal within the major river port of Germany and the presence in the region of very strong economic sectors such as the steel industry are the main strengths of this case study. Bottlenecks currently on the German railway network, especially near major urban centres, are the biggest threat to the efficiency of rail transport and the services that can be offered by operators. A critical issue highlighted by the study is the current capacity of the terminal, which might not be able to accommodate all the additional traffic created by ERFLS, thus requiring a capacity increase.

The findings of the socio-economic investigation are summarized in Table 5.7.

Table 5.7 Duisburg-Hohenbudberg Logport III, SWOT Analysis

Strengths	Weaknesses
- The city of Düsseldorf is an important international financial and business hub - Duisburg is an important center in some economic sectors such as logistics, ICT, city tourism, environment and technology - Strong push for innovation and logistics by major companies - Duisburg is Germany's largest river port - The current logistics equipment makes Logport III very similar to a smart terminal	- The current capacity of the terminal may limit the possibility of managing additional traffic - Connection with the national railway network
Opportunities	**Threats**
- The Rhine-Alpine corridor will contribute to increasing the accessibility of the area and will favour connections with other parts of Europe - Improvement of technologies in transport and logistics services - Universities and research centers	- Existence of bottlenecks on the German railway network - Non-competitive prices or rail transport compared with road transport - Rail transport low in punctuality and efficiency - Long times for the realization of the infrastructural intervention

5.4 KTL – Kombi Terminal Ludwigshafen

5.4.1 Base information

KTL is set on the BASF grounds in Ludwigshafen (see Figure 5.8), access is via the single track line from Oggersheim and electrification extends into the terminal. Trains typically get into the terminal by momentum access, then the locomotive is uncoupled and, when the train is set for departure, it is coupled to the train on the exit side, ready for brake tests and direct exit. Operations are carried out with gantry cranes that are linked to the train protection system. There are train gates but no automatic checks. Shunting occurs due to the operations being set up according to the flowing principle. The terminal operating system includes optimized handling algorithms. Motorway A6 access is within easy reach.

Figure 5.8 Ludwigshafen KTL terminal, location in the rail network

Table 5.8 Ludwigshafen KTL terminal, key figures

Area	305,000 m²
Storage capacity	2.300 TEU
Crane tracks	Module 1: 4 tracks of 564 m Module 2: 3 tracks of 620 m Module 3: 6 tracks of 620 m
Holding sidings	13 tracks of 600-700 m
Cranes	2+2+3=7 gantry cranes, payload 40 t each, capacity 25 transhipments per hour and crane
Capacity	Loading and unloading of up to 60 trains per day, handling of up to 500,000 loading units per year
Operating concept	The trains will be unloaded immediately. If they are in Ludwigshafen for a long period of time, they are put away and then pushed back into the crane tracks for loading (Fliessverfahren). The momentum access is practiced.
Opening hours	Monday–Friday 0:00-23:59, Saturday 0:00-13:30, Sunday 22:00-23:59
Electrification	The tracks are already electrified right up to the areas covered by the gantry crane.
Traffic volume	390,000 loading units in 2016 (traffic composition 80% containers, 17% semitrailers, 3% swap bodies)
O/Ds of trains at time of survey	Lübeck-Travemünde, Hamburg, Busto Arsizio, Trieste, Novara, Verona, Rjieka, Wels, Sopron, Munchen, Marseille, Le Havre, Mouguerre, Barcelona, Madrid, Antwerp Kombinant, Zeebrugge, Rotterdam, Duisburg DUSS, Dörpen

5.4.2 Smart terminal layout and operations

Two options were proposed and aim to obtain a dwell time for ERFLS intermodal trains of 2.5-5 hours.

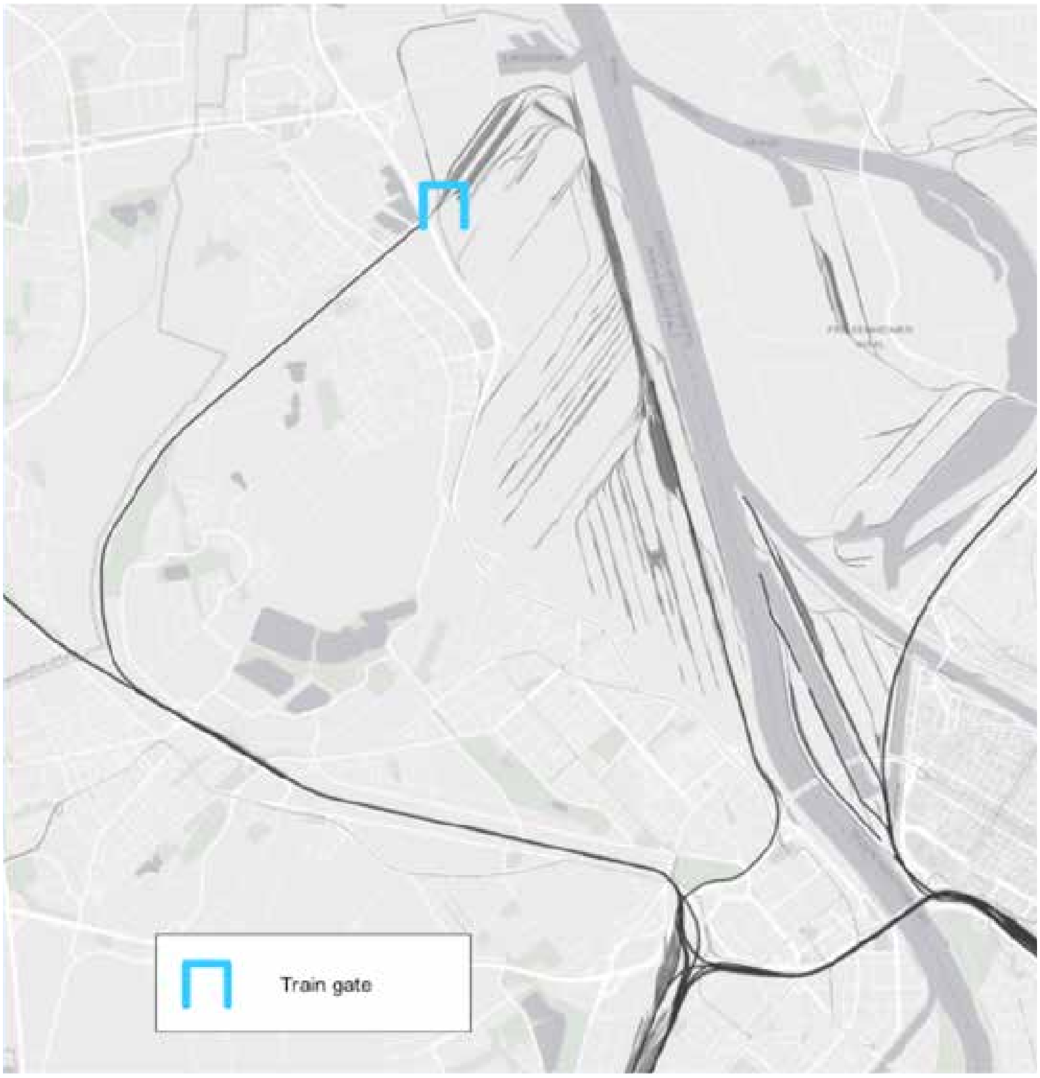
Option 1 (cost estimate 0.3 M€ ±50%) (Figure 5.9)

The trains continue to enter with momentum access, as currently. With a new, highly accurate train gate for recording wagon and container numbers and any obvious damage to wagons and containers, the time for checks may be reduced. The locomotive is then uncoupled and coupled to the opposite side of the train, while the train is unloaded/loaded by the cranes. After brake and integrity checks, the train exits directly the terminal.

It should be noted that the doubling of the single track Oggersheim – Ludwigshafen terminal access line has been postponed; moreover, there is a noise protection requirement with a limit on the number of permissible trains per day. In the case of short dwell times for liner trains, the aim should be to have as many trucks as possible for the delivery and collection of the containers during the dwell time of the liner train at the terminal due to limited parking space. In general, optimisation of HGV traffic is expected to result in improved terminal processing times.

The time required for the implementation of this option, including planning and permissions, is estimated to be at least 1½ years after a positive decision by the terminal operator.

Figure 5.9 Ludwigshafen KTL terminal, infrastructural measures, option 1



Option 2 (cost estimate 0.6 M€ ±50%) (Figure 5.10)

This option foresees the use of the existing route via the BASF plants that links into the terminal on the northern side. Trains enter via momentum access from either direction (south from Oggersheim, north via the BASF plant line), only simplified brake tests are required and trains can leave the terminal directly. Compared with option 1, the option 2 allows the locomotive to remain with the wagons during the entire stop at the terminal. Electrification of the line via the BASF plant is currently underway so this option would require mostly new, precise, train gates on both sides of the terminal.

Also, for this option, the time required for implementation, including planning and permissions, is estimated to be at least 1½ years after a positive decision by the terminal operator.

Figure 5.10 Ludwigshafen KTL terminal, infrastructural measures, option 2

5.4.3 Telematics

In terms of ERFLS telematics, KTL Ludwigshafen is planned as a satellite terminal. It currently has an advanced informatics system divided in two main parts. One, called GOAL (Global Oriented Application for Logistics), is dedicated to managing railway and road traffic arriving at the terminal and leaving it. The other part is called EDIGES and is dedicated to transmitting data to external parties. For each arriving or departing ITU, the relevant data are transmitted to the appropriate stakeholders only. KTL does not own either: they is licensed for use by HUPAC S.A. By using the GOAL software, the terminal can manage all statuses related to transport and handling operations that are of interest for ERFLS.

The system receives the messages for arriving ITUs (booking) and departing ITUs (deliveries) and inserts them on the TOS while waiting to receive the vehicles. On arrival of the vehicles, a check is carried out by visual inspection of ITU and documents, and by registering the ITU in the system. The system receives the composition of the arriving trains and relays the composition of the departing trains. Incoming trains are first treated as a single entity and, once on their terminal track, wagons and ITUs are itemised singularly to allow checking the load and passing on the information that the ITUs are available for pick up. There is a registry that georeferences each ITU at the terminal and tracks its status.

Table 5.9 Ludwigshafen KTL terminal, summary technical information of the current IT

CONNECTIVITY: Optic fibre	DBs: RPG2
BANDWIDTH: more than 10 mbs	PROTOCOLS: TCP/IP
TOS LANGUAGES: RGP	METHODS: FTP
INTERFACES: Client/Server	

The set-up of the telematics system for ERFLS must follow the commissioning of the of the smart terminal and is planned to take 22 days of work involving project manager, system, engineer, senior developer, electrician. The commissioning of the IT including tests of operations system, security, back-up, database, and ERFLS application tests, training and beginning of production stage is expected to require 25 working days. A first estimate of the overall costs for setting up the ERFLS IT system at KTL Ludwigshafen amounts to € 317.575.

5.4.4 Regional market analysis

Ludwigshafen is located in a region of above-average economic power and is an important transport node. The main industrial branches in the region are logistics, chemical industry, machine building industry, electronics, and automotive. The import - export freight flows of the region are almost balanced. KTL offers a large scope of services to the chemical industry which is reflected by a high share of hazardous goods and tank containers.

Concerning accessibility, KTL has very good connections to different highways through the industrial areas. The terminal road access is shared with the BASF plants, and congestion occurs very rarely. In fact, despite heavy use of the road network around KTL, there is no bottleneck due to numerous access routes to the terminal.

The region is an important transport node with the Trimodal Port of Ludwigshafen and the Rhine-Neckar Port of Mannheim where the trimodal terminals Contargo Mannheim, Contargo Ludwigshafen and DP World Mannheim are located.

