Deliverable D 3.4
Road map for SPD implementation

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Table of Contents

1. Executive Summary

This deliverable summarizes the work performed in WP3 within the IMPACT-1 project, task 3.4 “Road map for SPD implementation”. The deliverable describes the road map for how the two mode choice models described in D3.2 “SPD Specification” will be applied to the Shift2Rail use cases described in D3.3 “Use cases for SPDs”. The deliverable is a preparation for the continuation work to be done in the follow-up project IMPACT-2.

2. Abbreviations and acronyms

Abbreviation / Acronyms	Description
CCA	Cross-Cutting Activity
IMPACT	Indicator Monitoring for a new railway PAradigm in seamlessly integrated Cross-modal Transport chains
IP	Innovation Programme
KPI	Key Performance Indicator
LCC	Life Cycle Cost
MAAP	Multi-Annual Action Plan
SEIS	Socio-Economic Impact Study
SPD	System Platform Demonstrator
SPDIA	System Platform Demonstrator Integrated Assessment
TD	Technical Demonstrator
WA	Work Area
WP	Work Package

3. Background

3.1 Relation to the Shift2Rail Work Programme and the IMPACT-1 Project

The present document constitutes the Deliverable D3.4 “Road map for SPD implementation” in the framework of the WA 1.2 System Platform Demonstrator (“Shift2Rail Multi-Annual Action Plan (MAAP)” 2015).

Increasing the competitiveness of the railway sector compared to other transportation modes is one of the major goals of Shift2Rail. It is thus important to assess to what extent the Shift2Rail innovations has an influence on the societal level and on mode choice in particular.

In WP3 “SPD definition” within the IMPACT-1 project (“Indicator Monitoring for a New Railway PAradigm in Seamlessly Integrated Cross Modal Transport Chains – Phase 1, Project Proposal” 2016), requirements and specifications are developed for Scenario Platform Demonstrators (SPDs) for four main service categories: high-speed passenger rail, regional passenger rail, urban passenger rail and rail freight. WP3 within IMPACT-1 is thus a pre-study which will result in a road map for the implementation of SPDs. The aim of the implemented SPDs is on the one hand that they should be able to assess the impact of Shift2Rail innovations on society (SEIS), especially the impact on mode choice. On the other hand, they will later be used for the integrated assessment (SPDIA) of the achievements of the technical developments of Shift2Rail using the KPI model of WP4. Therefore, the SPDs themselves form an important basis for the assessment of the target achievement of Shift2Rail (see Figure 1).

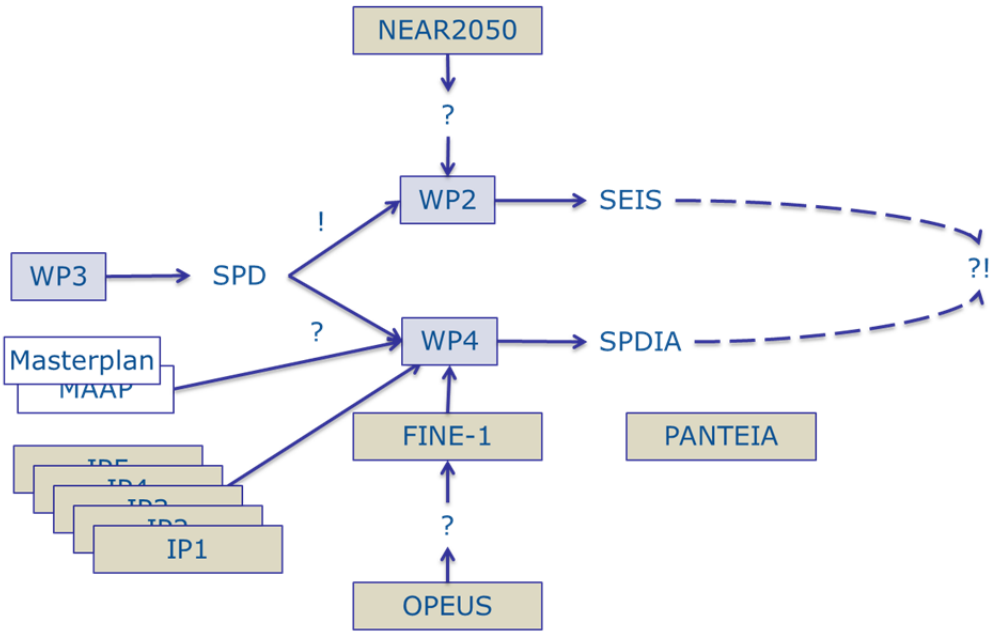

Figure 1: Use of the SPDs both for the socio-economic impact study (SEIS) and the SPD integrated assessment (SPDIA) of IMPACT-1/2.

