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First SPD integrated assessment

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1 Executive summary

The following deliverable shows the results for the Key Performance Indicators (KPIs) Life-Cycle Cost (LCC), Capacity and Reliability & Punctuality carried out with the reviewed quantitative KPI model fed by updated low-level KPIs of the Technical Demonstrators (TDs). It therefore documents the intermediate results of task 4.3 of IMPACT-2 and is a continuation of the deliverable D4.2 “Initial estimation of the KPIs” [5]. This deliverable combined with the deliverable D4.3 “Reviewed quantitative KPI model” [6] documents the progress since the first version of the quantitative KPI model developed within IMPACT-2 and displays the results of the reviewed System Platform Demonstrator (SPD) integrated assessment.

Additionally the following deliverable contains two annexes. One to describe the methodology for a model covering positive effects on the attractiveness of railway to the end-costumer triggered by Shift2Rail, the other to give an update on deliverable D4.1 “Reference Scenario” of IMPACT-1 [3].

Even though there are still potential for enhancement in the KPI model and its results identified and described in deliverable D4.3 [6] the comparison of the quality of the results shown in these deliverable to the quality of the results documented in deliverable D4.2 [5] shows that it can be foreseen that the quality of the KPI results will increase during the remaining project duration.

The enhancement of quality is thereby reached by increasing the quality of the three key elements of the KPI results: the KPI calculations, the stability of the baseline scenarios and the accuracy of the low-level KPI provided by the TDs.

Not only are the KPI results an important indication of the possible success of innovations developed within Shift2Rail, but they will also be one of the influential inputs to the mode choice model developed within work package 3 of IMPACT-2.

2 Abbreviations and acronyms

Abbreviation / acronym	Description
AMPI	Area of Major Potential Improvement
CCA	Cross-Cutting Activities
GA	Grant Agreement
IMPACT-1	Indicator Monitoring for a new railway PAradigm in seamlessly integrated Cross modal Transport chains – Phase 1
IMPACT-2	Indicator Monitoring for a new railway PAradigm in seamlessly integrated Cross modal Transport chains – Phase 2
IM	Infrastructure Manager
IP	Innovation Programme
JU	Joint Undertaking
KPI	Key Performance Indicator
LCC	Life-Cycle Cost
MAAP	Multi-Annual Action Plan
R&I	Research and Innovation
S2R	Shift2Rail
SPD	System Platform Demonstrator
TD	Technical Demonstrator
WA	Work Area
WP	Work Package

3 Background

The present document constitutes the Deliverable D4.4 “First SPD integrated assessment” in the framework of the WA2 “KPI method development and integrated assessment” (see figure 1), task 1, task 5 and task 6 of the Cross-Cutting Activities (CCA) defined in the Multi-Annual Action Plan (MAAP) at the time of the start of IMPACT-2 (September 2017) [1].

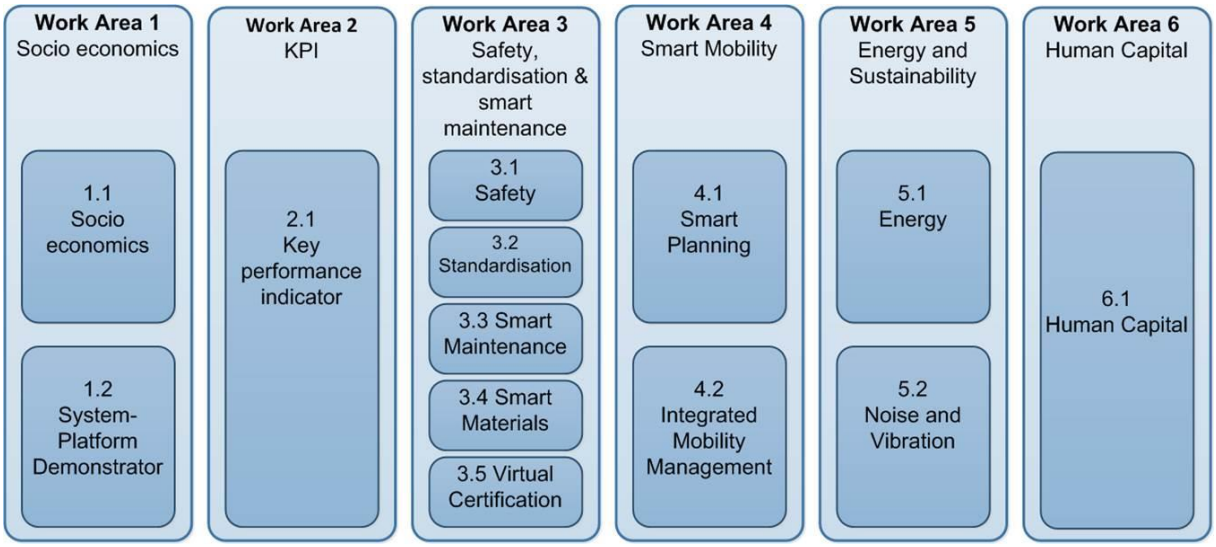

Figure 1: Overview Work Areas (WA)

IMPACT-2 constitutes of nine Work Packages (WPs) (see **Fel! Hittar inte referenskälla.**). The work reported in this deliverable has been performed within WP4 “KPI”.

