SMART RAIL

Smart Supply Chain Oriented Rail Freight Services

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Definitions & Abbreviations

ECT	European Container Terminals
EGS	European Gateway Services
ETA	Estimated Time of Arrival
RFC	Rail Freight Corridor
RNE	Rail Net Europe
RTW	Rail Terminal West
TIS	Train Information System

1. Introduction

1.1 Background and Objectives of Smart-Rail

Modal shift from road to the rail sector, mentioned in the White Paper on Transport [1] as well as other European and national policy papers, faces the challenge of providing the capacity for affordable and attractive services. The current European rail freight market is a complex system involving a great number of public and private stakeholders, such as infrastructure managers, rail operators, terminal operators and freight forwarders who jointly manage the operation of running trains from A to B. This complexity in the rail sector hampers the development of efficient and competitive rail freight services. Smart-Rail intends to contribute to the European policy targets by defining, implementing and monitoring new shipper-oriented rail freight concepts improving the competitive position of the rail sector in the Rhine-Alpine Corridor. In line with the Living Lab approach, the activities will start with simple measures and in next steps these will be more complex and cover a wider scope. Therefore, instead of analysing the full Rhine- Alpine corridor, in a first step, we focus on a part of this corridor: Rotterdam – Ruhr Area in Germany. In addition, the Smart-Rail project is aligned to the objectives of SHIFT²RAIL and its results will be used, in further, in this programme.

More specifically, the objectives of Smart-Rail are:

- to contribute to a mental shift of the rail sector toward a client and supply chain -oriented focus;
- to develop working business models for cooperation of different stakeholders;
- to develop a methodology and architecture for exchange of data/information required for the optimisation process, between stakeholders, making use of existing initiatives where available (for instance the European Corridor Management and national logistical information centres;
- to establish three Living Labs that each focus on different aspects and markets and develop tools, methodologies and concepts. The purpose of the Living Labs is to test, monitor and improve the innovative measures in real life conditions. Specific and more dedicated business models, information systems and new rail services will also be tested.

Central point of this Work Package is to improve flexibility and reliability in rail freight transport at competitive prices in line with the needs of the clients (shippers, logistic service providers) as in case of (un)expected disruptions on the rail network. Such improvement of the service, might agitate modal shift from road to rail.

Seven separate tasks are defined in the Description of Work (DoW) document to structure the work:

1. Problem analysis and the selection of relevant measures. In this step background information of the current situation will be described. In addition measures will be selected and designed. The focus of this task is to outline the first design of the selected measures.
2. Potential impact of measures for different stakeholders; This task will present the Key Performance Indicators (KPIs) used to monitor the impact of the measures on the corridor. A tool will be developed to show the quantitative impact in a fast and user friendly way. The tool in combination with stakeholder sessions will be used to raise awareness of and support for the implementation.
3. Information exchange for necessary level of transparency; In this task, the necessary data transparency to improve flexibility and reliability will be analysed. In addition, the willingness to share data will be discussed with stakeholders.

4. Alignment of value case for involved stakeholders that is needed for cooperation; Task 8.1, 8.2 and 8.3 will be consulted to determine business cases for measures and for different types of stakeholders on the Rail Freight Corridor.
5. Implementation of measures and design of monitoring approach; Results from all previous tasks will be implemented in a living lab environment. Within this Living Lab, continuous improvement will be monitored via a plan, do, check & act cycle, using the KPIs as identified in task 8.2.
6. Monitoring and adjustment of measures; The monitoring approach as developed will be used to continuously improve the measures taken on the corridor. Furthermore, additional measures might be implemented in this phase of the project.
7. Conclusion and recommendations; A final assessment of the results in this Living Lab is made. Furthermore, recommendations will be made to ensure durability of the living lab and the replicability of the impact on other Rail Freight Corridors.