Among the many intermodal rail connections of KTL, several are with seaports, which explains the high volume of maritime containers instead of continental trailers. The current transport time by rail Ludwigshafen KTL - Genoa VTM is three days with one inter terminal transhipment but there is currently no direct rail connection. Novara can be reached directly by rail within one day.

The chemical industry plays an important role in the supra-regional catchment area and also for the ERFLS case study terminal KTL. The commonly used swap tanks can be integrated into the ERFLS only by sorting some difficulties: the relations of the ERFLS differ in their demand for tanks and safety procedures for hazardous goods are time consuming. It should be noted that the large industrial companies in the area create and demand large transport quantities which are bundled in block trains or transported by vessel. An identified risk is high or low water level of the Rhine. Then, companies substitute inland waterway transport by rail transport which may result in overbookings at KTL and at the surrounding terminals.

5.4.5 Socio-economic points

From the ERFLS perspective, the terminal KTL Kombi-Terminal of Ludwigshafen is the one that most corresponds to a smart terminal already in the base scenario. The KPI has a high value and can influence to influence the scenarios. The summary indicator increases from 3.02 in the Scenario 0 to 3.18 for the ERFLS Scenario.

From an economic point of view, the introduction of ERFLS services are quantified in about 17 million euro turnover for the terminal, 6 million in taxes for the state and about 300 direct jobs and in the related industries.

The current level of saturation of the terminal capacity, based on the information available, will allow to manage the additional traffic produced by ERFLS for the movement of a significant number of tonnes of goods by rail and road transport (about 58,000 additional ITUs).

The equipment of the terminal combined with the location in the Rhein-Neckar region, very active from an economic point of view, are the strengths of the case study. Although KTL is well-equipped, there are some points on which it seems necessary to intervene to further develop activities; one, for example, may be the distance from the reference station for operations involving train-shunting operations with the help of a diesel locomotive or the parking areas for lorries which is inadequate. The risk is not being able to fully exploit the potential of ERFLS and therefore to produce benefits for the territory.

The other findings of this analysis are summarised in Table 5.10.

Table 5.10 KTL Ludwigshafen, SWOT Analysis

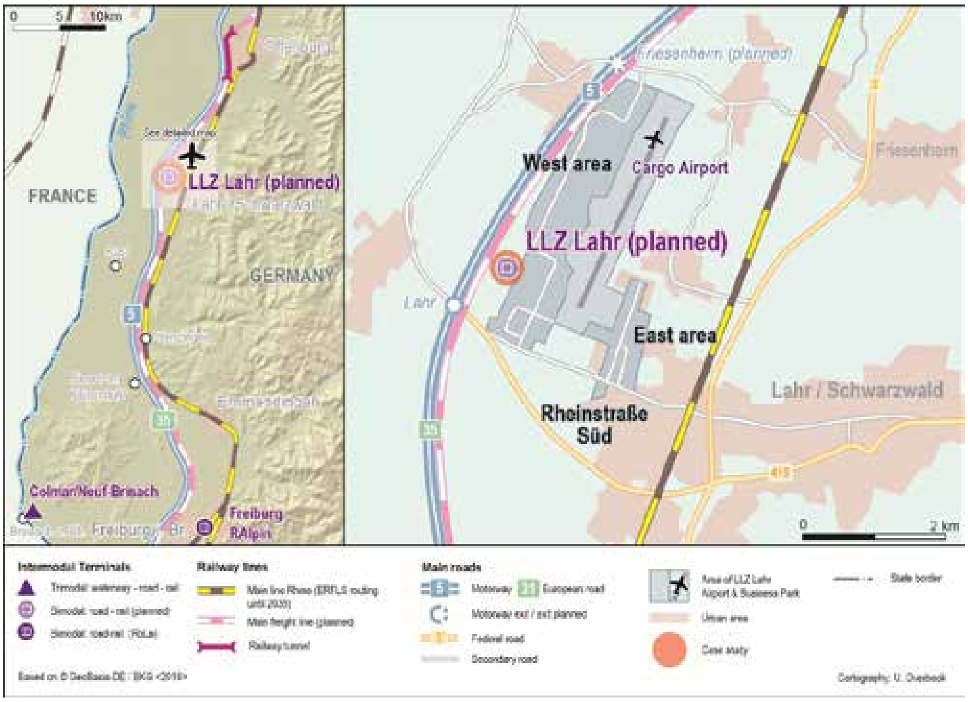
Strengths	Weaknesses
- Location in a region that is one of Germany's driving economic forces - Large number of enterprises active in services sector - Strong push for innovation and logistics by major companies - Terminal's layout compliant with the standards set for a smart terminal - Momentum access	- Distance from shunting station - Trailers storage capacity
Opportunities	**Threats**
- The Rhine-Alpine corridor will contribute to increasing the accessibility of the area and will favor connections with other parts of Europe - Improvement of technologies in transport and logistics services - Universities and research centers	- Existence of bottlenecks on the German railway network - Non-competitive prices or rail transport compared with road transport - Rail transport low in punctuality and efficiency - Long times for the realization of the infrastructural intervention

5.5 Lahr

5.5.1 Base information

The commissioning of the Lahr terminal is foreseen when the Offenburg – Freiburg (Breisgau) railway line will be upgraded and two new tracks will be built, parallel to the A5 motorway, dimensioned for speeds of up to 160 km/h and dedicated to freight trains (see Figure 5.11). It is envisaged that the new line will be in operation between 2030 and 2035. Plans have been made by Deutsche Bahn for freight train passing tracks in Lahr. Furthermore, there are plans for a new freight terminal in the same area. This terminal is anchored in planning; the Southern Upper Rhine Regional Plan identifies it as a priority area for combined transport.

Figure 5.11 The foreseen location of the Lahr terminal



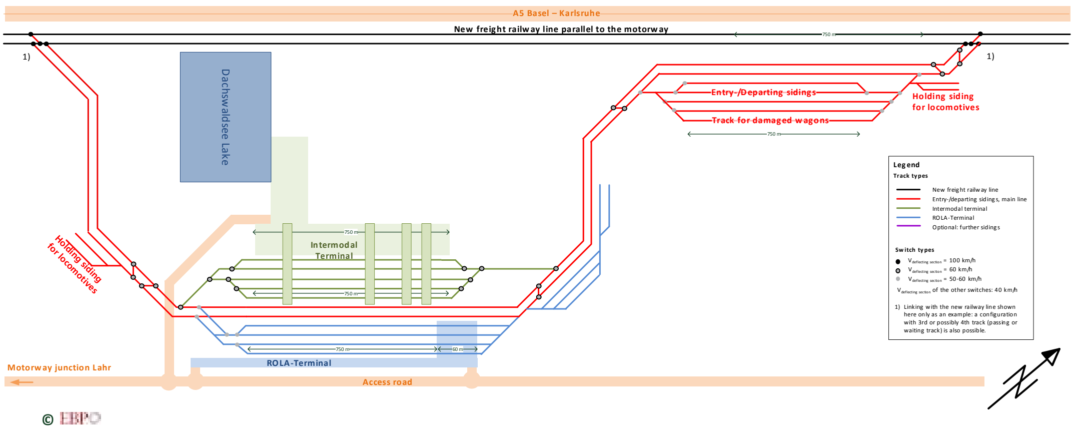
5.5.2 Smart terminal layout and operations

In a study carried out in 2014 for the CoDe24 project, a layout for a terminal for unaccompanied and accompanied combined transport was developed, which not only has sufficient capacity to handle the number of trains per day estimated on the basis of the demand forecast, but also allows for momentum access. Two alternative layouts were proposed, both including tracks allowing for momentum access and facilities to smart terminal standards. In fact, access will be from both sides, along electrified tracks extending into the terminal equipped with train gates. Momentum access is foreseen from either direction. Gantry cranes will be installed and linked to the interlocking system, and suitable spaces for trucks will be included. Access to the "Lahr" entry/exit of motorway A5 will be within 1 km, and there will be no need for trucks to cross any residential area.

The precise positioning of the facility in the landscape presents a particular planning challenge. The area has various restrictions that determine the possibilities for positioning: need for dredging lakes, municipal boundaries, minimum distance to settlement areas due to noise emissions, etc.

The Lahr terminal is therefore planned as a “smart terminal” from the outset and therefore there is no need to convert it to a smart terminal. The cost of the intermodal transport terminal as originally planned is approximately 65 million euro. The implementation of the terminal can be at the earliest simultaneously with the implementation of the 3rd and 4th track of the Rhine Valley line, i.e. 2030-2035. It is foreseen that the facilities at Lahr will allow for ERFLS intermodal trains’ dwell times of about 2-4 hours.

Figure 5.12 Planned intermodal terminal Lahr, track diagram showing one of the layouts proposed



5.5.3 Study about the effects of ERFLS on the road network and the effect of truck access control on handling operations

A supplementary study on the influence of the ERFLS train concept on the road network in the Lahr area was carried out as part of the current Action. The study builds on the figures for the maximum quantity of tonnes and trains derived from the study developed in 2014 for the CoDe24 project on the demand at the terminal. Three scenarios were considered whereby freight to and from Lahr would be carried respectively by conventional intermodal shuttle trains only, by ERFLS liner trains mostly, and by a mix of the two concepts (with 2/3 of ERFLS trains and 1/3 of conventional ones). After explaining some assumptions required, the study indicates that 627 ITUs per day would be handled in Lahr which would result in up to 928 truck journeys per average day. This was compared with 2014 traffic levels, finding it a minor addition to the current traffic.

In addition, the study explored the effects of controlling the access times of the trucks to the terminal on the handling operations, in particular on the possibility of moving ITUs directly from truck to train or the other way without placing them on the storage lanes. The findings revealed that influencing truck arrival times at the terminal can make a significant contribution to reducing the number of transhipments required and the amount of storage space. This applies regardless of whether shuttle trains or liner trains primarily stop at the terminal, although under the assumption of several liner trains per day. In fact, the probability of direct transhipment for ITUs from trucks to ERFLS trains, in the case of frequent ERFLS trains with short dwell times, replicates the probability of direct transfer between trucks and shuttle trains with long dwell times. Table 5.11 illustrate the effect of controlling truck access to the terminal on the proportion of direct truck-train transfers and on the requirements for yard storage space.

For a few departures (4x per day and direction) and short liner train stopping times, an increase in the number of transhipments required, as compared to shuttle trains, is generally observed. This increase is in the single-digit percentage range.

Table 5.11 Planned intermodal terminal Lahr, overview of the proportion of direct railway-road transhipment

	Variant A "Conventional shuttle trains with long dwell times"			Variant B "Hybrids"			Variant C "Mainly trains with short dwell times"		
Control of truck arrival times at the terminal	**None (A1)**	**Minor (A1)**	**Major (A1)**	**None (B1)**	**Minor (B1)**	**Major (B1)**	**None (C1)**	**Minor (C1)**	**Major (C1)**
Proportion of containers that can be transferred directly between rail wagons and trucks	29%	53%	76%	21%	47%	74%	36%	57%	79%
Proportion of containers requiring intermediate storage	71%	47%	24%	79%	53%	26%	64%	43%	21%

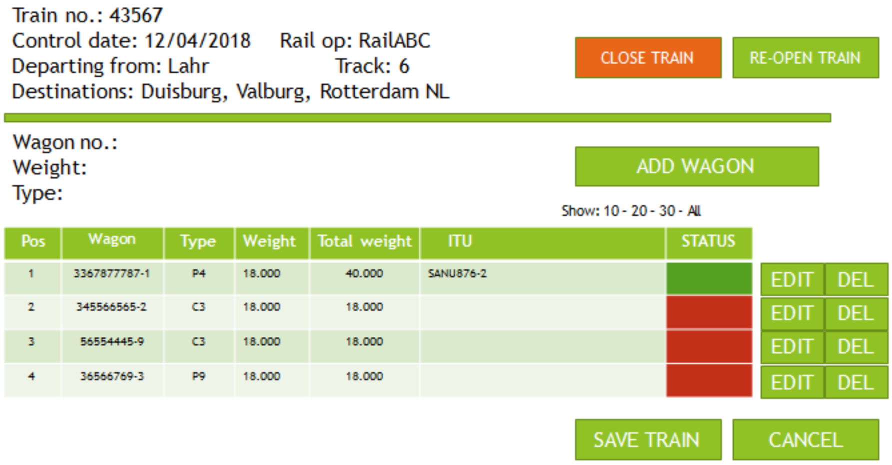
Since – in the case of Lahr – the inflow of trucks to the terminal triggers only a comparatively small increase in traffic (3-5%) on the roads leading to the terminal, any offsetting of truck journeys during the course of the day is of secondary importance. Furthermore, the immediate proximity to the motorway allows rapid accessibility for trucks without them having to cross residential areas.

