# SMART⤫RAIL

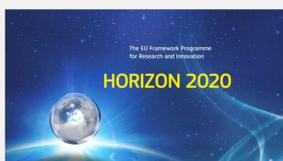**Smart Supply Chain Oriented Rail Freight Services**

## GA No. 636071

| | |
|---|---|
| **Deliverable No.** | D8.5 |
| **Deliverable Title** | Implementation of measures and design of monitoring approach |

| | |
|---|---|
| **Document ID** | Smart-Rail-D8.5 |
| **Dissemination level** | Public |
| **Main Author** | Thijs Smit – TNO |
| **Issue date** | 7-July-2016 |

## Disclaimer and acknowledgement

**Disclaimer**

EUROPEAN COMMISSION MOVE HORIZON2020 – Research and Innovation Action

## Smart-Rail consortium

# Document information

## Additional author(s) and contributing partners

| Name | Organisation |
|------|--------------|
| Paul Melia | Railistics |

## Document Change Log

| Version | Date | Comments |
|---------|------|----------|
| v0.1 | 10-June-2016 | First draft of document |
| v0.x | 7-July-2016 | Revised version based on the comments of Name Reviewer(s) - Organisation |
| v1.0 | | First final version, approved by Executive Board, (will be) submitted to EC. |

## Document Distribution Log

| Version | Date | Distributed to |
|---------|------|----------------|
| v0.1 | 10-June-2016 | Philipp Stoebke (ThankMatch) <br> Olav Eidhammer (TOI) |
| V0.2 | 7-July-2016 | |

## Verification and approval

| | Name | Date |
|---|------|------|
| Verification Final Draft by WP leader | Mr. Jaco van Meijeren | 06.06.2016 |
| Approval Final Deliverable by coordinator | Mr Paul Tilanus | 07.06.2016 |

# Table of contents

# List of Figures

# Definitions & Abbreviations

| | |
|---|---|
| ATA | Actual Time of Arrival |
| ATD | Actual Time of Departure |
| CIT | Continuous Improvement Tracks |
| ECT | European Container Terminals |
| EGS | European Gateway Services |
| ETA | Estimated Time of Arrival |
| ETD | Estimated Time of Departure |
| NEXT | IT Tool developed by DB Netz |
| RFC | Rail Freight Corridor |
| RNE | Rail Net Europe |
| RTW | Rail Terminal West |
| TIS | Train Information System |

# 1  Introduction

## 1.1  Background 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 Continuous Improvement Track (CIT) 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 CITs that each focus on different aspects and markets and develop tools, methodologies and concepts. The purpose of the CITs  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 cases 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 CIT environment. Within this CIT, 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 CIT is made. Furthermore, recommendations will be made to ensure durability of the CIT and the replicability of the impact on other Rail Freight Corridors.

## 1.2    Task 8.5 objectives

The objective of task 8.5 "implementation of measures and design of monitoring approach" is to describe the monitoring approach of the three measures once implemented in the CIT approach. Each measure has a different goal for which specific KPI's need to be developed. In order to do so, not only data is required but also the mutual agreement between stakeholders and an approach for monitoring the KPI's, and as the effectiveness of the measure. The outcomes of the previous tasks of this Work Package will be included in task 8.5.

## 1.3    Structure of the deliverable

Deliverable 8.1 focuses on the selection of measures that will be elaborated as in this CIT have been described. In Deliverable 8.2 the potential impact of these selected measures are illustrated. Deliverable 8.3 focuses on the information exchange that is necessary for the implementation of the measures, where deliverable 8.4 focuses on 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 give an overview of all the preparations that are needed for the actual implementation of the measures in the CIT approach in a number of cycles that will be described in Deliverable 8.6.

# 2  Implementation of measures and design of monitoring approach

## Goal of this CIT

The goal of this CIT is to test, implement, evaluate and further develop measures identified by and with stakeholders in an effort to improve the rail service.

First and foremost, this CIT will focus on 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 CIT 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

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

Involved stakeholders: KombiRail Europe, Optimodal, ProRail, Port of Rotterdam.

As pointed out in tasks 8.2 and 8.4, the involved stakeholders have different needs and interests at various levels. At the same time, they deliver a specific service that contributes to the realization of this rail service and thereby have a mutual interest.