For a measure to be successfully implemented in the Living Lab environment it is important that the involved stakeholders cooperate. Cooperation between organisations does not come natural and requires that the meaning and potential impact of the measure is well understood. For individual stakeholders this means that the content, scope and advantages of the measure(s) are clear to them. Besides, it should be clear what kind of activities are expected from different stakeholders for a successful implementation of a measure.

Equally important is that involved stakeholders understand each other's role in the railway chain and more specifically, for each measure. The role a stakeholder has in the railway chain can help understand its influence on certain processes as well as its interest in the potential impact of a measure or measures.

In sessions leading up towards the start of this Living Lab, involved stakeholders made it clear that there is no need for the development of a calculation tool to show the potential impact of measures to them. Instead they would like to start with activities towards implementation of the measures in the Living Lab environment. The Living Lab approach makes the practical impact of the measure to individual stakeholders most clear: learning by doing in practice.

1.2 Task 8.2 objectives

In Deliverable 8.1 the selection of three measures that will be elaborated in this Living Lab has been described. It concerns the following measures:

1) Analysis of performance of rail freight service Rotterdam – Duisburg / Neuss
2) Hub concept terminal Rotterdam for exchange of containers between different rail services
3) Pre-defined paths for short term slot allocation in Germany

In this Deliverable 8.2 the potential impact of these three measures will be illustrated. The main objective is to create insight in the potential impact of the three measures for the different stakeholders. To achieve this, each measure will be described in more detail for which the following structure is applied:

- Background: clear description of the content of the measure and what it aims to achieve;
- Stakeholders: who are the involved stakeholders and which role do they currently have in the railway chain;
- Short term impact: expected impact for the different stakeholders within the timeframe of this Living Lab (2 years);
- Long term impact: expected impact for the different stakeholders in the period after this Living Lab.

1.3 Relation of Deliverable 8.2 to other deliverables WP8

As described before, in Deliverable 8.1 the selection of measures that will be elaborated in this Living Lab have been described.

In this Deliverable 8.2 the potential impact of these selected measures will be illustrated.

Following, Deliverable 8.3 focuses on the information exchange that is necessary for the implementation of the measures. Deliverable 8.4 describes the alignment of the value case for involved stakeholders. Deliverable 8.5 describes the implementation of measures and the design of the monitoring approach.

Overall, Deliverables 8.1 to 8.5 gives an overview of all the preparations that are needed for the actual implementation of the measures in the Living Lab approach in a number of cycles that will be described in Deliverable 8.6.

2. Potential impact of measures

Goal of this Living Lab

The goal of this Living Lab is to test, implement, evaluate and further develop measures identified by and with stakeholders in an effort to improve the rail service. As mentioned in task 8.1, stakeholders made it clear that there is a clear and urgent need for the availability of / accessibility to accurate data for the improvement of the rail freight performance. This Living Lab will start with the main measure "Data exchange, data analytics and data use for smart applications in the logistic chain".

Three measures were identified by involved stakeholders that reflect their need and interest and fit within the Living Lab approach:

1) Analysis of performance of rail freight service Rotterdam – Duisburg / Neuss
2) Hub concept terminal Rotterdam for exchange of containers between different rail services
3) Pre-defined paths for short term slot allocation in Germany

This chapter gives a description of each of these measures followed by an overview of the potential impact of the measures.

1.1 Analysis of performance of rail freight service Rotterdam(NL) – Duisburg / Neuss (DE)

Involved stakeholders: (KombiRail Europe, Optimodal, ProRail, Port of Rotterdam)

Background
The involved stakeholders want to improve the performance (reliability, flexibility, efficiency and visibility) of a specific rail service between Rotterdam in the Netherlands and Neuss in Germany. This rail service (roundtrip) is executed five times per week and carries intermodal containers. Depending on the day of the week, one or two terminals in the Rotterdam area may be serviced to load and unload containers. The process scheme below provides an overview of the terminals and marshalling yards that are serviced.