5.5.4 Telematics

Lahr is planned as a satellite terminal. Since the Lahr terminal is at the planning stage there is no current intermodal telematics.

The work on the Lahr prospective terminal included the description of the operations required from the TOS that will be required to manage the terminal and communicate with the ERFLS system. The definition of the operations of the TOS is accompanied by the indication of the databases required to implement it and by the illustration of the procedures to deal with trains and ITUs obtained with the use of a mock-up user interface (see Figure 5.13). It was estimated that the installation of the TOS, including operational staff training will require 7 days of work of a senior system engineer (€ 4550). The annual licence of the TOS has been estimated to 10.000 euro.

Figure 5.13 **The figure shows one of the mock-up screenshots prepared to illustrate the functions required for the Lahr TOS. The screenshot shows the wagons of a train and the buttons to load/unload them (EDIT) or remove them from the composition (DEL). The green status indicates a loaded wagon, the red status indicates an empty wagon**



The set-up of the telematics system for ERFLS is planned to take 22 days of work involving project manager, system, engineer, senior developer, electrician. The commissioning of the IT including tests of operations system, security, back-up, database, and ERFLS application tests, training and beginning of production stage are expected to require 25 working days. A first estimate of the overall costs for the ERFLS system amount to € 348.850, including the costs for licensing and setting up the TOS mentioned above.

5.5.5 Regional market analysis

Lahr will not take part in the ERFLS starting phase because the area has no rail access yet. The foreseen terminal will be located between the current logistics park (house to several logistics service providers) and the third and fourth track of the planned freight Rhine valley railway, parallel to motorway A5. The current railway line is key for the Rhine-Alpine connections, but it is also a bottleneck, hence the need to double the number of tracks and allocate passenger and freight trains to different tracks. The estimated modal shift impact of the project on freight traffic volumes (BVWP 2016, Section 1.6) is valued 7,688 tonnes per year (truck to rail) or 6.487,160 tkm per year. The Lahr logistics park has a motorway access and a new motorway junction Lahr-Nord/Friesenheim is part of the regional plan but not yet part of the German Federal Transport Plan.

Lahr is situated in the European Trinational Metropolitan Region Upper Rhine Valley next to the French and to Swiss border, and warehouses and storage are available as well as large industrial spaces. The airport comprised in the logistics park is licensed for passenger and cargo flights and is currently sparsely used, mainly for private business and cargo flights. Although site factors and intermodal interconnections are excellent, at present the potential is not being exploited.

The economic structure of Baden-Wurttemberg is shaped by many medium sized companies and their suppliers in the fields of mechanical engineering, automobile, electronics and chemical industry which are very export-oriented.

There are several intermodal terminals in the supra-regional catchment area (Ortenau Area). Among them two trimodal terminals, which are located in Strasbourg, and two other trimodal terminals located in the port of Kehl in the Ortenau area. Contargo South runs trimodal terminals in Ottmarsheim, Basel and Weil am Rhein.

Thus, ERFLS at Terminal Lahr could be attractive for companies in the area between these facilities. However, the planned smart terminals in Lahr and Weil am Rhein are very close to each other at a distance of less than 100 kilometres. It is unlikely that an ERFLS schedule will serve both locations within one train path as the modal shift potential is low regarding time and cost factors.

5.5.6 Socio-economic points

Since the terminal does not exist, yet, the component that most affects the definition of the scenarios is the socio-economic one which, in both scenarios, returns a KDI value of 2.50.

The effects of the traffic produced by ERFLS have been estimated in about 61,000 ITUs that can be quantified in about 18 million euro turnover for the terminal, 6 million euro in taxes for the State and about 300 direct jobs and in related industries.

The SWOT analysis in table 5.12 reports the qualitative findings of the socio-economic investigation. The area in which the Lahr terminal is located presents many strengths deriving from an economy that takes advantage of the presence of many large international companies, active both in industry and in services. Furthermore, there is a large opening towards the outside, thanks to the numerous exports. In this context, modern and efficient infrastructures are essential to facilitate accessibility and ease of movement of goods and passengers. In this sense, the completion of the works planned for the corridor will help to eliminate all those bottlenecks that currently limit the capacity of the German railway network and may be an obstacle to the development of an intermodal transport that really meets the needs of the markets and is useful to reduce all of the externalities that make the mobility of goods a factor that often impacts negatively on the citizens' quality of life.

Table 5.12 Planned intermodal terminal Lahr, SWOT Analysis

Strengths	**Weaknesses**
- Economy of the region characterised by strong industries and high export ratio; - Presence, in the region, of internationally reputed industrial giants such as Bosch, IBM, Daimler - Strong push for innovation and logistics by major companies - Layout of the terminal in compliance with a smart terminal	- The terminal does not exist, yet
Opportunities	**Threats**
- The Rhine-Alpine corridor will contribute to increasing the accessibility of the area and will favor connections with other parts of Europe - Baden-Württemberg and Alsace are two regions with a high presence of foreign companies active in many sectors of the economy that express a high demand for goods and services - The flexible access to various modes of transport (road, air and, in the future, rail) will offer an optimal interface for intermodal cooperation in one place - Improvement of technologies in transport and logistics services - Universities and research centers	- The time required for the construction of the terminal may not fit with the entry into operation of the erfls system - Existence of bottlenecks on the German railway network - Non-competitive prices or rail transport compared with road transport - Rail transport low in punctuality and efficiency - Long times for the realization of the infrastructural intervention

5.6 Basel - Weil am Rhein

5.6.1 Base information

The Basel-Weil am Rhein combined transport terminal is located directly on the border between Germany and Switzerland, between the stations of Weil am Rhein and Basel Bad (see Figure 5.14). The facility is owned and operated by DUSS, a subsidiary of DB Netze.

Access is from the sidings of the Basel Bad Marshalling Yard, north of the terminal. Routes to/from Switzerland are through a loop north of Basel Bad. At present it is possible to drive through the terminal on 2 out of 6 tracks. Momentum access is not used and only a short part of the access electrification is missing. Currently, gantry cranes are used and direct exit is not possible. Road-side, there are quick entry facilities and access to two motorways is nearby. Capacity for storage is limited and there are frequent traffic jams on the access road caused by customs clearance times.

The main data concerning Weil am Rhein are reported in Table 5.13.

Figure 5.14 Basel-Weil am Rhein intermodal terminal, location on the rail network

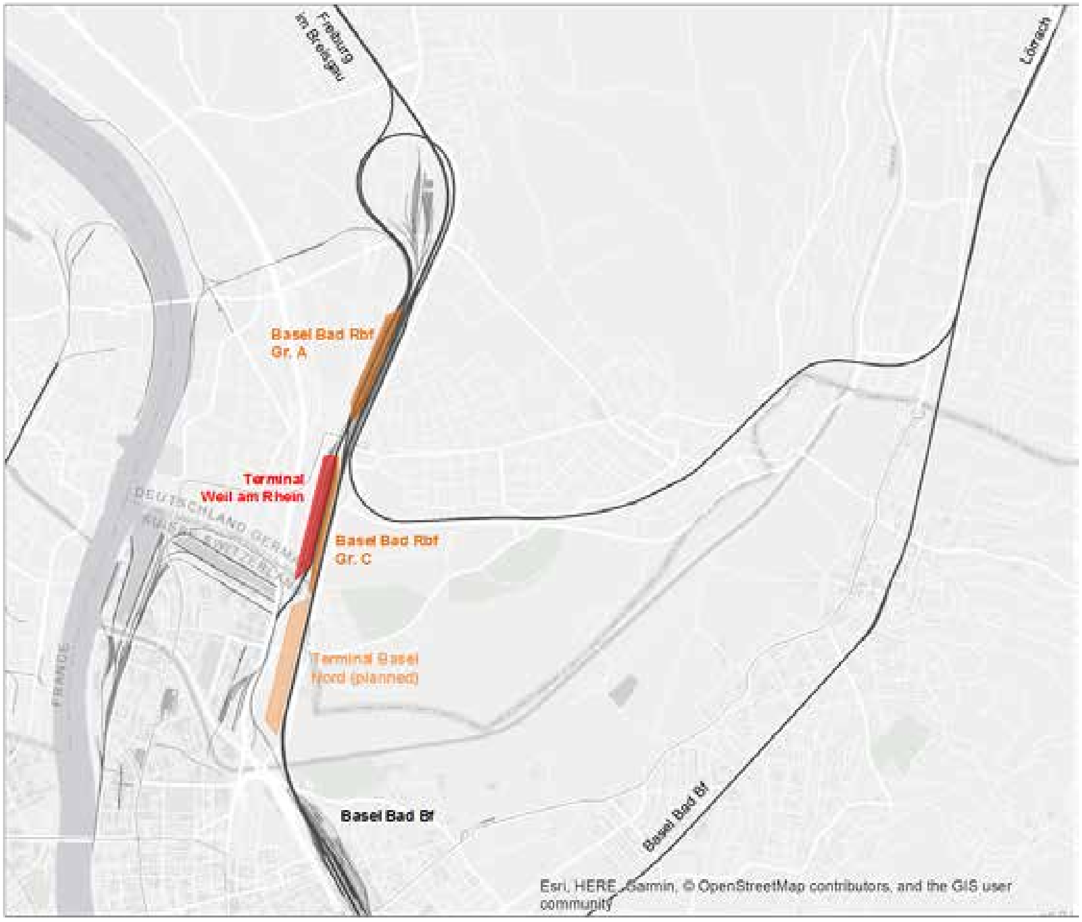


Table 5.13 Basel-Weil am Rhein intermodal terminal, key figures

Area	70,000 m² (estimate EBP)
Storage capacity	367 TEU (unstacked)
Crane tracks	4 tracks of 645 m and 2 tracks of 550 m
Holding sidings	n.s.
Cranes	3 gantry cranes, payload 41 t each
Capacity	Handling of up to 130,000 loading units per year
Operating concept	Flow factor 1.5 (i.e. part of the train remains under the crane during the entire layover in Weil am Rhein, another part of the train is moved to a holding siding after unloading and then loaded again when back on the crane track).
Opening hours	Monday – Friday 06:00-19:00, Saturday 07:00-11:00
Electrification	The tracks are already electrified to close to the areas covered by the gantry crane.
Traffic	Max. 130.000 loading units
O/Ds of trains at time of survey	Beura-Cardezza terminal Domo II, Bremerhaven, Busto Arsizio – Gallarate, Hamburg-Billwerder, Hamburg-Burchardkai/ Altenwerder/EUROKOMBI, Köln-Eifeltor, Rostock Seehafen, Wuppertal