The overall Shift2Rail objectives are described in the Shift2Rail Strategic Master Plan ("Shift2Rail Strategic Master Plan" 2015): to achieve a Single European Railway Area, enhance the attractiveness and competitiveness of the European railway system and to help the European industry to retain and consolidate its leadership on the global market, see also Figure 2.

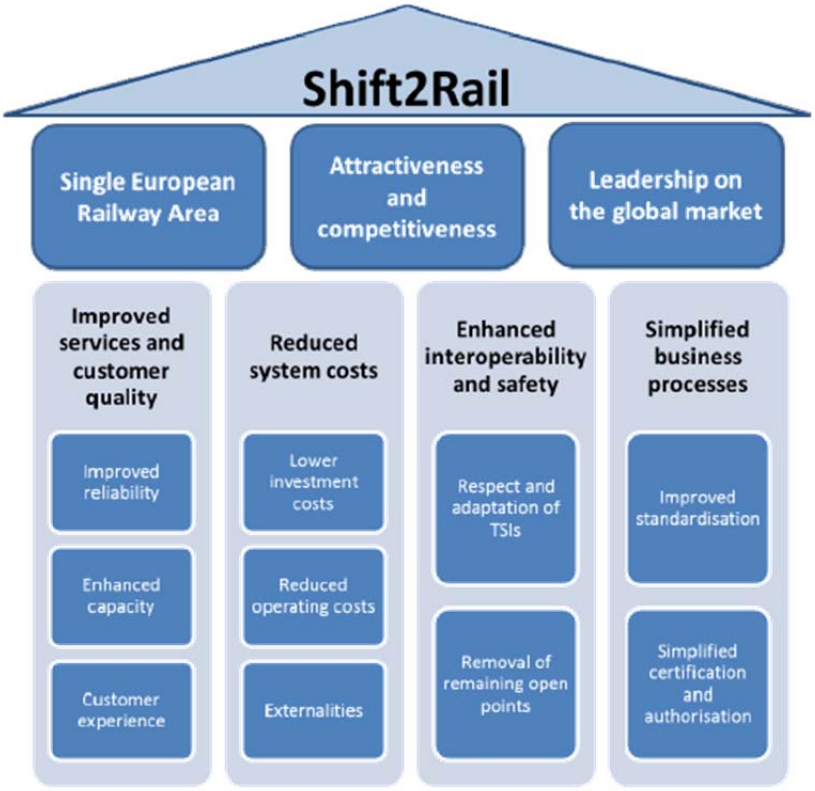

Figure 2: Overall Shift2Rail objectives as described in the Master Plan ("Shift2Rail Strategic Master Plan" 2015).

To achieve these objectives the Master Plan identifies five Innovation Programmes for the technical activities and five cross-cutting themes, the first of these cross-cutting themes being long-term needs and socio-economic research, see Figure 3. Shift2Rail thus encompasses both technical Innovation Programmes (IPs) and Cross-Cutting Activities (CCAs). IMPACT-1 is one of the CCA-projects within Shift2Rail.