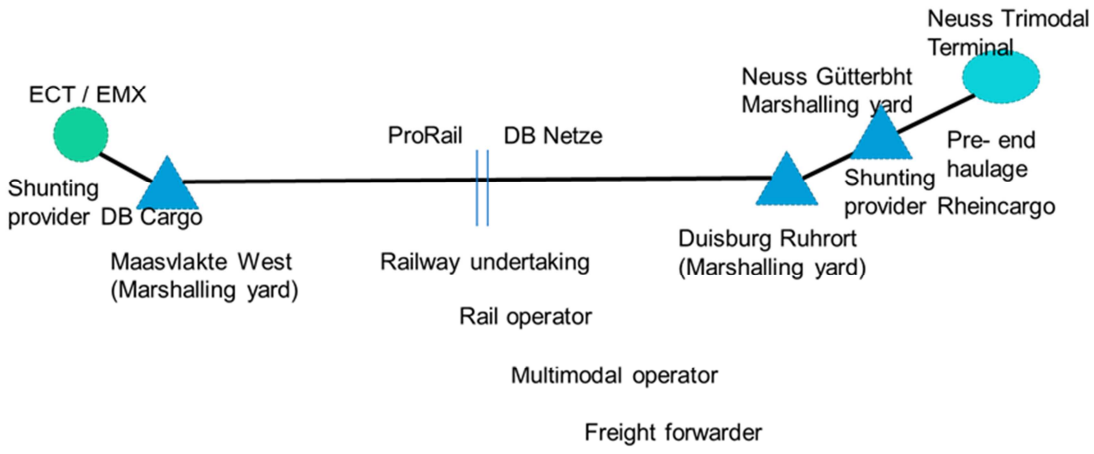

Figure 1-1 Process scheme

In order to analyze the performance of this rail service, a lot of data (and information) is needed and gathered from the involved stakeholders. With the stakeholders, an agreement was signed under which conditions available data could be analyzed and shared within this Living Lab. Thus far, the following data has been provided for analysis:

- **Punctuality**:
  - planned time vs. actual time on intermediate stations between marshalling yard Maasvlakte West and Emmerich
  - planned arrival time vs actual arrival time on the terminals and marshalling yards
  - planned departure time vs actual departure time on the terminals and marshalling yards

- **Lead time**:
  - planned lead time vs. actual lead time of the rail service roundtrip (differs per day, depending on number of terminals visited)
  - planned lead time vs. actual lead time between marshalling yards and terminals visited

- **Flexibility**:
  - number of times the rail service has been executed as planned, rescheduled, rerouted or skipped including the different timeframes in which this took place,
    - Year plan phase
    - Ad-hoc planning phase:
      - up to 36 hours prior to departure)
      - period between 36 hours and 5 minutes prior to departure
  - weight of the full train (to check if stated weight corresponds with actual weight)

Both for incoming and outgoing trains these items are monitored.

With the data and the selected indicators, analysis of the rail service can be conducted. For the duration of this Living Lab, the available performance data can be used under different conditions:

- Under normal conditions
- During disruptions
- During the construction phase of the "third track" in Germany
- During issues with rail bundling of containers at the Tweede Maasvlakte in Rotterdam

Based on the available data, fine-tuning of the performance indicators will take place with the relevant stakeholders. As the rail freight service covers terminals, marshalling yards as well as Dutch and German railway infrastructure it is important to take these different train processes into account.

In doing so, different patterns, recurring problems or new insights may become visible that are worth investigating further. These outcomes are shared with the involved stakeholders and will be further analyzed and interpreted. Based on these results, measures to improve the performance of the rail freight service will be developed together with the stakeholders. Identified and agreed upon measures will be implemented, tested and evaluated in order to analyze its impact on the performance. For the duration of this Living Lab, this is an iterative cycle.