5.6.2 Smart terminal layout and operations

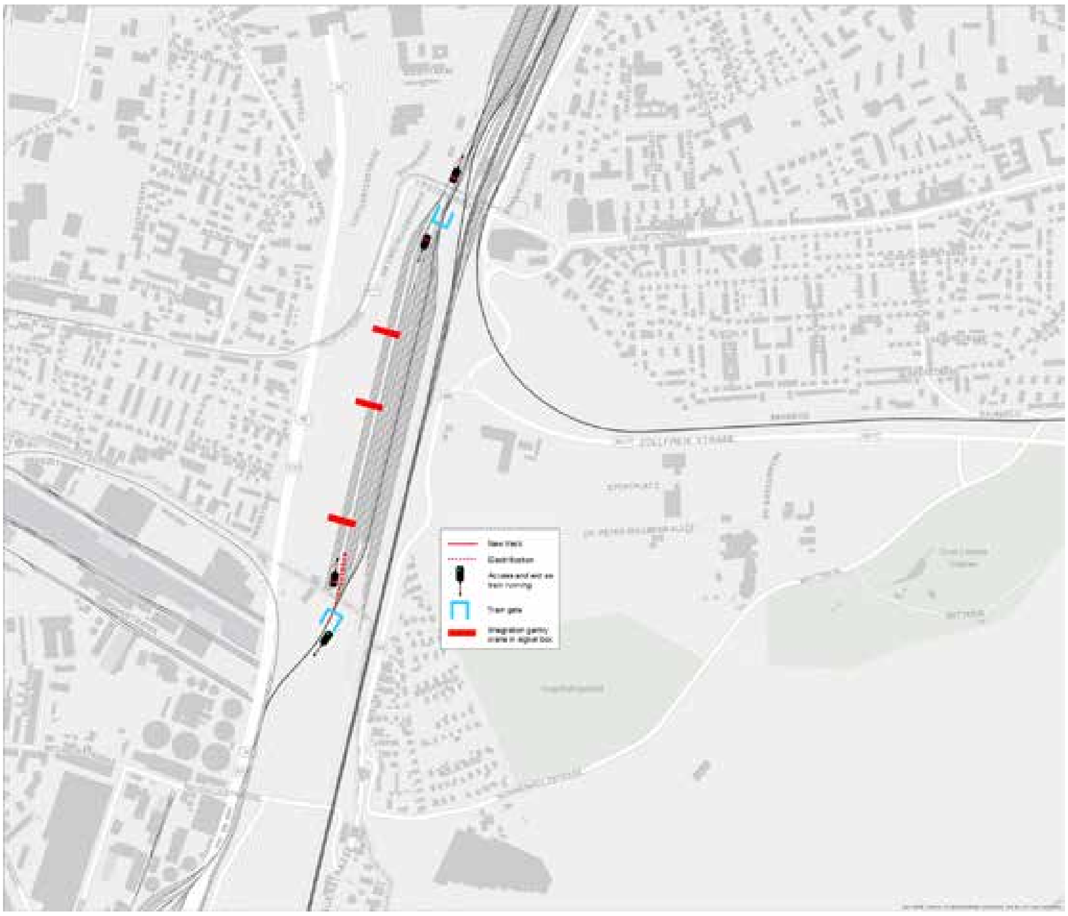
Single option (no cost estimate available due to uncertainty of costs for control and signalling technology) (Figure 5.14)

Liner trains approach directly from the north and south via momentum access. The wagons can be loaded and unloaded immediately. Although the main line locomotive remains coupled to the wagons during the entire loading and unloading process, a partial brake test is required in accordance with the current regulations (stopping time > 1 hour). After the departure check of the wagons and containers, the liner train can depart northbound and southbound.

Adaptations required include the electrification of a short track section north and south of the area covered by the cranes (2 tracks), integration of 3 gantry cranes and 2 tracks into the interlocking system, installation of train gates. The time required for implementation, including planning and permissions, is estimated to be at least 6 years after a positive decision by the terminal operator. The adaptation described aims to obtain intermodal ERFLS trains' dwell times of 3-6 hours.

It should be noted that SBB Cargo is planning the Basel North terminal, south of the Weil am Rhein terminal. Whether and how the southern connection proposed here is possible when implementing this Basel North terminal project could not be ascertained.

Figure 5.15 Basel-Weil am Rhein intermodal terminal, infrastructural measures, single option



5.6.3 Telematics

Basel Weil am Rhein has been characterised as a satellite terminal. The IT system at Weil has all the features required to be integrated in a system connecting the terminals along a corridor. An essential factor is the presence a module to communicate data that is part of the software BLU. This is a software used by DUSS to manage handling of ITUs, crane operations, statistical analyses and invoicing. BLU is based on a central system allowing remote access through the web from any connected work station. By using a network of servers with web services, BLU is able to relay the transport statuses required to monitor and control ERFLS traffic.

The BLU software receives messages for arriving trucks and ITUs and departing trucks and ITUs, and adds them to the system while waiting to receive the vehicles. For each ITU it identifies arrival, movement, storage locations (georeferenced), and destination. By using this information, the operations office may plan and optimise handling work on the yards. Each ITU has a status attached depending on its availability. The system receives the composition of the arriving trains and sends the same type of data for departing trains. On train arrival, the data is acknowledged as a whole train entity, so as to assign it a track where it can be worked. Later, wagons and ITUs are itemised singularly to allow checking the incoming trains and passing on the information the ITUs are available for pick up.

Table 5.14 Basel-Weil am Rhein intermodal terminal, summary technical information of the current IT

CONNECTIVITY: Optic fibre	DBs: SQL
BANDWIDTH: more than 10 mbs	PROTOCOLS: TCP/IP
TOS LANGUAGES: NET	METHODS: FTP/WEB SERVICE
INTERFACES: Client/Server/Web	

The set-up of the telematics system for ERFLS is planned to take 22 days of work involving project manager, system, engineer, senior developer, electrician. The commissioning of the IT including tests of operations system, security, back-up, database, and ERFLS application tests, training and beginning of production stage are expected to require 25 working days. A first estimate of the overall costs for commissioning the ERFLS system in Basel-Weil am Rhein amounts to € 317.575.

5.6.4 Regional market analysis

The DUSS terminal Basel-Weil am Rhein is located at the border triangle Germany, Switzerland, France and very close to both the port of Weil am Rhein and the Port of Switzerland. The latter is being expanded with the construction of trimodal Basel gateway Nord (from 2019-2022) that will determine the competitive position of DUSS Basel-Weil with potential ERFLS service.

The largest economic sectors in the Basel region are the pharmaceutical industry, life sciences and the financial industry. Transport-wise, as of 2018, 30% of Swiss foreign trade passes the Basel logistics region. As for rail freight trains, Basel is the busiest border on the Rhine Alpine Corridor. Indeed, due to its geographical border location, the DUSS terminal is a logistic gateway for transalpine shipments to and from Switzerland, for transit to the northern Italian industrial centres and France. Road access to the Weil am Rhein Terminal is on Swiss territory and reachable from both Germany and Switzerland.

The Weil am Rein terminal handles loading units that are 20% continental and 80% maritime and there is little space for extension. At the German-Swiss border, technical and operational dwell times occur. To prevent extra time losses, border dwell time should be synchronized with ERFLS transhipment dwell time in Weil, further investigation is needed once the system has been set up.

From a system's view, the planned smart terminals in Lahr and Weil are very close to each other since they are less than 100 kilometres apart. It is unlikely that an ERFLS schedule will serve both locations within one train path as the modal shift potential is low regarding time and cost factors.

5.6.5 Socio-economic points

The scenario indicators, calculated for the DUSS Weil am Rhine terminal, are 2.50 and 2.69 respectively for the base scenario and the ERFLS scenario.

The economic impact that can be associated with ERFLS system can be estimated at around 300 direct and indirect jobs, while the revenues for the State are estimated at around w6.7 million euro.

The analysis of the overall context (see Table 5.15) shows that the real strength in both scenarios is the geographical and economic scope in which the terminal is placed, since it is also the location of important companies of several industries, as mentioned in section 5.6.4 above.

One of the main weaknesses of the scenario, however, seems to be precisely the terminal in its current configuration, because of several bottlenecks including the lack of adequate parking spaces for trucks waiting to carry out customs checks. Failure to intervene adequately risks transforming the impact of ERFLS into a negative cost for the community that will be more congested on the roads.

Table 5.15 Basel-Weil am Rhein intermodal terminal, SWOT analysis

Strengths	Weaknesses
- The terminal's catchment area has a very dynamic economy - A lot of international companies have their headquarters in this area - Strategic location on border between Germany and Switzerland - The terminal is an important hub for transalpine combined transport to Switzerland, Italy and France	- Bottleneck along road access to the terminal - Lack of automated access control system - Bottlenecks at customs checks - Lack of adequate parking spaces for trucks waiting to carry out customs checks
Opportunities	**Threats**
- The Rhine-Alpine corridor will contribute to increasing the accessibility of the area and will favor connections with other parts of Europe - Improvement of technologies in transport and logistics services - Universities and financial and research centers active in the region	- Bottlenecks along cross border sections - Non-competitive prices of rail transport compared with road transport - Rail transport low in punctuality and efficiency - Long times for the realization of the infrastructural intervention

5.7 Novara

5.7.1 Base information

The Novara complex is made up by three terminals operated by reach stackers, owned by CIM and managed by Eurogateway. Two of those terminals are considered for adaptation in the following paragraphs.

At present the layout of all terminals in Novara entails rail access from one side only: access is with shunting movements from the entry-exit sidings of Novara (see Figure 5.16), there are train gates but manual checks are required. Road-side, the terminal has fast entry facilities, enough space for loading/unloading next to the crane tracks and easy motorway access. The terminal includes facilities for handling broken wagons and has an optimized handling algorithm in its terminal operating system.

The main data about the Novara complex are reported in Table 5.16.

Figure 5.16 Intermodal terminals in Novara, location in the railway network

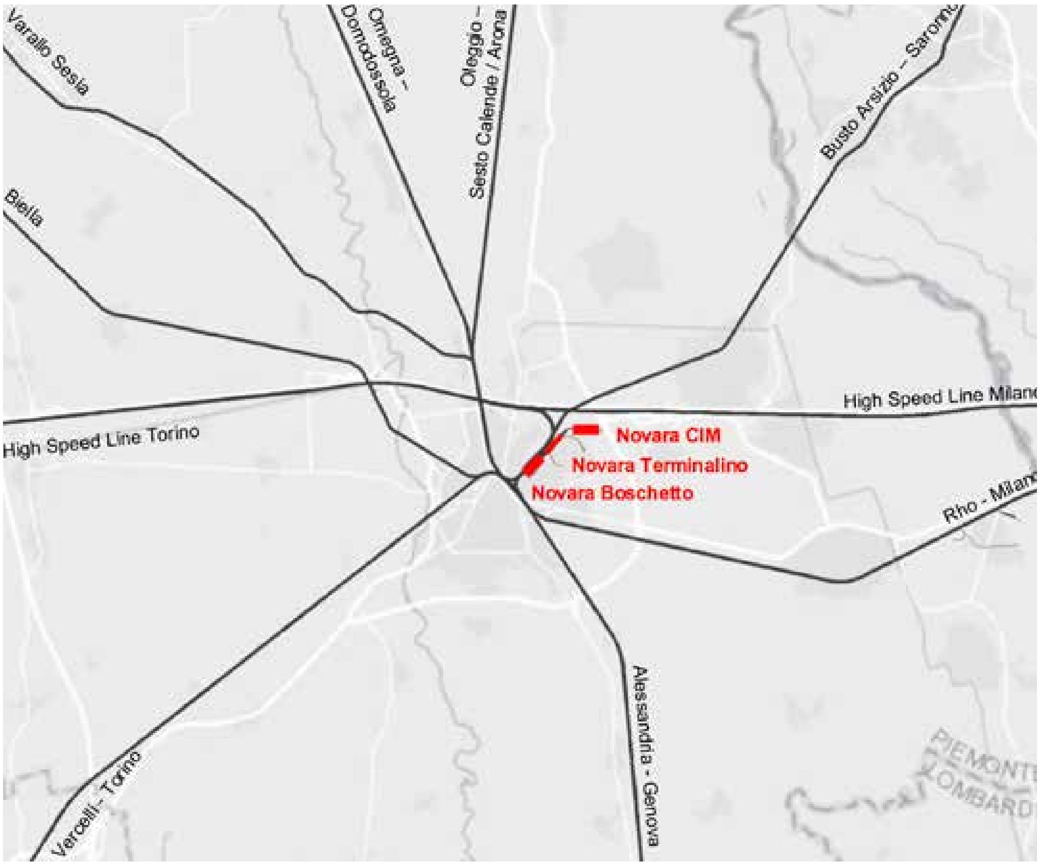


Table 5.16 Key figures for the Novara terminal. Information on the terminal for the "rolling highway", which is operated by RAlpin AG, is not included