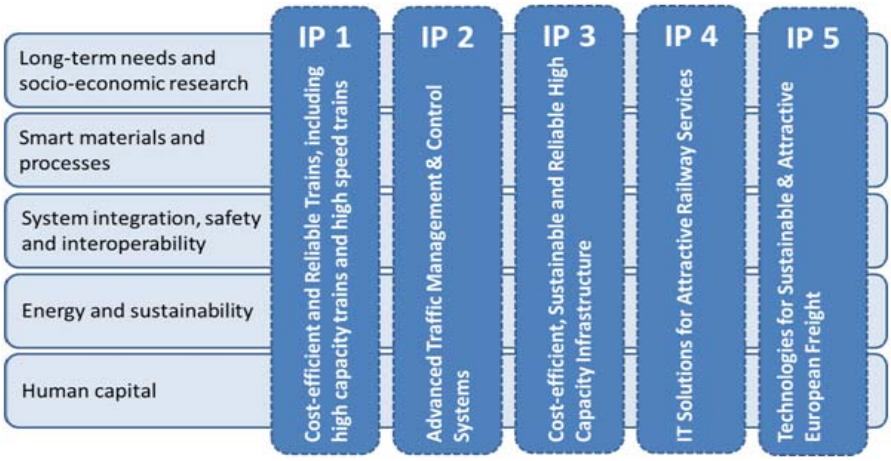

Figure 3: Shift2Rail Innovation Programmes (IPs) and cross-cutting themes as defined in the Master Plan ("Shift2Rail Strategic Master Plan" 2015)

The Multi-Annual Action Plan (MAAP) ("Shift2Rail Multi-Annual Action Plan (MAAP)" 2015) further specifies the work to be done within the long-term needs and socio-economic research cross-cutting theme and divides it into two work areas (WA): 1) Socio-economics and system platform demonstrators and 2) Key Performance Indicators, see Figure 4. The work in IMPACT-1/2 is done within work area 1 and 2 within the CCA activities of Shift2Rail.

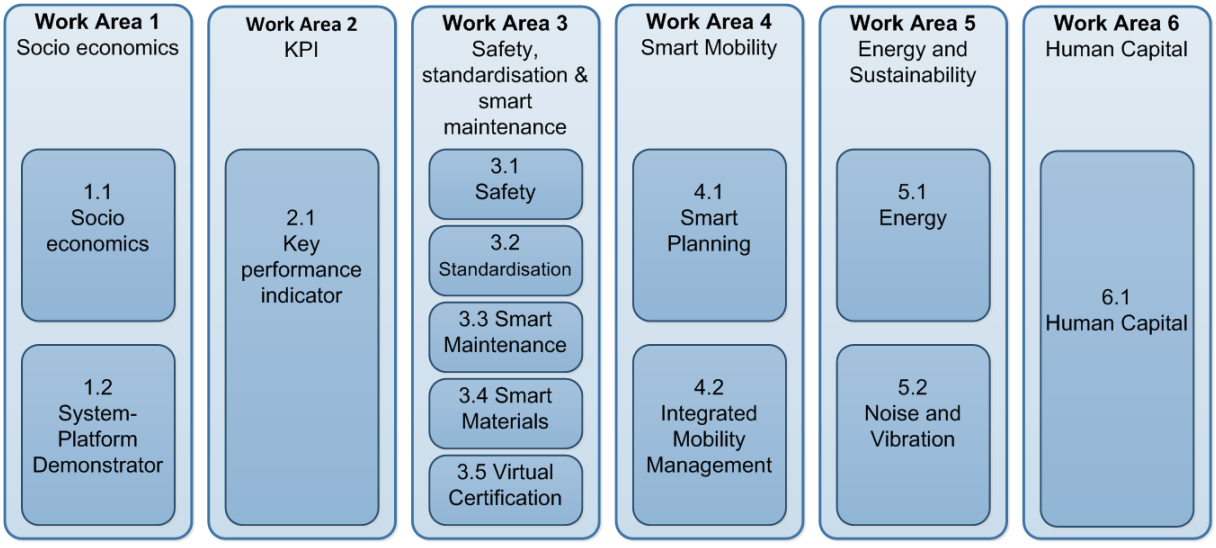

Figure 4: Work areas within Shift2Rail cross-cutting themes as defined in the MAAP ("Shift2Rail Multi-Annual Action Plan (MAAP)" 2015) .

The master plan ("Shift2Rail Strategic Master Plan" 2015) states three quantitative Key Performance Indicators (KPIs): reliability, life-cycle cost (LCC) and capacity. Furthermore, the master plan describes one qualitative KPI, which is attractiveness.