In the initial meetings leading up towards the actual selection of this rail service, each stakeholder was asked to indicate when this rail service would be considered to have been executed successfully. The following views were shared:

1) The train has driven punctually and according to the timetable (KombiRail)
2) Actually running the train has not caused additional costs (KombiRail)
3) The loading rate of the train is achieved (Optimodal)
4) The actual running of the train has not caused any displacement on the corridor, the train has driven according to the year plan (ProRail)
5) There were no displacements at the marshalling yard (ProRail)
6) The right data was shared on the right moment for both planning and actually running the train (ProRail)

Based on these views, stakeholders have indicated that there is a shared interest to improve the **reliability** (punctuality, no displacements, right data at the right time) and the **efficiency** (loading rate achieved / no additional costs incurred) of the rail service.

The interest of all involved stakeholders is to achieve the planned **lead time** of the entire roundtrip from terminal to terminal. Doing so satisfies the demand of the shipper and would indicate the rail service is reliable. Equally, if unplanned disruptions in the supply chain however do occur, there is a need for adaption which requires **flexibility** from the involved stakeholders. Stakeholders expressed the need for quick solutions (e.g. alternative train paths) and at the same time an ETA with which the shipper can be informed about the actual status of the rail service.

*Determining KPI's*

With these different views, the next step was to develop and agree on KPI's that could monitor the performance of the rail service during this CIT. At the same time, the KPI's must measure the effectiveness of the measures that will be implemented to improve the reliability, flexibility, lead time and efficiency of the rail service. Stakeholders also expressed that economic or financial KPI's should not be part of this CIT.

All of the suggested KPI's can and will be monitored under different conditions during the course of this CIT:

- 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

The following KPI's were suggested for this measure:

**Reliability**

1) Departure time punctuality at the marshalling yards, terminals and intermediate stations covering the roundtrip of the rail service
2) Arrival time punctuality at the marshalling yards, terminals and intermediate stations covering the roundtrip of the rail service
3) Throughput time punctuality at different intermediate stations

**Flexibility[1]**

1) Number of times the year plan of the rail service is altered prior to departure
2) Number of times the actual plan of the rail service is altered prior to departure
3) Number of times the rail service is rerouted
4) Number of times the year plan of the rail service has been cancelled
5) Number of times the actual plan of the rail service has been cancelled

**Efficiency**

1) Planned loading rate of the roundtrip
2) Actual loading rate of the roundtrip
3) Planned utilization rate of the marshalling yards
4) Actual utilization rate of the marshalling yards

**Lead time**

1) Lead time at the terminal, the time between arriving and departing (ECT Delta, ECT Euromax, Neuss Trimodal Terminal)
2) Lead time of the entire roundtrip (between ECT Delta terminal and Neuss Trimodal Terminal)
3) Lead time between marshalling yards (Maasvlakte West, Duisburg Ruhrort and Neuss Gütterbahnhof) and the different terminals

These are the KPI's that will monitor the performance of the rail service and the effectiveness of the improvement measures from the start. Enhanced insight during the course of this CIT can however lead to the development and selection of additional KPI's or the combination of two or more. And with the possibility of having new stakeholders participating in this measure, other data may become available that proves interesting to include yet allows for monitoring specific processes of the rail service.

---

[1] These indicators can be measured only for the Dutch Railway infrastructure network (ProRail).

For now and as described in task 8.3, the kind of data that is put available by the stakeholders serves as an important condition for monitoring KPI's at all. With this available data, a logical first step is to check to what extent the suggested KPI's can actually be monitored.