Area	CIM terminal: 170,000 m² Boschetto: 50,000 m² Terminalino: 25,000 m² (currently under construction)
Current traffic	CIM terminal: 200,000 loading units (composition 10% containers, 30% semitrailers, 60% swap bodies)
Capacity for storage (storage lanes)	308 TEU
Loading tracks (in the range of the cranes	CIM terminal: 3 x 650 m + 4 x 600 m = 4350 m Boschetto: n/a Terminalino: 2 x 559 m = 1118 m
Storage sidings	n/a
Cranes	CIM terminal: 7 reach stackers, load-bearing capacity 40 t (each), 15 transfers per hour Boschetto: 5 reach stackers, load-bearing capacity 40 t (each), 15 transfers per hour Terminalino: 4 reach stackers, lead-bearing capacity 40 t (each), 15 transfers per hour
Capacity	Loading and unloading of up to 24 trains per day, Transfer of up to 300,000 load units per year
Operating concept	Train remains on the crane track for the entire duration of its stay (unloading, loading) in the terminal (*Standverfahren*)
Opening hours	CIM terminal: Monday-Friday 0:00-23:59, Saturday 0:00-12:30 Boschetto: Monday-Friday 05:00-21:30, Saturday 07:00-12:30 Terminalino: n/a
Electrification	No
Current traffic	CIM terminal: 200,000 loading units (composition 10% containers, 30% semitrailers, 60% swap bodies)
O/Ds of trains at time of survey	Rotterdam, Lubeck, Ludwigshafen, Köln, Valenton, Antwerp, Charleroi, Genk, Rostock, Zeebrugge, Worms, Trieste

5.7.2 Smart terminal layout and operations

Four options were proposed, considering different terminals inside the Novara compound. They are intended to obtain a dwell time for ERFLS intermodal trains of 3.5-6 hours, except for option 4 which refers to a terminal fully to ERFLS standards and would enable dwell times of 2-4 hours.

Option 1: CIM terminal with few infrastructure adjustments (cost estimate 2.5 M€ ±50%) (Figure 5.17)

This option foresees the electrification of the access to the CIM terminal, and the upgrade of the safety system of an internal level crossing to allow for an increase in shunting speed. Trains getting into the current entry yard are uncoupled from the locomotive which is then coupled to the back of the train and pushes back the consist into the terminal. After the brake test, the locomotive is ready to take the train to the main line directly from the terminal.

The reduction of terminal dwell time is achieved with an increase in shunting speed, and the direct exit of trains.

The time required for implementation of this option, including planning and permissions, is estimated to be at least 2 years.

Figure 5.17 Novara intermodal terminal (CIM), Infrastructural measures, option 1

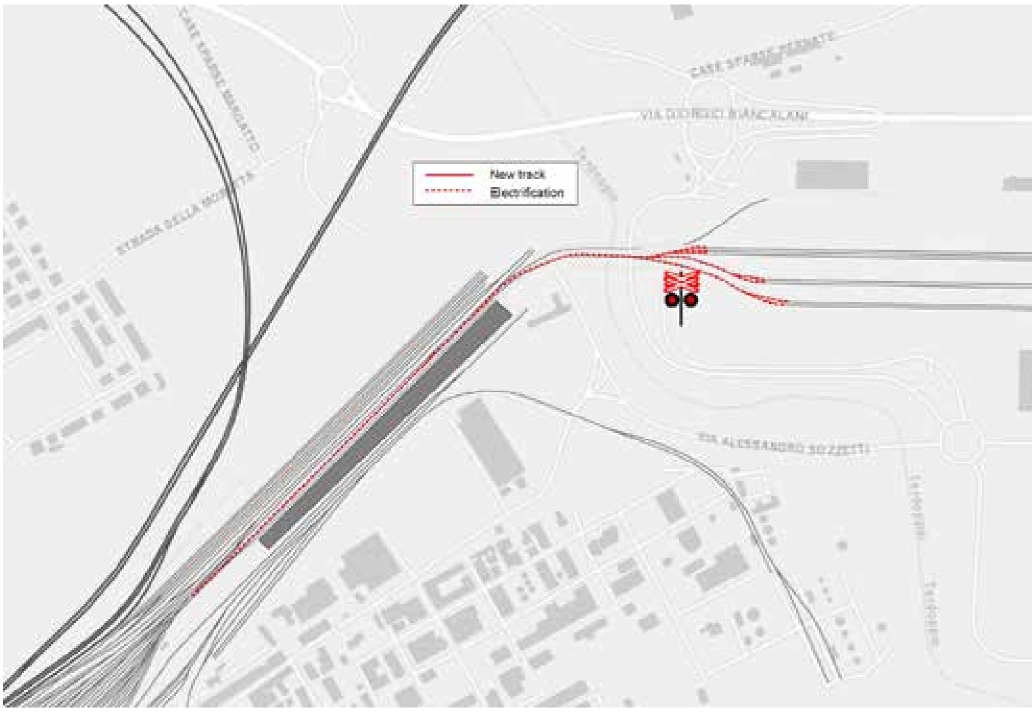


Figure 5.18 Novara intermodal terminal (CIM), infrastructural measures, option 2

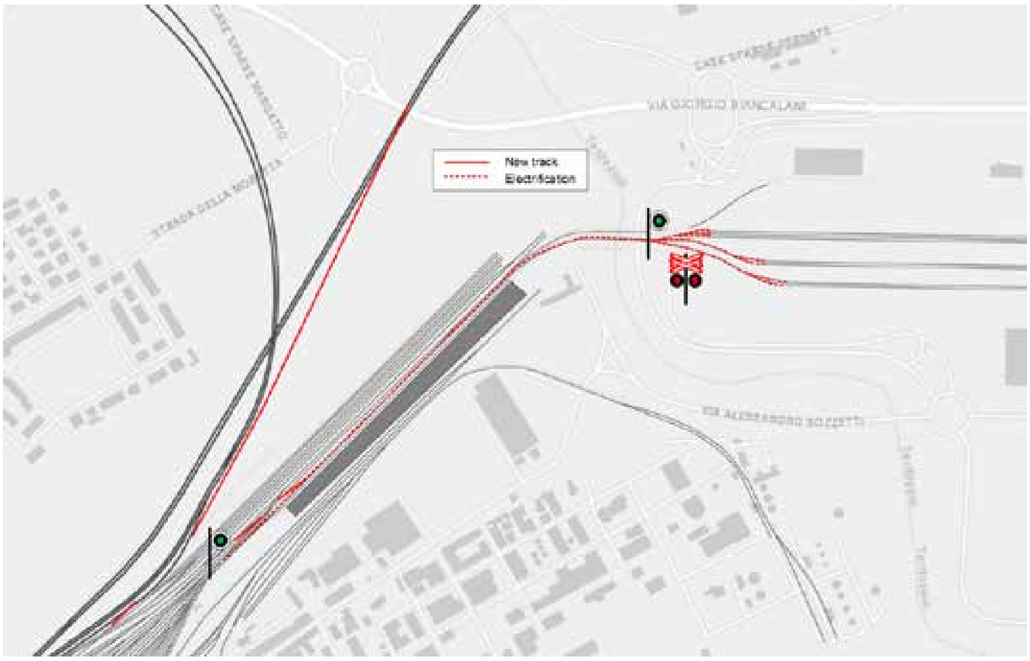


Figure 5.19 Novara intermodal terminal (CIM), infrastructure measures, option 2c

Option 2/2a/2b/2c: CIM terminal with more extensive infrastructure upgrades (cost estimate 11.1 M€ ±50%) (Figure 5.18 and Figure 5.19)

This option entails making the entry/exit sidings of the Novara terminal become accessible from two sides by linking the Busto Arsizio line (see Figure 5.16) to the Novara entry/exit sidings (about 800 m main line track) and extending signal control accordingly. Electrification of the access to the CIM terminal as well as upgraded signalling would allow for entrance by momentum access from the south and a shunting movement to/from the north. Direct exit would be possible for trains heading south.

A further option 2a considers the entrance by shunting to simplify signalling and its connections to the reach stackers. Still, another variant (option 2b) entails replacing reach stackers with gantry cranes to improve speed of operations (crane rails are already in place). A further variant, option 2c, defines how 4 of the CIM tracks, currently of 650 m maximum, could be extended to 700-750 m.

The time required for the implementation of this option, including planning and permissions, is estimated to be at least 2-3 years.

Option 3: Adaptation of Terminalino (cost estimate 1.3 M€ ±50%) (Figure 5.20)

Access to Novara by momentum access could be possible by basing ERFLS services in the Terminalino (see Figure 5.16), consisting of two parallel tracks, whose access from the current entry sidings would need to be electrified and the exit towards the CIM terminal would need to be opened. Moreover, the whole Terminalino would need to be equipped with signals. While trains are unloaded/loaded the locomotive would be moved to their opposite side thus enabling direct exit from the terminal. Dwell time would be reduced by momentum access, direct exit and brake tests carried out during ITU handling. The terminal is operated with reach stackers and their transfer capacity on one of the tracks may be reduced. It should be noted that Terminalino accommodates 450 m long trains and cannot be extended.

The time required for the implementation of this option, including planning and permissions, is estimated to be at least 2-3 years.

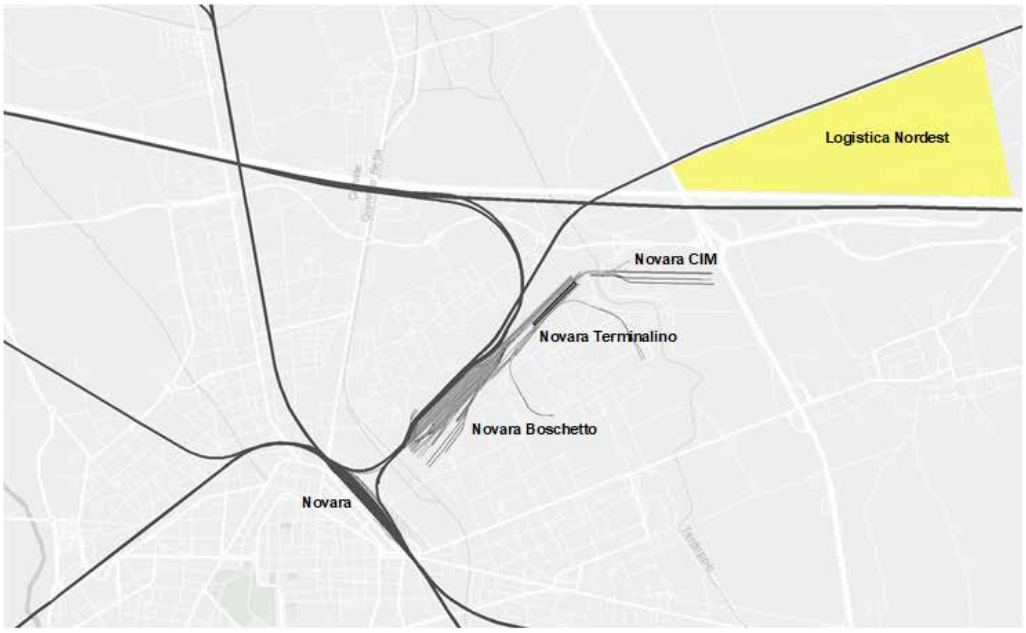
Figure 5.20 Novara intermodal terminal (Terminalino), infrastructural measures, option 3

Option 4: New smart terminal in Novara Nordest (cost estimate 52.8 M€ ±50%)
(Figure 5.21)

A new terminal built directly according to the "smart terminal" concept in the area just north-east of CIM between the high-speed line and the Busto Arsizio line (see again Figure 5.16) would allow for the full reduction of dwell time possible with the ERFLS concept. The Busto Arsizio line would possibly need to be adapted (it is now single track and used by passenger trains only).