The quantitative KPIs are defined in the IMPACT-1 document "Definition of Shift2Rail KPI" ("Definition of Shift2Rail KPI - Documentation within the IMPACT-1 Project. Document Status: First Issue." 2017). The success of Shift2Rail should be monitored by means of these KPIs. Key target levels have been set for the quantitative KPIs. The assessment of to what extent Shift2Rail reaches the key target levels for the quantitative KPIs is carried out within WP4 of the IMPACT-1/2 projects. Figure 5 shows the relation between WP2, WP3 and WP4 of the IMPACT-1/2 projects.

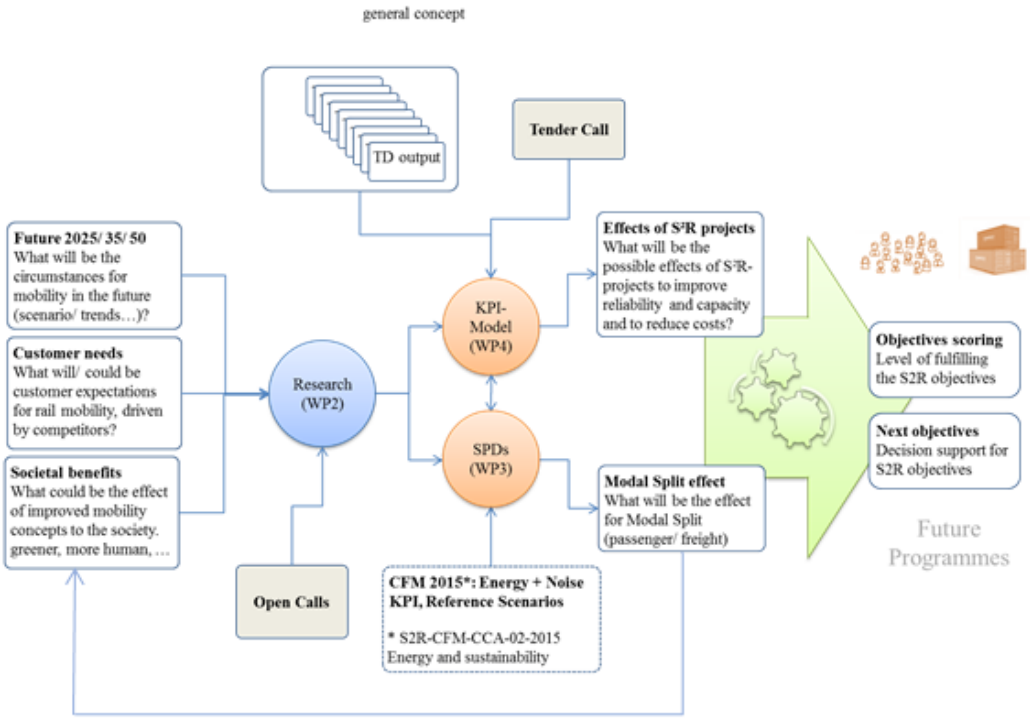

Figure 5: Relation between the work packages of IMPACT-1/2.

The key target levels specified in the master plan for the quantitative KPIs are:

1. 50% increase in the reliability and punctuality of rail services by 2030,
2. 50% reduction of the life-cycle cost of railway transport (i.e. the costs of developing, building, maintaining, operating, renewing and dismantling infrastructure and rolling stock) by 2030,
3. 100% increase in the capacity of the railway transport system by 2030.

3.2 Relation to SPD use cases

Mode choice effects will be evaluated for one use case for each market segment: high-speed passenger rail, regional passenger rail, urban passenger rail and rail freight. The use cases are spread around Europe and are based on requirements defined in D3.1 SPD Requirements (Kristoffersson 2017a), that enable all Shift2Rail innovations to be assessed using at least one use case. The use cases are described in more detail in D3.3 Use cases for SPDs (Kristoffersson 2017b).

4. Objective/Aim

This deliverable D3.4 belongs to WP3 within IMPACT-1, which is part of work area 1.2 System Platform Demonstrator. The purpose of D3.4 is to outline a road map for the application of the mode choice models specified in the deliverable D3.2 “SPD Specification” to the use cases described in D3.3 “Use cases for SPDs”.