Involved stakeholders

For this measure the following stakeholders are involved:

1. KombiRail Europe – Railway Undertaking

KombiRail Europe is a railway undertaking that provides traction for, amongst others, railway operators, shippers and logistical service providers. For this specific measure, KombiRail offers traction between the marshalling yard Maasvlakte West (NL) and the marshalling yard of Duisburg Ruhrort (DE).

2. ProRail – Infrastructure Manager

ProRail is responsible for the Dutch Railway infrastructure in terms of construction, maintenance, safety and management thereof. They also manage the available capacity between passenger and rail freight traffic and monitor the train processes on the Dutch Railway infrastructure.

3. Port of Rotterdam – Port Authority

The Port of Rotterdam aims to enhance its competitiveness as a port by strengthening its hinterland connections by road, barge and rail. As such, they support initiatives such as Smart-Rail that aims to improve the railway product to shippers on the Rhine – Alpine corridor.

4. Optimodal – Rail Operator

As a rail operator, Optimodal exploits rail services between Rotterdam and destinations in Europe. Logistical service providers and deep sea carriers book capacity on these rail services for their containers. Optimodal buys traction from a railway undertaking for actually running the trains.

5. RNE (RailNetEurope) - Association

RNE is an association set up by a majority of European Rail Infrastructure Managers to enable fast and easy access to European rail, as well as to increase the quality and efficiency of international rail traffic. They have developed TrainInformationSystem (TIS), which is an application for tracking (real time) rail freight trains throughout the European rail network and can be used to analyze the performance of rail freight trains. In this measure, TIS data will be used to analyze the past performance of the specific rail service between Rotterdam and Neuss.

The above mentioned stakeholders are already involved in this Living Lab. At the same time, discussion with other stakeholders are ongoing to have them involved as well. They include DB Cargo Netherlands, DB Netze, Rheincargo, EGS and ECT.

Short term potential impact

With the initial analysis of the rail service, the first and foremost impact of this measure is the insight in the performance of the rail freight service. Based on this insight, problems and patterns of delays and disruptions can be made visible. It specifically provides information on the performance of the different processes (terminal, marshalling yard, line haul). More specifically some examples of potential impact are:

- Rooting out of the main factors for causing delay / disruptions per rail service day over a certain period. As a result, new focus areas for improvement are created.
- Differences between servicing one and / or two terminals may appear and provide valuable information for improvement;
- Updated or different data is required by stakeholders and between stakeholders under normal conditions and in case of disruptions;
- Differences between the Dutch and German railway system (infrastructure and process management) are more clear;
- Improved understanding on the line haul and last mile processes;
- Identification of opportunities for improving the utilization rate at marshalling yard Maasvlakte West;
- Elimination of redundant processes and information / data

Analyzing and discussing these results enhances the mutual understanding of the role each stakeholder plays in the rail service. It provides the kind of insight to identify quick wins and start testing them in the Living Lab. These quick wins are not bound to actual performance only, but can also focus on the planning process of the roundtrip. This process is an iterative cycle of continuous improvement of the rail service, each time focusing on a different aspect of the rail service process.

During the course of the Living Lab, the construction of the third track will provide a unique opportunity for comparing the performance of the rail service. By that time, the initial analysis of the rail service under normal conditions and (un)planned disruptions will provide a good comparable base.

Long term potential impact

For the long term, potential impact is expected in the improved competitiveness of this rail service. It is the result of the continued effort of the stakeholders for improving the reliability, flexibility, efficiency and visibility. Other yet related potential impacts include:

- Established (real time) data sharing between terminal and line haul processes leading to improved reliability of rail freight transport
- Aligned cross-border processes between Dutch and German infrastructure managers for planning and monitoring train paths

2.2 Pilot hub concept RTW terminal Rotterdam

Involved stakeholders: European Gateway Services (EGS), European Container Terminals (ECT)

Background

With the inauguration of three new deep sea terminals at the Maasvlakte in Rotterdam, shippers and deep sea carrier organisations can now choose from five deep sea terminals to have their cargo transhipped and transported to the hinterland. It is expected that this increase of the number of container terminals will result in greater fragmentation of containers. The potential impact for railway operators and railway undertakings is that the rail service they respectively offer and execute most likely becomes more difficult to manage. The result of this new situation is that the (cost) effective bundling of containers is becoming more difficult and different stakeholders are searching for solutions.