The time required for implementation of this option, including planning and permissions, is estimated to be at least 6-8 years after a positive decision by the terminal operator.

Figure 5.21 Novara intermodal terminal, area of possible development Logistica Nordest



5.7.3 Telematics

Novara is planned as a control tower of the ERFLS telematics system. The ICT system at CIM Novara has all the features required to be integrated in a system to connect terminals along a corridor. Management of rail and road traffic arriving and leaving the terminal is carried out with GOAL (Global Oriented Application for Logistics, the same used in Ludwigshafen) which enables the terminal to manage the statuses related to transport and handling operations. Exchange of data with third parties is via the EDIGES module of GOAL. Terminal operations and ITU stock management are carried out with WOLT (Web Oriented Logistic and Transport), a TOS which georeferences ITUs and equipment and may plan handling tasks.

The system receives the messages for arriving ITUs (bookings) and departing ITUs (deliveries) and inserts them on the TOS while waiting to receive the vehicles. The gate-in / gate-out procedures entail a visual inspection of ITU and documents, after which the operation is registered in the system. The system receives the composition of the arriving trains and relays the composition of the departing trains. Incoming trains are first treated as a single entity and, once on their tracks, wagons and ITUs are itemised singularly to allow checking the load and passing on the information that the ITUs are available for pick up.

Table 5.17 Novara intermodal terminal, summary technical information of the current IT

CONNECTIVITY: Optic fibre	DBs: SQL – RPG2
BANDWIDTH: more than 10 mbs	PROTOCOLS: TCP/IP
TOS LANGUAGES: Visual c#, php, aspx, .net	METHODS: FTP/WEB/WS
INTERFACES: Client/server – WEB	

The set-up of the telematics system for ERFLS is planned to take 23 days of work involving project manager, system, engineer, senior developer, electrician. The commissioning of the IT including tests of operations system, security, back-up, database, and ERFLS application tests, training and beginning of production stage are expected to require 25 working days and will need to follow the set-up of the ERFLS IT at the smart terminals. A first estimate of the overall costs for commissioning the ERFLS system in Novara amounts to € 334.350.

5.7.4 Regional market analysis

Novara lies within the North Italian industrial triangle formed by Torino, Milano and Genova. The Interporto (freight village) to which the case study terminals belong, is an inland trade link between the Italian seaports, the Rhine-Alpine rail freight corridor and the domestic market network. The freight village has very good links to the motorway network. However, the roadside connections with the economically strong production centres around Milan are insufficient. Freight flows from the production centres destined to Novara must inevitably run through the busy ring road around Milan, which brings along the risk of delays. The Milan industry is served by local terminals (Busto, Rivalta), and in the immediate catchment area of Novara, the internationally active manufacturing industry is weaker, mainly agricultural production and food industry has settled there. Moreover, although Novara is located in the hinterland of the port of Genoa, it has little importance for Far East/oversea maritime flows. Indeed, there is no direct sea container rail transport from the seaport of Genoa to the Interporto Novara and vice versa. Novara is situated on the closest rail connection from the ports northwards, however, the main industries are located in Milan (north-west, south) on the opposite side of Novara.

Most Italian traffic is north-oriented, there are imports from the Northern Range, exports of Italian products to markets in central/northern Europe and exports to the Dutch seaports for oversea container transhipment. Freight flows to Switzerland and Southern Germany will increase if the Ports of Genoa are better connected to the hinterland with the new Terzo Valico Apennine crossing. The Terzo Valico will strengthen the position of the Ports of Genoa towards the seaports Rotterdam and Antwerp because travel times will be reduced significantly by the new railway line. Rail freight traffic via Domodossola/Luino is already increasing at present.

5.7.5 Socio-economic points

In the calculation of the scenarios there are two elements that influence the value of the indicators; from the socio-economic point of view is the presence of a very strong production area like the province of Milan which has a very important reference point for the logistic activities and the transport of goods, from an infrastructural point of view, it is the CIM itself, which represents an essential logistic node not only for the Italian north west but for the whole of Italy.

Already in the base scenario the value of the indicator is quite high: 3.17. In the ERFLS scenario it increases to 3.35. The immediately measurable effects of ERFLS services are those deriving from the increase in traffic volumes. Against an estimate of approximately 77 thousand ITUs/year, the benefits for the territory translate into 380 direct jobs and in the related sector, and additional remittances for the state of approximately 8.5 million euro.

With the commissioning of all the infrastructural works connected to the Rhine-Alpine corridor and the Terzo Valico, the Novara terminal will have a hinge role in the corridor railway system and its position will be even more strategic in the north-south connections.

Among the strengths of the scenario are certainly the location of the terminal near one of the most developed regions of Europe, Lombardy, the strategic position along the main transport axes that connect Italy with central Europe and an economic context where the demand for innovation in the transport and logistics sectors is very strong.

A critical issue is the limited capacity of the terminal to manage additional traffic: available data show that the terminal is close to saturation, so the estimated increase of around 20% may not be fully accommodated. Therefore, a further possible effect of the ERFLS system could be to speed up the expansion of the terminal or, alternatively, to encourage the creation of a further smart terminal in the territory either with the construction of a new one or the update of an existing one.

Among the weaknesses is the current terminal equipment that is far from the standards required for the corridor.

The results of the analysis are summarised in Table 5.18.

Table 5.18 Novara intermodal terminal, SWOT analysis

Strengths	**Weaknesses**
- The presence, among the Terminal's catchment area, of Milan which is one of the most developed cities in Europe - Strong push for innovation and logistics by major companies - CIM is the second terminal in Italy in terms of volumes of freight handled - Strategic location along the main core network axis that cross the north of Italy	- Large interventions are required to became a smart terminal - Low residual handling capacity of ITUs - Bottlenecks along access roads to terminal
Opportunities	**Threats**
- The Terzo Valico, once operating, will contribute to increasing the connections with the port of Genova - End of works on the Italian section of the corridor, particularly the Terzo Valico - Improvement of technologies in transport and logistics services - Universities and research centres	- Bottlenecks along the cross-border section to Switzerland - Bottlenecks along the railway network due to a high demand of passengers services - Non-competitive prices of rail transport compared with road transport - Long times for the realization of the infrastructural intervention - Missed completion of the Terzo Valico

5.8 Possible timetables

A set of possible timetables for ERFLS services was drawn up with the aim to check their feasibility with the Corridor One Stop Shop (C-OSS). The latter check, even with the involvement of the Corridor management and the Swiss Path allocation body (Trasse CH), was not successful since the request was very unlike normal C-OSS procedures, that do not typically deal with paths stretching the whole length of the corridor and include several stops at terminals, as the Action assumed.

Possible timetables were set up considering train routings either via the Luino border point or the Domodossola border point. Two infrastructural scenarios were considered, with reference years respectively at 2020 and at 2030. The former did not include the Valburg and Lahr terminals, and considers ERFLS services limited to Novara on the Italian side. The latter scenario considered all six ERFLS terminals, the new Rhine Valley line and the Terzo Valico in place, as well as trains travelling to Genoa. For each of the four alternatives, best and worst case times for stops at terminals were calculated. Tentative timetables via Luino at 2020 and at 2030 are shown in Table 5.19.

Table 5.19 Tentative timetable for a route along the whole corridor and crossing the Swiss-Italian border at Luino. Times in hh:mm

Route via Luino	2020			2030		
	Travel Time	Dwell time		Travel Time	Dwell time	
		Best	Worst		Best	Worst
Rotterdam (Maasvlakte)	-	-	-	-	-	-
Valburg	1:51	3:00	5:00	1:51	2:00	4:00
Duisburg (Logport III)	1:39	6:30	6:30	1:39	3:00	6:00
Ludwigshafen	4:59	3:00	5:00	4:59	2:30	5:00
Lahr	-	-	-	2:37	2:00	4:00
Basel Weil am Rhein	4:08	7:00	8:00	1:17	3:00	6:00
Novara	6:28	-	-	6:23	3:30	6:00
Genova Marittima	-	-	-	2:40	-	-
Total travel or dwell time	**19:05**	**19:30**	**24:30**	**21:26**	**14:30**	**31:00**
Total travel time including stops		**38:35**	**43:45**		**35:56**	**52:26**

Route via Luino	2020			2030		
	Travel Time	Dwell time		Travel Time	Dwell time	
		Best	Worst		Best	Worst
Genova Marittima	-	-	-	-	-	-
Novara	2:48	-	-	2:01	3:30	6:00
Basel Weil am Rhein	6:28	7:00	8:00	6:23	3:00	6:00
Lahr	-	-	-	1:17	2:00	4:00
Ludwigshafen	3:59	3:00	5:00	2:37	2:30	5:00
Duisburg (Logport III)	4:59	6:30	6:30	4:59	3:00	6:00
Valburg	1:36	3:00	5:00	1:36	2:00	4:00
Rotterdam (Maasvlakte)	1:51	-	-	1:51	-	-
Total time	**18:53**	**19:30**	**24:30**	**20:44**	**16:30**	**31:00**
Total travel time including stops		**38:23**	**43:23**		**37:14**	**51:14**

6 Transport and environmental effects

6.1 Introduction

This chapter summarises the work reported in Milestone 10 about the modelling exercise to estimate energy and environmental potential effects of ERFLS. In order to estimate energy and CO_2 effects, freight transport along the corridor was analysed and modelled, thus obtaining also estimates of cargo transport shifted to ERFLS rail services. The chapter closes by summarising a calculation of carrying capacity of ERFLS trains developed as part of the study for a possible ERFLS timetable (Milestone 5).

6.2 Freight transport demand along the corridor

The demand for freight transport along the corridor was analysed with reference to the NUTS2 zones belonging to Belgium, Germany, the Netherlands, Switzerland and Italy that are shown in Figure 6.1.

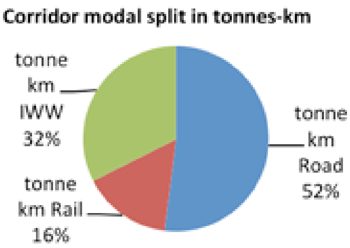
Figure 6.1 NUTS2 along the corridor

In 2015 more than 200,000 million of tonnes-km travelled along the Rhine-Alpine Corridor. Road was the most used mode of transport (52% of the tonnes-km), followed by IWW (32%) and rail (16%) (see Table 6.1 and Figure 6.2).