WP	**Name**
WP1	Project management
WP2	Socio-economic impact
WP3	SPD implementation
WP4	**KPI**
WP5	Standardisation
WP6	Smart Maintenance
WP7	Integrated Mobility
WP8	Human Capital
WP9	Dissemination

Table 1: Work packages within IMPACT-2

4 Objectives/aims

This document has been prepared to provide a summary of the results of the reviewed SPD integrated assessment. The results are carried out with the reviewed quantitative KPI model documented in deliverable D4.3 [6] and fed by the estimations of low-level KPIs of the TDs on their knowledge in 2019. The model is a continuation of the first initial KPI model described in Deliverable D4.1 of IMPACT-2 [4].

5 Reviewed SPD integrated assessment

The results of the reviewed quantitative KPI model of IMPACT-2 give a more detailed indication of the impact the TD´s innovations developed in Shift2Rail have on the three KPIs Life-Cycle Cost (LCC), Capacity and Reliability & Punctuality.

5.1 Results of the project status 2019

The results are calculated for a future in which Shift2Rail innovations have been implemented. Therefore, mitigation is not considered in the results. Changes to previous results are based on three aspects: further developments in the model (see chapter 5.2.2), more accurate estimations by the TDs of their improvements because of their deepened knowledge gained in their development process and adapted baseline scenarios.

One of the most significant improvements in comparison to the results displayed in deliverable D4.2 of IMPACT-2 [5] is that the four SPDs High Speed, Regional, Urban (Metro) and Freight, which build the baseline for the calculation of the three KPIs, have been reviewed and adapted. Due to a deeper knowledge of the area of improvement in the TDs, more detailed reference scenarios have been developed. This allows calculating the improvements towards the KPIs in more detail and with a better reflection of the technical effects of the TD innovations (see Chapter 5.2.2).

5.1.1 Results of the overall Shift2Rail Programme obtained from the KPI model

The new estimations of the KPI are displayed in table 2 - table 5. A detailed discussion on the causes for the changes between the results of the initial estimations (D4.2.) and the reviewed estimation in this deliverable will be given in chapter 5.2. A number of assumptions and restrictions have been made which are in detail described in chapter 5.2.3. These assumptions and restrictions have to be taken into account when interpreting the displayed results. For orientation the results of the initial KPI model, which were published in deliverable D4.2 [5] are also displayed here.

SPD 1 – High-Speed		
KPI	*Initial estimation (D4.2)*	*Reviewed estimation*
LCC reduction	-17 %	-15 %
Reliability & Punctuality increase	19 %	29 %
Capacity increase	74 %	69 %

Table 2: KPI results for High-Speed

The estimations for passenger and freight results for LCC and Reliability & Punctuality can be compared as they follow a similar calculation approach. For the capacity calculation however the decisive factor for passenger trains is the peak hour as there is enough capacity available during off-peak hours. For freight however the capacity is not limited to specific hours but to

the general line capacity in dense corridors. Therefore it is calculated for the duration of a whole day [7].

SPD 2 – Regional		
KPI	*Initial estimation (D4.2)*	*Reviewed estimation*
LCC reduction	-25 %	-21 %
Reliability & Punctuality increase	15 %	51 %
Capacity increase	49 %	57 %

Table 3: KPI results for Regional

For SPD3 (Metro), it was detected that providing a value for Reliability & Punctuality is not suitable. As the frequency of the trains is as high as every three to five minutes, the punctuality of any individual train is not the decisive factor but the time interval between two following trains. The definition used for the KPI Reliability & Punctuality [7] is therefore not applicable for metro trains. As there is no data available for any metro system with a considerable issue with their frequency, no individual solution for calculating Reliability & Punctuality for a metro scenario has been developed.

SPD 3 – Metro		
KPI	*Initial estimation (D4.2)*	*Reviewed estimation*
LCC reduction	-9 %	-16 %
Reliability & Punctuality increase	11 %	Not applicable
Capacity increase	26 %	23 %

Table 4: KPI results for Metro

As Capacity, especially for the freight scenario, is highly dependent on signalling, further investigations on the correlations of different effects need to be carried out to ensure a reliable result. Therefore, at this stage of the KPI model development only a range for the Capacity increase of the rail freight scenario can be displayed, dependent on the improvement that can be achieved by the signalling system (see also table 9).