As a logistical service provider, European Gateway Services offers high frequent rail and barge services between Rotterdam and inland terminals in the European hinterland. Two of their rail services make use of Rail Terminal West (RTW) in Rotterdam for loading and unloading containers that are coming in from Germany: one rail service from Duisburg which has only the RTW as destination and one rail service from Munich which has both

RTW and Euromax as destinations in Rotterdam. This measure will test whether it is possible to exchange containers between these two different rail services at the RTW. Containers on the Duisburg train with destination Euromax will be unloaded at RTW and will be loaded on the Munich train at RTW. The Munich train then goes to Euromax where these containers are unloaded again. With the hub concept with rail services, expensive road transport for inter terminal transport is avoided and available rail freight capacity is utilised in a better way. It concerns a very concrete pilot in order to test the reliability and flexibility of rail freight.

In order for this pilot to start, the following conditions need to be met:

- The reliability and predictability of the incoming rail services from Germany (Duisburg and Munich) is such that the transhipment of containers at the RTW can be prepared and well executed;
- The time necessary for transhipment of the containers (between the rail services) at the RTW is sufficient;
- The available capacity on one of the train services is sufficient to carry the containers of the other train service as well;
- Information on the number of containers to load / unload at the RTW for both rail services.

During this pilot, these and other conditions will be evaluated to identify the possibilities and bottlenecks for bundling containers. Beforehand, a brainstorm session with involved stakeholders will be organized to capture the most (obvious) pitfalls and bottlenecks for making this pilot a success. This way we can develop solutions before the start of the pilot or at least be able to cope with them during the pilot. At the same time, specific areas of interest by the stakeholders may be shared that can be analysed or tested.

In addition to the brainstorming session, both rail services will be analysed based on historical data of realised arrival and departure times at the RTW (data received from ECT). They need to be understood from a planning and performance (reliability, flexibility, efficiency) perspective. The following data is therefore required:

- Data about arrival and departure (planned and actual) of both rail services at the RTW terminal for the last six months
- Data about the number of containers on the Duisburg train that have Euromax as destination
- Data about available capacity of the Munich train between RTW and Euromax for the last six months

Besides, the data analysis to analyze the possibilities based on historical data, a practical pilot will be carried out. In this pilot, the exchange of containers will be tested in practice on every Friday for a period of six weeks. A main goal of this practical pilot is to analyze and evaluate what bottlenecks show up if this concept is implemented.

In a first step (as described above), this pilot is carried out with two rail services of synchromodal operator EGS. A foreseen extension of this pilot is to include rail services of other rail operators as well. This will make the pilot much more complex because of the different stakes of the different rail operators.

Involved stakeholders

For this pilot, the following stakeholders are involved:

1. European Container Terminals (ECT) – deep sea terminal operator

ECT exploits two deap see terminals located on the Maasvlakte in the Port of Rotterdam, the Euromax and the Delta Terminal. It also manages a number of inland terminals, of which Rail Terminal West in Rotterdam is one.

2. EuropeanGatewayServices (EGS) – Logistical service provider

As a logistical service provider, EGS connects the network of deep sea terminals and inland terminals of ECT with its rail and barge services. It covers destinations in Germany, Belgium, France, Austria, Switzerland and the Netherlands.