When looking purely at the data and what can be monitored based on that, without having to combine data, differences emerge between the indicators (see figure 2-1). These differences are indicated by the lines directly underneath the figure. For monitoring the **reliability** of the rail service, the KPI's span the entire scope of the roundtrip and the same can be said for the **lead time** KPI's (both lines are indicated green). For monitoring the **flexibility**, only the Dutch part of the roundtrip is covered by the data from ProRail. If DB Netz would become involved as a stakeholder, opportunities for additional data could become available for measuring flexibility of the German part. The monitoring of the **efficiency** of the rail service is not possible at this moment, which is why the line is indicated red.
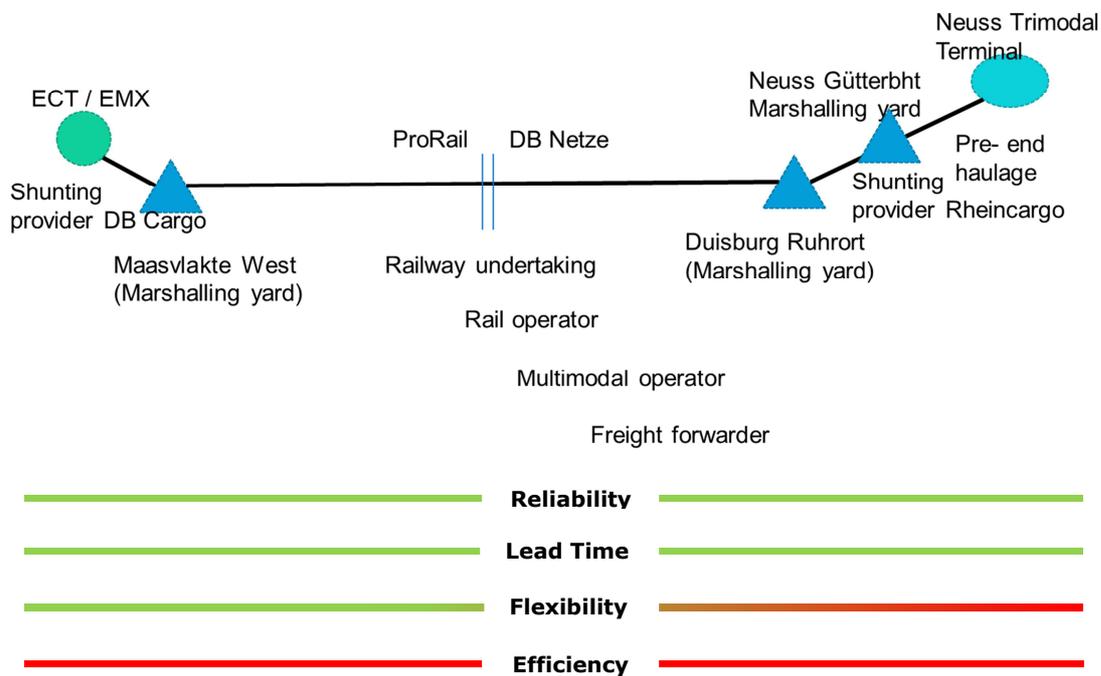


**Figure 2-1 Process scheme**

*Monitoring approach*

The identification of the KPI's and the consequent match with the available data, has provided the basis for actually monitoring both the performance and effectiveness of the measures selected for implementation.

First, however, the different data sources (TIS, KombiRail and ProRail) will be combined to be able to analyze the performance of the full roundtrip of the rail service. The documents contain performance data of the rail service from a year back in time for the different processes, such as linehaul, marshalling yard and terminal processes that make up the roundtrip. More than 40 service points can be analyzed. This analysis serves not only the need to identify bottlenecks, but also the enhanced understanding of these processes and how they interact.

A logical next step is to start with the process of monitoring. The following approach will be applied during this CIT:

1) **Performance analysis**. The initial performance data sources of TIS, KombiRail and ProRail are updated on a monthly basis and provided for continued performance analysis. (Doing so enhances the possibilities of signaling changes in the rating of the KPI's, which could mean that the impact or effectiveness of a measure implemented earlier is notified).

2) **Identification of patterns**. The results of the performance analysis lead to interesting insights of the different processes and identifies bottlenecks or patterns that (re) emerge over a certain period of time. These results provide important input for engaging with the stakeholders about their impact on the reliability, flexibility, efficiency and lead time of the rail service. They require to be understood collectively and from the discussion it should become clear if certain patterns or bottlenecks are considered important (enough) to tackle. Or, from a different perspective, are interesting to investigate further because it requires to be analyzed more profoundly.

3) **Development of measures**. If stakeholders decide that a bottleneck or pattern is indeed negatively impacting the performance of the rail service and follow up actions are needed, measures can be developed to counter this. The process of developing a measure can vary and depends on, among other things, the sense of urgency of the bottleneck and the wishes, possibilities and resources of the stakeholders involved. There has to be mutual agreement on the approach towards tackling the bottleneck and a clear picture on who is doing what during implementation. At the same time, stakeholders may conclude to just simply begin and adapt accordingly.

4) **Implementation of measures**. Once the measure is developed, the process of implementing the measure commences. During this process all kinds of new insights may present themselves. Stakeholders will have to keep each other informed about the progress, difficulties and share (quick) results. Doing so allows for adaptations of the implementation plan.

5) **Evaluation of measures.** After implementation of the measures, the effectiveness on the overall performance of the rail service is analyzed and discussed. The results of the KPI's and it's interpretation are just one aspect of the evaluation process. Other aspects include the decision process between stakeholders over possible continued development of the existing measure, perhaps to focus on developing another measure (or co-develop both simultaneously).