The purpose of this document is therefore to describe what data needs to be collected for each use case and outline how the mode choice models specified in IMPACT-1 shall be implemented in the follow-up project IMPACT-2 for calculation of mode choice effects, assuming that Shift2Rail key targets have been reached.

5. Road map to implementation

Table 1 summarizes the steps needed in order to apply the mode choice models specified in D3.2 "SPD Specification" to the use cases outlined in D3.3 "Use cases for SPDs". The first step is to collect data. These data are of two kinds: general elasticity and parameter values from literature and data specific to the different use cases. The second step is to apply the collected data to the mode choice models and calculate resulting changes to passenger/goods demand for rail transport and competing modes. The third step is to perform a sensitivity analysis on uncertain values/parameters in the model. In the fourth step the results for the different use cases are analysed and compared, and in a fifth step the model results are handed over to WP2 for calculation of socio-economic benefits.

Table 1: Road map to implementation – description of steps needed.

	Step	**Description**
1	Data collection	Collection of elasticity and parameter values from literature. Collection of baseline travel data from the use case areas.
2	Application of data to mode choice model	Calculation of mode choice effects.
3	Sensitivity analysis	Conduction of sensitivity analysis.
4	Result analysis and comparison	Analysis of mode choice effects and comparison of differences and similarities between the use cases and improvement area.
5	Preparation for next step	Handing over of results to WP2 for calculation of socio-economic benefits.

6. SPD passenger mode choice model implementation

6.1 Data collection

Deliverable D3.2 "SPD Specification" describes the model proposed to use for passenger mode choice evaluation. In this section the data needed to feed that model is outlined. Two types of data need to be collected:

1. General elasticity values and weighting parameters
2. Use cases specific data on travel times and costs

General elasticity values and weighting parameters are common to all three passenger SPD use cases. The only exception is the cross elasticity, which might differ between the use cases if different competing modes are identified. Table 2 shows which data is needed regarding the general elasticity values and weighting parameters. These are also further discussed in D3.2 "SPD specification". The "attractiveness change" parameter should be seen as a bonus, since it is not needed in order to do the basic calculation of mode choice effects assuming that the *quantified* key target levels have been reached. Given that data can be found, it could be a way to assess the effects of the non-quantified KPI attractiveness.

Table 2: General data needed common to all three passenger SPD use cases.

Data	**Definition**	**Source**
Own elasticity	The percentage change in passenger demand for railway transport as a response to a percentage decrease of the generalized cost for railway transport.	Literature/Sampers model
Cross elasticity	The percentage change in passenger demand for competing mode(s) as a response to a percentage decrease of the generalized cost for railway transport.	Literature/Sampers model
Weighting parameters	Weighting parameters for in-vehicle travel time, waiting time, delay time and cost, as well as an alternative specific constant, all as part of the generalized cost function to the user.	Literature/Sampers model
Attractiveness change	*Percentage change in the alternative specific constant for railway transport as response to improvements in travel information and ticketing/booking.*	*Literature*

Table 3 shows the use case specific data needed for all three use cases described in D3.3 "Use cases for SPDs". There is one use case for each passenger rail market segment: high-speed, regional and urban passenger rail. The high-speed use case is a line between LGV Paris and Poitiers in France, the regional use case is a line between Magdeburg and Frankfurt/Oder in Germany and the urban use case consists of two metro lines (Línea 1 and Línea 2) in Bilbao, Spain. The data in Table 3 needs to be collected for each use case. Competing modes may differ between the use cases, e.g. air might be a competing mode for the high-speed line, but not for the other two use cases.

Table 3: Use case specific data needed to feed the mode choice model.