Short term potential impact

With the brainstorm session and follow up analysis of both rail services, impact is to be expected in the clear identification of opportunities and bottlenecks for bundling containers at the RTW. Insight will be gained in amongst others the following topics:

- Number of containers both rail services usually carry and the capacity still left available for transhipment of the containers;
- Time window at the RTW between which time containers can be transhipped between the rail services;
- Requirements identified for actually transhipping the containers (capacity of ECT and EGS personnel, physical infrastructure,…);
- Reliability: planned arrival time vs. actual arrival time at the RWT of the rail services;

These outcomes will provide the basis for actually implementing the bundling of the containers.

Long term potential impact

If the pilot proves successful, the working concept of bundling containers at the same terminal can be extended to other rail services and (in combination with) other rail terminals and / or deep sea terminals. The continuous effort of testing the bundling concept can lead to a more reliable and flexible railway product for the shipper. If rail terminals and deep sea terminals realize the long term impact of bundling containers, more pilots might be set up to bundle containers covering the area of the Maasvlakte. The potential impact might be that a new interorganizational structure will manage the handling and bundling of containers at the Maasvlakte.

2.3 Pre-defined paths for short term slot allocation in Germany

Background

The allocation of infrastructure capacity is a major issue for rail transportation. An effective way to prevent congestion on the network is slot allocation, which is a type of traffic planning. A key characteristic of this is that train operators have to reserve a 'slot' on the network before train departure. Short term slot allocation for trains in Germany is especially relevant for all trains leaving the port areas, since more than 80% start their run without pre-allocated fixed slots. Germany is separated into seven regions (Figure 2-2 Dispatching Regions of DB Netz

), when a slot is requested for a route over multiple regions a path can only be allocated for each individual region. This results in the situation that while a train is travelling through a certain region, there may be no slot planned for the next region. Reserving these slots is a process that can be time consuming for all the involved stakeholders and also results in the situation that the arrival times at the end of a route are often not known and can often not be guaranteed.

A practical example of this is shown Figure 2-2 Dispatching Regions of DB Netz

. It gives an impression as to the problems Infrastructure Managers and operators are facing with slot allocation. As slots in Germany can only be allocated region by region, freight trains going through Germany on one of the Rail Freight Corridors (Rhine-Alpine Corridor or North Sea Baltic Corridor) have to be allocated with a slot a minimum of three times, which can be time consuming, and inefficient especially knowing the fact that trains from the ports start their run without pre-allocated slots. For the Rhine-Alpine Corridor, pre-arranged time slots already exist for a couple of years.

Figure 2-2 Dispatching Regions of DB Netz[1]

What are we going to do

German Infrastructure Manager - DB Netz, has started with the development of the next generation of IT tools, and one of the goals is also to optimise capacity allocation and utilisation on the railway network and to make transport more efficient, a role where short term slot allocation can play a major role.

In designing this tool DB Netz firstly carried out an analysis of all freight traffic in the network taking into account loco types, lengths, weights, electrification etc. which resulted in a "most common train" with the following characteristics:

- Weight: 2000 tonnes
- Length: 600m
- Speed: 100 km/h
- Brake: (P)

[1] Source DB Netz

- Locomotive: DB Class 185

Compared to the situation in the Netherlands, the characteristics for a "most common train" are somewhat different:

- Weight: 2700 tonnes
- Length: 600m
- Speed: 85/95 km/h
- Brake: (P)
- Locomotive: BR189

On some corridors, certain special cases have been put in place such as the Emmerich-Oberhausen where trains of 690m have been accounted for. Trains that fall outside these general parameters will have paths specially designed for them as is the current situation. However, under normal circumstances pre-arranged paths have been designed to cope with this "average train".

All requested train paths will be routed through the "best route" and when bottlenecks in the network are found trains here will be prioritised and rerouted.

This tool has already been rolled out on three RFC Corridors (including Rhine-Alpine) for the 2015 annual timetable and will be rolled out country wide for the 2016 annual timetable (including North Sea-Baltic).