This monitoring approach does not necessarily follow these steps chronologically, it is rather expected that it is dynamic as it is performed in a real life practical environment with multiple stakeholders. It resembles the CIT approach, to start simple and build mutual understanding over the roundtrip process, and continue to develop and implement new measures accordingly. This is an iterative process.

## 2.2 Pilot hub concept RTW terminal Rotterdam

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

Given the fact that this pilot endures for a six week period, the applicability of the concept is first and foremost tested. The pilot addresses the much discussed topic of bundling containers between terminals and exchanging them on the terminal site itself. In this particular case, two rail services will be analysed that visit the RTW terminal from different destinations as illustrated in figure 2-1. During certain periods of their time schedules, they overlap each other at the RTW terminal. It is in this specific period of time that exchange of containers between the rail services becomes optional. Until now, however, it remains unclear what the possibilities and potential benefits are for exchanging containers there. With the data made available by the stakeholders as described in task 8.3, analysis will first focus on these specific overlapping time windows and, based on historical data, to which extent these time windows at the RTW terminal have actually been realized.
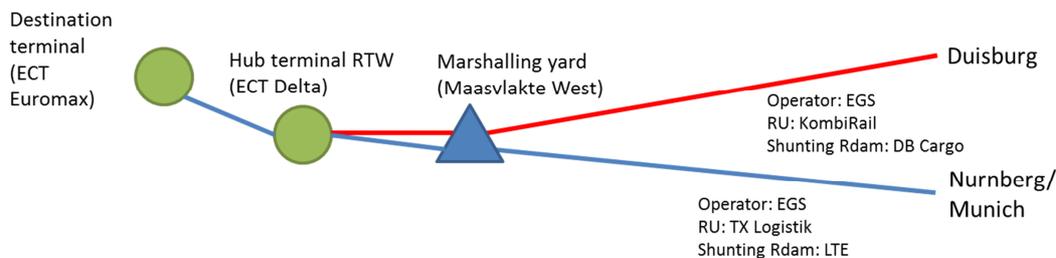


**Figure 2-2 Process scheme**

*Determining KPI's*

A next step is to select the kind of KPI's that allows for monitoring the progress of the pilot and test its viability. Although different in duration (six weeks) from measure 1, this measure makes similar use of the Dutch and German rail infrastructure and as such will be monitored under different conditions as well:

- Under normal conditions
- During disruptions

The following KPI's are suggested for this measure:

**Reliability**

1) Arrival time punctuality at the RTW terminal of both rail services
2) Departure time punctuality at the RTW terminal for both rail services
3) Arrival time punctuality at the marshalling yard Maasvlakte West for both rail services
4) Departure time punctuality at the marshalling yard Maasvlakte West for both rail services

**Flexibility**

1) Number of times the year plan of the rail service is altered prior to departure
2) Number of times the actual plan of the rail service is altered prior to departure
3) Number of times the rail service is rerouted
4) Number of times the year plan of the rail service has been cancelled
5) Number of times the actual plan of the rail service has been cancelled

**Efficiency**

1) Planned number of containers to be exchanged
2) Actual number of containers exchanged

**Lead time**

1) Lead time at the RTW terminal, the time between arriving and departing for both rail services
2) Planned lead time for unloading, moving and loading a single container between the two rail services at the RTW terminal
3) Actual lead time for unloading, moving and loading a single container between the two rail services at the RTW terminal

*Monitoring approach*

The monitoring approach for this measure resembles to some extent the approach of the first measure. The following approach will be applied during this CIT:

1) **Performance analysis**. With the available historical data an analysis will be performed to look in retrospect at the number of times exchange of containers would be possible based on the time schedules of the rail services. With this information, analysis will focus on the arrival and departure times of the rail services at the RTW terminal which indicates whether exchange of containers would have been possible.

2) **Identification of patterns**. The reliability of the rail services is an important condition for allowing the exchange of containers to take place. The identification of bottlenecks is a prerequisite for understanding why overlapping time windows have not been met at the RTW terminal. At the same time, what is the flexibility of the rail system if disruptions / distortions do occur. This can be tested in this pilot.

3) **Development of concept.** The results of the analysis provide valuable input for the development of a concept for exchanging containers. The processes at the terminal are assessed and requirements discussed. For EGS and ECT, among other things, it means aligning different processes and finding the resources to actually be able to test or implement the concept.