Data	Definition	Source
Competing mode(s)	Relevant modes competing with rail for passengers for the corridor under study.	Travel survey/operator
Passenger demand	Peak hour passenger demand in the baseline situation for rail and competing mode(s).	Travel survey/operator
In-vehicle travel time	Peak hour average in-vehicle travel time for rail in the baseline situation.	Travel survey/operator
Frequency	Peak hour average frequency for rail in the baseline situation.	Travel survey/operator
Delay time	Peak hour average delay time for rail in the baseline situation.	Travel survey/operator
Travel cost	Average peak hour ticket price for rail in the baseline situation.	Travel survey/operator

6.2 Application of data to mode choice model

The mode choice model can be programmed using a tool such as Excel. Once the data described in the previous section is collected, the data can be applied to the mode choice model. This process will be similar for the three use cases. Deliverable D3.2 describes the assumptions needed in order to translate Shift2Rail key target levels into effects on the frequency, delay time and travel cost. Applying these changes to the use case specific data for the baseline situation will give the changes in generalized cost needed to calculate effects on passenger demand.

6.3 Sensitivity analysis

As noted also in D3.2, the own elasticity is generally stable across use cases, whereas the cross elasticity is dependent on the market share for rail in the situation where the cross elasticity was estimated. A sensitivity analysis with a high and low value for the cross elasticity will therefore be performed.

6.4 Result analysis and comparison

In this step the resulting changes in passenger demand for rail transport and competing mode(s) will be compared across the three use cases. The result analysis will investigate questions such as:

- Which use case shows the largest increase in passengers to rail and why?
- Which use case shows the largest decrease in passengers for competing modes and why?
- Which are the main drivers in the model, attracting passengers to rail?
- Is the model very sensitive to the value on the cross elasticity?

6.5 Preparation for next step

The calculated changes in passenger demand for rail and competing mode(s) are in this step handed over to WP2 of IMPACT-2. In WP2 calculations of socio-economic benefits of the Shift2Rail innovations will be made, using the output from the mode choice modelling described above.

7. SPD freight mode choice model implementation

Deliverable D3.2 proposed to use the Samgods model (Bergquist, Bernhardsson, and Rosklint 2016) in order to model modal choice for freight transport. The use case on which the mode choice model will be applied is a cross-border freight transport corridor from Hallsberg in Sweden to Munich in Germany. This corridor is part of the Scandinavian-Mediterranean freight corridor, which in turn is part of the European freight corridor network.

7.1 Data collection

Samgods already contains a lot of data, especially regarding freight transport within, to, from and through Sweden. However, two important data sources are lacking:

1. Data on capacity limitations for tracks outside Sweden. This leads to unwanted effects of transhipment from rail to truck at the Swedish border.
2. Data on freight train delays, together with data on the relation between freight train delays and cost for goods transportation.

7.2 Application of data to the mode choice model

Given that data on rail freight capacity limitations on and around (alternative routes) the part of the use case corridor that lies in Germany and Denmark can be collected, then the Samgods model can be applied to investigate questions such as:

- What are the effects of longer freight trains on ton-km goods transported by rail?
- What are the effects of increased freight train frequency on ton-km goods transported by rail?
- What are the effects of more efficient freight terminals on ton-km goods transported by rail?
- What are the effects of increased average speed and transport time on ton-km goods transported by rail?

If data on freight train delays and its effect on transport costs can be collected, then the Samgods model can be applied to investigate:

- What are the effects of reduction in freight train delays on ton-km goods transported by rail?

7.3 Sensitivity analysis

A sensitivity analysis is made concerning how sensitive the Samgods model is to capacity limitations in the rail network. To do this the model can be run with and without capacity limitations in the rail network.

7.4 Result analysis and comparison

In this step, results will be analysed and discussed. The ability of different kind of capacity improvements (longer trains, efficient terminals and increased frequency) and improvements in punctuality to attract freight transport to rail will be compared and discussed.

7.5 Preparation for next step

The calculated changes in ton-km transported by rail and competing mode(s) are in this step handed over to WP2 of IMPACT-2. In WP2 calculations of socio-economic benefits of the Shift2Rail innovations will be made, using the output from the mode choice modelling described above.

8. Conclusion

This Deliverable has described the steps needed in order to apply the models outlined in Deliverable D3.2 to the use cases described in Deliverable D3.3. It shows that data collection is a very important part of the application of the models to use cases, for freight and passenger transport. Both general data regarding elasticities and use case specific data needs to be collected within the follow-up project IMPACT-2. This Deliverable also high-lights the connection to WP2 where the results of the demand modelling will be used when calculating socio-economic benefits.

9. References

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