The following phases show planned development and how this tool/system can be implemented into Smart-Rail, in particular within this Living Lab:

Phase 1

Take the current tool as it is and use it in a virtual situation in Duisburg. This is based on real trains in the Venlo and Emmerich. From this virtual testing a comparison can then be made between the virtual results and the results obtained and currently used system. This will indicate which system offers the more efficient results.

Phase 2

A prototype is developed for short-term allocation and implemented in Duisburg as a standalone tool. This is again tested virtually to see if it will work in real-time. If successful, real-time testing can then follow in the Venlo/Emmerich area.

Phase 3

Virtual testing will be expanded beyond the German borders and Pro-Rail slots will be included manually. Dispatching will take place in Kijfhoek or at the Port. If this initial testing is successful then real-time allocation can be trialled.

Phase 4

The ProRail slots will be integrated into the prototype. This will again be virtually tested.

Phase 5 (Long-term)

Terminal Planning can be included into the prototype, virtually at first and then in real-time.

As a parallel task, the requirements of the tool at each phase need to be included. Certain agreements will also need to be sought. Firstly, from DB Netz in Frankfurt, then Duisburg and finally from ProRail.

Involved stakeholders

The main potential stakeholders that will benefit from the IT-Tool and consequently pre-identified paths are:

- Infrastructure Managers (Primary Stakeholders)
  - DB Netz – Infrastructure Manager, Germany
  - ProRail – Infrastructure, Netherlands
- Railway undertakings and terminal operators (Secondary Stakeholders)

Short term potential impact

The major short term benefits of the new tool for ad-hoc-slot-allocation will be the fast delivery of ad-hoc-slots for operators. So far, slots can only be allocated region to region or line by line, but with this tool, one of the potential benefits for the train operators is that the allocation is going to be much faster than it is today, since many of ad-hoc trains, especially trains from the port areas, leave without fixed slots at all.

For Infrastructure Managers, such as DB Netz, the tool will help to reduce process times and costs for allocation. This tool will increase capacity for freight trains especially on busy segments (an increase of 5% minimum is expected based on initial testing and analysis). In addition to this, average system speed of freight trains is expected to increase.

Capacity would be especially increased in cases of expected or unexpected perturbations, through enabling easy planning and dispatching for re-routing of trains. All stakeholders would especially benefit from the:

- Improved ETA for ad-hoc-trains,
- Reduced transport times, reduced transport costs,
- Higher capacity,
- Improved reliability, and
- Increased flexibility.

An example from the previous testing and analysis shows that for the Duisburg – Rotterdam corridor, it would be easier from the operator's point of view to achieve two round trips per day for its locomotives, which would improve the competiveness with road. Consequently, customer satisfaction of shippers will be improved.

Existing problems between DB Netz and ProRail in planning and dispatching between Duisburg and Rotterdam would be eliminated by including ProRail's pre-arranged slots between Kijfhoek and the border in the tool.

Long term potential impact

The long-term potential impacts of this tool are many and including the following:

- Improvement of overall freight transport services
- Improvement of the operational reliability
- Better information for the client
- Better resource planning
- increased competitiveness of the rail compared to road transport

3. Conclusion

This Living Lab will test three different measures that respond to the needs of the involved stakeholders. Each measure contributes to the main goal of improving the rail service to the shippers, yet have a different focus to see what will be realized. The availability of and accessibility to relevant data will, however, play an important role in each of the three measures.

During this Living Lab, clear benefits are expected in the improved understanding of the role the involved stakeholders have and potentially can have in order to improve the rail service or to be able to bundle containers. The detailed analysis of past performance of the rail services will reveal quick wins that can be directly tested, implemented and evaluated in an continuing cycle. Requirements for improving the overall and specific sub processes of the rail service or bundling of containers will be identified. On the longer term and after this Living Lab, stakeholders will have experienced the benefits of testing the effects and measures and continue to do so. It will lead to the improved competitiveness of the rail service itself and towards the shipper.