4) **Implementation of concept.** In the six week period, the concept will be tested in practice. It will provide valuable information about the train processes in and outside of the terminal, in particular the reliability and flexibility thereof, and the viability of actually exchanging containers at the RTW terminal. These two processes must interact smoothly. Since it will mean doing things not done before, the learning curve will be steep and will provide valuable information for evaluation.

5) **Evaluation of the test and concept.** It is not expected that the first concept will prove to be successful directly in all aspects thinkable. Yet, the very attempt alone and the questions that emerge from planning and testing the concept will provide clear steering information on how to proceed.  This may include the expansion of scope with different and / or more rail services.

## 2.3  Pre-defined paths for short term slots allocation in Germany

As elaborated in Section 2.1, the involved Stakeholders in this CIT, namely KombiRail Europe, Optimodal, ProRail, and the Port of Rotterdam, each have their own area of interest; however there is some degree of overlap between these. These are however mostly focused on the Dutch side of the border.

In order to balance this, utilising the tool as described in D8.2 will allow for a more detailed analysis of the German situation. With the use of pre-arranged paths improvements in various KPIs can be expected.

*Determining KPI's*

The KPIs determined in this CIT focus on improving reliability, flexibility, and efficiency of services in line with the main objectives for improvement identified by Smart-Rail. Accordingly, choosing and measuring the right KPIs relies upon having a good understanding of what is important when comparing the slots that have been executed in reality and those slots that have been simulated by NEXT. The KPIs utilised as part of this measure will define a set of values against which to base improvements or declines in service. These raw sets of values, which are fed to systems in charge of summarising the information, are called indicators.

Generally, the KPIs chosen should follow the SMART criteria[2]:

- **S**pecific: This means the measure has a specific purpose for the business

- **M**easurable: It is measurable to really get a value of the KPI,

- **A**chievable: The defined norms have to be achievable,

- **R**elevant: The improvement of a KPI has to be relevant to the success of the organisation,

- **T**ime: It must be time phased, which means the value or outcomes are shown for a predefined and relevant period.

The following KPI's are suggested for this measure which will be measured in terms of the actual services currently being run and then in a theoretical situation based on the simulated outputs from NEXT.

### Reliability

1) Departure time punctuality at the marshalling yards, terminals and intermediate stations covering the roundtrip of the rail service
2) Arrival time punctuality at the marshalling yards, terminals and intermediate stations covering the roundtrip of the rail service
3) Accuracy of departure times in terms of planned and achieved times.
4) Accuracy of departure times in terms of planned and achieved times.
5) Simpler interaction with ProRail – this is a qualitative KPI that will be judged based on discussions with ProRail and DB Netz and will be able to form the basis of an improved framework for working together.

### Flexibility

1) Number of available pre-defined slots that are available to RUs
2) Improved service frequency
3) Easier process to gaining ad-hoc slots
4) Improved last-minute booking
5) Improved re-booking

### Efficiency

1) Capacity improvements
2) Number of indirect trans-shipments
3) Average Network Speed
4) System-wide increase in capacity

*Monitoring approach*

Different approaches can be employed when measuring KPIs relating to this tool. It is important that the most up-to-date data is utilised when carrying out the analysis with NEXT.

When monitoring the development and accuracy of NEXT the following can be taken into account:

---

[2] Source: Pang, P. Y., 2009

- Quality of ad-hoc slots that are currently offered
    - Is there a guaranteed time of arrival?
    - Is there a guaranteed time of departure?
    - Is there a guaranteed travel time?
    - What is the average travel speed?
    - Is there a delay between the planned journey and the realised journey?
    - What is the time required to provide an ad-hoc slot?

- Quality of ad-hoc slots that result from the simulation in NEXT
    - Is there a guaranteed time of arrival?
    - Is there a guaranteed time of departure?
    - Is there a guaranteed travel time?
    - What is the average travel speed?
    - What is the difference between the real slot and the proposed slot by NEXT? Has there been an improvement?
    - Is there a delay between the planned journey and the realised journey?
    - What is the time required to provide an ad-hoc slot?
    - What is the percentage of slots that have been rejected by the IM in reality that could have been accommodated by simulation in NEXT?

# 3  Conclusion

Each measure will be monitored from a comprehensive and full scale approach that has been developed to implement and monitor measures. The chosen approach for each measure will allow more partners and pilots to be added as the measure develops in time and during this CIT. This is an important element in the CIT approach.

The approach will allow to extend and benchmark results and successful types of measures to other WPs like WP 3, 5 and 6 and include them in the dissemination process in coming periods of the projects.