Table 6.1 Tonnes-km travelling along the Rhine-Alpine Corridor (2015) (elaboration on Eurostat data)

Total tonnes km (·10⁶): 216,165		
	Tonnes	**Tonnes-km (·10⁶)**
Road	757,952,347	112,278
Rail	107,015,023	337,052
IWW	329,135,900	701,812

Figure 6.2: Modal split along the Rhine-Alpine Corridor (tonnes-km, 2015) (elaboration on Eurostat data)



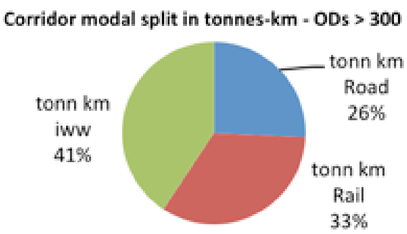
However, considering only goods travelling for more than 300 km (the minimum distance considered in the third objective of the 2011 EC White Paper for the shift from road to rail or IWW) the modal splits of IWW and rail increase significantly: the share of IWW becomes 41%, rail increases to 33%, while road decreases to 26% (see Table 6.2 and Figure 6.3).

Table 6.2 Tonnes-km travelling along the Rhine-Alpine Corridor for distances > 300 km (2015) (elaboration on Eurostat data).Distances > 300 km

Distances > 300 km

Total tonnes km (·10⁶): 68,865		
	Tonnes	**Tonnes-km (·10⁶)**
Road	36,058,159	17,192
Rail	32,711,223	22,455
IWW	56,049,300	27,218

Figure 6.3 Modal split along the Rhine-Alpine Corridor for distances > 300 km (tonnes-km, 2015) (elaboration on Eurostat data)



Focussing the analysis on the international freight transport along the Rhine Alpine Corridor, the modal split varies significantly among the several origin-destinations, as shown in Table 6.3, with IWW and railway having usually the largest share, excluding flows between Germany-Switzerland and Italy-Switzerland, where road plays an important role.

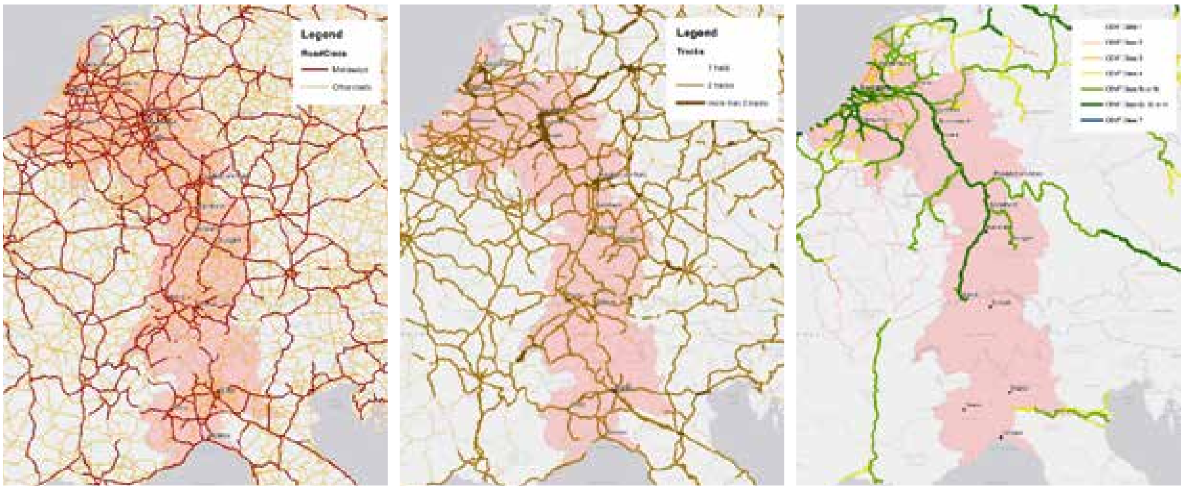
Table 6.3 International freight transport modal split along the Rhine-Alpine Corridor for distances > 300 km (tonnes-km, 2015) (elaboration on Eurostat data)

Origin	Destination	Road > 300km [% tonnes-km]	Rail > 300km [% tonnes-km]	IWW > 300km [% tonnes-km]
Belgium	The Netherlands	32%	26%	42%
	Germany	12%	9%	79%
	Switzerland	7%	24%	69%
	Italy	16%	84%	-
The Netherlands	Belgium	42%	5%	52%
	Germany	21%	12%	67%
	Switzerland	18%	26%	56%
	Italy	21%	79%	-
Germany	Belgium	20%	2%	77%
	The Netherlands	41%	8%	51%
	Switzerland	52%	40%	8%
	Italy	26%	74%	-
Switzerland	Belgium	19%	20%	62%
	The Netherlands	16%	31%	53%
	Germany	68%	29%	2%
	Italy	60%	40%	-
Italy	Belgium	17%	83%	-
	The Netherlands	16%	84%	-
	Germany	19%	81%	-
	Switzerland	75%	25%	-

6.3 The potential for shifting freight transport to intermodal rail due to ERFSL services and the effects on CO_2 emissions and energy consumption

In order to understand the ERFLS potential in terms of CO_2 emissions and energy saved, it was necessary to set up a model simulating freight flows along the whole corridor travelled by ERFLS services refined to NUTS2 level, by reconstructing the freight OD matrices, and calibrating a modal split model considering all relevant alternative transport modes between each OD pair (road, intermodal rail, IWW, and ERFLS), which was successfully validated against Eurostat data.

Figure 6.4 The road, railway and IWW networks as modelled to estimate modal shift and environmental effects



The modal shift model used is able to estimate the choices of shippers and freight forwarders related to the transport mode used. This kind of model considers a systematic utility associated to a generic decision-maker and to a series of mutually exclusive alternatives (the modes). A vector of attributes is associated to each mode and each decision-maker and the model returns the probability that the decision-maker will select one alternative.

Three different attributes have been considered: cost, time (for all modes of transport) and frequency (only for rail and IWW services). The first two attributes include all the main components of times and costs, such as travelling and handling times and costs, shunting times and costs, waiting times in nodes, etc. The utility of each mode of transport is completed by an "alternative specific constant", present for all the alternatives except road. The ASC is used to take into account all other attributes not previously estimated such as reliability, punctuality, etc.

Figure 6.5 Simulated transport alternatives in the two scenarios

After validating the model with 2015 data, two different Scenarios were simulated:
- In the first one (Scenario I) only three ERFLS rail nodes (Valburg, Ludwigshafen and Novara) were considered, together with the two ports of Rotterdam and Genoa, for a total of five ERFLS nodes. Scenario I represents the initial phase of the ERFLS transport system implementation, in which only a portion of the service will be available.
- In the second one (Scenario II) all six ERFLS rail nodes were considered, together with the two ports, for a total of eight ERFLS nodes. Scenario II represents the second phase of the ERFLS transport system.

Two cases were simulated for each Scenario, considering alternatively the same costs for ERFLS as for intermodal rail (case 1) or costs increased by 10% with respect to conventional intermodal rail (case 2). The environmental and energy effects were calculated starting from the model results in terms of modal shift (tonnes-km shifted from road to ERFLS) by using Copert 4 emission factors.

The simulations were carried out considering always the current freight demand in order to isolate the effect of the ERFLS service and avoid being influenced by other exogenous factors (i.e. transport policies, trade variations, commercial agreements between Countries, etc.).

In the Scenario II Case 1 simulation, the ERFLS service attracts 18 million tonnes per year (10,070 million tonnes-km). The resulting modal shift from road to ERFLS, considering distances greater than 300km, is 13% (tonnes-km). With such a shift it is possible to estimate a truck reduction of 280,000 vehicles per year (104 million veh-km) with CO_2 savings equal to 72,000 tonnes per year and energy saving of 25,500 tonnes of oil equivalent (toe) per year.

Table 6.4 Results related to ERFLS Scenario II - Case 1

Scenario II Case 1 – (6 ERFLS nodes + 2 ports; ERFLS Costs = Conventional intermodal rail costs)	
Corridor modal shift	+ 18 Mln tonnes per year on ERFLS
	+ 10,070 Mln tonnes per km per year on ERFLS
	13% tonnes-per km per year (>300km)
	4.5% tonnes-per km per year
Truck reduction	- 280,000 veh per year
	- 104 Mln veh-km per year
CO_2 consumption	- 72,000 tonnes per year
Energy consumption	- 25,000 toe per year

These figures decrease slightly in case 2 (ERFLS Costs = Conventional costs + 10%): ERFLS attracts 14 million tonnes per year (7,400 million tonnes-km) and the resulting modal shift from road to ERFLS, considering distances greater than 300 km, is 9% (tonnes-km), as reported in Table 6.5.

Those positive results suggest the opportunity of further studies in order to estimate in detail the potential ERFLS demand, for example considering the peculiarities of certain commodities or including other relevant aspects for freight transport, such as the shipment size and the balancing of flows.

Table 6.5 Results related to ERFLS Scenario II - Case 2

Scenario II Case 2 – (6 ERFLS nodes + 2 ports; ERFLS Costs = Conventional costs + 10%)	
Corridor modal shift	+ 14 Mln tonnes per year on ERFLS
	+ 7,400 Mln tonnes-km per year on ERFLS
	9% tonnes-km per year (>300km)
	3.5% tonnes-km per year
Truck reduction	- 240,000 veh per year
	- 91 Mln veh-km per year
CO_2 consumption	- 63,000 tonnes per year
Energy consumption	- 22,000 toe per year

6.4 Replacement effect of a single train with full exchange of loads at the terminals

The work linked to the development of the tentative timetable summarised in section 5.8 went on to quantify the transport capacity provided by a train headed by a DB BR 189 locomotive hauling a consist of Sgnss wagons, with gross weight limit of 1600 tonnes. Results show that fully loaded wagons (taken to the weight limit) allow carrying 1,126 tonnes of payload while if, more realistically, 25 tonnes of payload per wagon are considered, a total payload of 853 tonne per train may be admitted. Considering 250 working days/year, the first calculation returns a transport capacity of up to 3,941,000 tonne/year and the case with 25 tonne per wagon returns up to 2,985,500 tonne transported per year. This case considers that there is one ERFLS train pair per day along the whole corridor and that the train is fully unloaded and fully loaded at each terminal.

Those results were obtained with a different approach than the results reported in 6.1. In 6.1 the estimates refer to the potential ERFLS tonnes transported based on the demand for goods transport obtained from Eurostat data detailed to NUTS 2 level. While assumptions on frequency of services, travel times and distances show a good correspondence, the approach taken 6.1 does not consider train capacity constraints whereas the one in the present section does. Moreover, the model in 6.1 considers potential shift from road, conventional rail, and IWW whereas the estimate considered here refers to truck replacement only.

Concluding, even though results are different, they may be seen as consistent. The modal split model returned information on the potential of ERFLS, based on a given frequency (5 trains/week in each direction) that may need to be increased to accommodate all the goods for which ERFLS could be attractive. The supply-based approach based on the train capacity highlights the maximum amount of cargo that 5 trains/week in each direction can take, thus indicating that a higher frequency is necessary to carry the amount estimated in 6.1.

7 Conclusions

The European Rail Freight Line System is feasible

The European Rail Freight Line System (ERFLS) Action, developed over the years 2015-2018, successfully investigated the feasibility of the concept of liner intermodal freight trains that make several short stops at a system of terminals along the Rhine-Alpine Corridor, where intermodal units are loaded or unloaded much in the same way as passengers get on and off intercity trains at intermediate stations.

Smart terminals will reduce times in terminals

Smart terminals are the cornerstone of ERFLS. They have layout and operational practices allowing for direct entry and exit of trains as well as for dwell times of intermodal trains as short as 2 hours. This compares to dwell times of 4-8 hours that are current practice. Smart terminals also have optimised road-side operations and exchange operational information among them through the ERFLS telematics systems.

Six terminals along the whole Rhine Alpine Corridor were examined and all can become smart terminals

The concept of smart terminals was investigated on six different terminals:

- RTG Valburg (planned), the Netherlands
- Duisburg Logport III (operational), Germany
- KTL Ludwigshafen (operational), Germany
- Lahr (planned), Germany
- Basel Weil am Rhein (operational), Germany, on the Swiss border
- Novara (operational), Italy

Each of them posed specific challenges. The Action put forward a number of feasible changes to layout and operations so as to allow for direct entry and exit of intermodal trains and to achieve substantial dwell time reductions.

Benefits also with limited changes to existing terminals

At some terminals operations and layout are already similar to those of smart terminals. This is the case in Ludwigshafen. Other terminals such as Novara or Duisburg require more important transformations. Time benefits can be obtained even when only a part of the possible measures to speed up dwell time at terminals are feasible.

Times and costs for adapting existing terminals are available

The study Action provided a description of how the terminals examined can be adapted to become smart terminals, also discussing alternative options. A first estimation of cost and times for works was also provided for each transformation option.

Operational improvements devised for ERFLS benefit all intermodal traffic

Operational rail side improvements and optimisation of road-side operations at smart terminals can be enjoyed by both ERFLS trains and conventional intermodal traffic. In fact, smart terminals do not have to be dedicated entirely to ERFLS trains.

ERFLS and smart terminals can already be obtained by optimising current technologies and practices, and are open to new technologies

ERFLS may be already implemented by using or adapting technologies currently available. Putting them together in a single concept led to operationalising the smart terminal model. However, the concept is not linked to the particular technologies considered in the Action. In fact, the ERFLS concept is open to new technologies that optimise intermodal operations.

Challenges and solutions to extend practices to new contexts

New contexts for existing technologies or procedures have revealed challenges that need to be addressed to have ERFLS services operating among a network of smart terminals. Challenges encountered comprise:

- the lack of operational rules for terminals along lines equipped with the ERTMS level 2 safety system which could possibly be solved by considering their similarity with passenger stations;
- the need to develop new procedures to have momentum access to terminals in some countries, such as Italy, whereas it is standard practice at some terminals in other countries (notably in Ludwigshafen or Wien);
- train path requests for freight trains travelling across several Countries and stopping only shortly at a number of terminals are complicated due to the need to coordinate several infrastructure managers and the Corridor One Stop Shop (C-OSS).

Successful solutions to those challenges can be attained by involving infrastructure managers and safety regulators in the setting up of ERFLS. Moreover, addressing those challenges would benefit intermodal rail freight as a whole, not just ERFLS.

ERFLS telematics will link all operators using their own systems

The Action confirmed that a telematics layer linking terminals, trains, slots and operators is feasible and may be already developed by building on current practice and ensuring that operators from terminals to forwarders and shippers keep using their own systems and their own data formats. Sharing of information will extend to road hauliers so as to support the optimisation of their work and the road-side operations at the terminals.

The ERFLS telematics layer is therefore a comprehensive step towards the digitalisation of intermodal rail freight.

Sharing of real time data about terminals, trains and intermodal units

Reliable real time information is critical to stakeholders and the ERFLS telematics system was designed so that it is assured. The Action developed a specification for the telematics component of ERFLS, detailing times and costs for its development and deployment. Suitable current technologies were identified but also the telematics component of ERFLS is readily open to new technologies.

The market potential looks rather good!

The Action included regional market analyses that revealed different situations at the terminals investigated but, altogether, a rather good potential for ERFLS except, perhaps, in a case such as Duisburg where the availability of intermodal transport is already very high.

Commercial appeal and devices to accommodate small intermodal flows

ERFLS aims to attract small flows from SMEs to intermodal transport. Discussing RTG Valburg, a major operator noted that even some ten intermodal transport units would commercially warrant a stop, which supports the value of the concept. Other stakeholders indicated the need to regulate the use of the trains to ensure that they are not booked entirely by the most significant flows along the most requested OD pairs.

Interaction with stakeholders requires a uniform sale channel

ERFLS should have a uniform sale channel, which is enabled by the proposed telematics system. The Action ascertained that a freight exchange platform would not be beneficial. Only once ERFLS is well established, could it be usefully included in a freight platform dealing with whole transport chains, but not in one concerning the sole rail leg.

ERFLS is an attracting alternative for a significant share of traffic along the Rhine Alpine Corridor

A detailed modelling exercise about freight transport along the Rhine Alpine Corridor considered rail, road and inland waterway as available options. The model revealed that even in a basic configuration with six terminals and the ports at either end ERFLS is an attracting alternative for a significant share of traffic which can amount to 7,400-10,070 million tonnes-km per year (14-18 million tonnes/year). This is equivalent to a 9-13% modal shift from road to ERFLS calculated for distances longer than 300 km.

ERFLS delivers the energy efficiency of rail to the cargo it attracts

The freight shifted to rail with ERFLS would entail saving 240,000-280,000 truck trips per year (91-104 million veh-km per year). This, in turn, saves 22,000-25,000 tonne of oil equivalent/year.

Intermodal transport with ERFLS leads to significant savings in CO_2 emissions

Shifting 14-18 million tonnes of freight per year to rail leads also to saving 63,000-72,000 tonnes of CO_2 emitted per year. This corresponds to the CO_2 absorbed in a year by 1,800,000-2,000,000 trees respectively.

Positive effects of ERFLS in terms of traffic, new jobs and remittances

The socio-economic analyses of the terminals and their catchment areas detailed the positive effects of ERFLS in terms of additional traffic at the terminals, corresponding turnover and remittances as well as expected new jobs. In the best scenario they can be as follows:

Terminal	Additional ITU	Turnover (€ X1000)	Income (€ x1000)	Tax (€ x1000)	New jobs
Valburg	80,000	24,092	1,606	8,834	402
Duisburg	110,000	32,883	2,192	12,057	550
Ludwigshafen	58,000	17,299	1,153	6,343	300
Lahr	61,000	18,225	1,127	6,700	300
Weil am Rhein	61,000	18,299	1,220	6,710	300
Novara	77,000	23,018	1,535	8,440	380

Strengthening the rail system along the Corridor will assist the development of ERFLS

The Action delivered SWOT analyses of terminals' catchment areas which showed the strengths of the locations due to the local economic systems and often also to the features of the terminals. However, the SWOT analyses noted the weaknesses due to capacity limits at several terminals (among which Weil am Rhein and Novara), issues with congestion – and bottlenecks – along several stretches of the Corridor (for instance, at the end of the Betuwe line) and the important threat due to the current lack of competitiveness of rail as compared to road transport. Those points call for incentives, improvement of the terminals, and enhancement of the railway lines to further the use of intermodal rail.

8 Recommendations

Develop a pilot with test trains and terminals to demonstrate the concept

The Study Action confirmed the feasibility of the European Rail Freight Line System concept. The next step is to set-up a partnership able to run ERFLS trains between smart terminals with at least an initial telematics system, so as to demonstrate the concept and its advantages in practice. A successful pilot would also set the basis for the actual full implementation. At least a rail operator, an intermodal operator, and a minimum of three terminals should be among the interested partners developing the pilot project. It would be beneficial if also some shippers joined the partnership. The market power of shippers would establish and develop the demand for ERFLS services so that the pilot could further develop into regular services, not just on the Rhine Alpine Corridor but also on the other TEN-T rail corridors.

Involve infrastructure managers and safety regulators in the pilot

The study Action revealed a number of difficulties due to using existing technologies and practices in new contexts (among them: momentum access, train movements from ERTMS level 2 lines into terminals). Dealing successfully with such items requires involving infrastructure managers and safety regulators in the development of the pilot implementation. In particular, the cooperation between the terminal manager and the infrastructure manager is critical for the successful implementation of momentum access.

Terminals should cooperate and take the lead to develop ERFLS

All parties involved in intermodal transport may benefit from ERFLS trains, but terminals are those that would benefit most from increasing and optimising their traffic, as well as gaining a more prominent role in the local economic system. Moreover, terminals would be the actors most interested to attract smaller flows, which are the target of ERFLS, with a view to making rail transport more flexible. Therefore, terminals should take the lead in developing ERFLS along the Rhine-Alpine Corridor.

Policy should support systems instead of single terminals

Having terminals develop and work as a system with other actors is key to establishing ERFLS. To this aim, policy actions should include supporting and funding whole intermodal systems across Countries instead of single terminals only.

Keep it at Corridor level

Transformation of terminals may bring local benefits, since the measures suggested to obtain smart terminals are generally valid to optimise intermodal operations. However, to reap the full benefits of ERFLS, operations should be optimised at corridor or system level. Only by fully developing the ERFLS concept as a system along a corridor may all stakeholders benefit, and therefore could have a strong interest in the concept. For instance, were a terminal to optimise operations on its own, only limited benefits due to an improved load factor would accrue to transport operators, and no benefits from improved access to intermodal transport – due to more stops – would go to the local economic system.

ERFLS should be integrated in the TEN-T network and benefit from TEN-T funding

The Rhine-Alpine corridor extends across several countries and so do other Corridors along which the ERFLS system could be foreseen. ERFLS is therefore a concept at EU level and in order to support it, it should become part of EU governance of corridors. This should occur by including ERFLS in the TEN-T definition, incorporating it in the TEN-T implementation, and allowing ERFLS to access TEN-T funding.

The Rhine Alpine Corridor is the right freight lane to set up ERFLS

The present study Action focussed on the Rhine Alpine Corridor and it would be the best option to set up pilot ERFLS activities due to the significant intermodal flows and the existing cooperation structure among stakeholders (in particular, the existence of the Rhine Alpine EGTC).

Include terminals in Corridor governance

The ERFLS partnership realised how important is the pivotal role that terminals play in the system. That hinge function is crucial and warrants a more important role for terminals in the governance of the Corridors than they currently have.

Exploit the synergies

ERFLS is about the digitalisation of rail freight to exploit the untapped potential of information that each stakeholder could distribute. Synergies with other Actions and projects providing complementary products are required. One example of such a project is ELETA, the CEF Action started in 2017 on estimating the time of arrival of intermodal trains at terminals. That information would enrich the set of data that ERFLS intends to distribute in order to optimise operations.

Build on the environmental benefits

The benefits of ERFLS in terms of reduced carbon footprint and reduced negative impact on communities thanks to organised flows should be demonstrated during the pilot and used to promote the system further.

Build on the consistency of ERFLS with the EU policy outlook

A proposal to amend Directive 92/106/EEC on Combined Transport was put forward in 2017 and is currently still being discussed. The main objective of the proposed amendments is to reduce the negative effects of transport activities and put more effort in reaching a shift from road transport to rail or waterways transport. Art. 6 of the proposal includes measures to support investments in terminal construction and expansion. It also indicates that Member States should support investments in the operational efficiency of existing terminals with a view to have a balanced distribution of facilities across Europe, notably on the TEN-T network. Moreover, the proposed amendment suggests that Member States take further measures to support the competitiveness of combined transport as compared to road transport.

Although currently the amendment to the Directive is still being debated, the measures mentioned above are in line with recent European transport policy and ERFLS fits their objectives. Therefore, the progress of the amendment should be monitored and used to support the development ERFLS in practice.

Improve the flexibility of rail path bookings procedures

The Action experienced difficulties when trying to discuss train paths along the whole Corridor and considering stops at intermediate terminals. Ways to deal with prospective train paths requests should be more flexible allowing for new products on the tracks.

List of abbreviations

CESAR	Co-operative European System for Advanced information Redistribution
C-OSS	Corridor One Stop Shop
EDI	Electronic Data Interchange
ERFLS	European Rail Freight Line System
ERTMS	European Rail Traffic Management System
GUI	Graphic User Interface
HGV	Heavy Goods Vehicle
ITU	Intermodal Transport Unit
IWW	Inland Waterways
MTO	Multimodal Transport Operator
NUTS	Nomenclature des Units Territoriales Statistiques
TEU	Twenty foot Equivalent Unit
TOS	Terminal Operating System
XML	eXtensible Markup Language