SPD 4 – Freight		
KPI	*Initial estimation (D4.2)*	*Reviewed estimation*
LCC reduction	-36 %	-39 %
Reliability & Punctuality increase	71 %	78 %
Capacity increase	82 %	42-114 %

Table 5: KPI results for Freight

5.1.2 Results for specific parts of the railway system

Besides the results for the whole railway system of the respective market segments, the reviewed KPI model is also able to show results individually for the Innovation Programmes (IPs) of Shift2Rail.

As for the results of the initial KPI model [5] the results per IP are measured against the IP-specific baseline. This means that the improvement per IP show the improvement in the part of the railway system which the IP can actually influence e.g. for IP3 (infrastructure) in the High speed scenario a decrease of the LCC by 19% was calculated. This means that the innovations developed in IP3 are able to reduce the life-cycle cost of the infrastructure (excluding the signalling system) by 19% in the underlying high speed scenario. This method has been chosen to extract effects of the proportions of subsystems on the whole railway system from the IP-specific results.

The results for every IP per SPD are shown in Table 6 - Table 9. Thereby IP1 (passenger vehicles) is not reflected in SPD4 - Freight as the IP is focusing on passenger trains and IP5 (freight traffic) is not reflected in SPD1, SPD2 and SPD3, as these are passenger transport scenarios.

Additionally it should be noted that the Capacity increase for IP3 is based on a reduction of the needed capacity reserve in the timetabling in the peak hour, therefore no large improvement is possible. Further as already addressed in chapter 5.1.1, the conversations about the influence of IP2 on the freight capacity are not mature enough to calculate a stable result. Therefor a range is considered in the current results.

SPD 1 – High-Speed	Vehicle / IP1	Signalling / IP2	Infrastructure / IP3
LCC reduction	-5 %	-32 %	-19 %
Reliability & Punctuality increase	23 %	10 %	58 %
Capacity increase	22 %	38 %	0.4 %

Table 6: KPI results for High-Speed per IP

SPD 2 – Regional	Vehicle / IP1	Signalling / IP2	Infrastructure / IP3
LCC reduction	-8 %	-45 %	-26 %
Reliability & Punctuality increase	35 %	10 %	61 %
Capacity increase	20 %	30 %	0.4 %

Table 7: KPI results for Regional per IP

SPD 3 – Metro	Vehicle / IP1	Signalling / IP2	Infrastructure / IP3
LCC reduction	-3 %	-59 %	-15 %
Reliability & Punctuality increase	Not applicable		
Capacity increase	2 %	20 %	0.4 %

Table 8: KPI results for Metro per IP

SPD 4 – Freight	Freight / IP5	Signalling / IP2	Infrastructure / IP3
LCC reduction	-17 %	-20 %	-18 %
Reliability & Punctuality increase	79 %	10 %	52 %
Capacity increase	32 %	0-50 %	6 %

Table 9: KPI results for Freight per IP

Within the freight scenario there can be an additional -27 % decrease of cost per metric ton-kilometre achieved due to a more efficient process and utilisation of rolling stock.

The results are not shown per TD and furthermore will not be shown in future versions of the model, because there are numerous interrelations and interactions between the TDs. These do affect the improvements of the KPIs and therefore a reasonable reflection of the importance of each single TD will not be possible.

5.2 Discussion of the results in comparison to the results of the initial model

In the following the major differences between the results of the initial KPI model shown in deliverable D4.2 [5] and the results shown here will be explained.

5.2.1 Progress in the model since the start of IMPACT-2

As the KPI model is being developed alongside the different TD projects, it is continuously improved and adapted in parallel to the progress of the TDs. This subchapter will summarise the main progress of the development of the KPI model between the status at the beginning of IMPACT-2 D4.1 [4] and the current status D4.3 [6].

One major change was that the approach for the calculation of the Reliability & Punctuality has been changed for all IPs. In former versions, the number of delayed services was determined. In the latest version, the calculation is carried out via delay minutes per failure cause. This method allows taking the severity of a failure into account.

For IP2 (signalling), the approach was adapted due to the integrity of the different TDs in IP2 to which the former approach was not suitable. Unfortunately, the new developed approach could not fully be applied for the results shown above due to time restrictions.

For IP3 (infrastructure) the KPI model has been extended. On the one hand a factor for the downtime due to unplanned maintenance and the resulting improvements in more line capacity during peak hour was incorporated. On the other hand the interdependence between vehicle and infrastructure and therefore IP1 / IP5 with IP3 was accounted for by including a formula to illustrate the interdependency showing the dependency of maintenance costs in relation to the axle load of the vehicle.

As IP5 (freight rail) has been restructured since the start of IMPACT-2 there is still a continuous refinement of the reference scenario under progress to capture all TD innovation in as much detail as possible. One big change already included in the model is the diversification of the waggon from one to two different waggon categories to account for the different requirements of the goods and thus the differences of the innovation potential. All waggon related parameters have in this context been adapted as well.

The most recent development especially for IP4 (IT solutions) can be found in Annex 8.1.

Another aspect that has been added to the 2019 version of the KPI model are noise reduction effects. Interior noise and vibration have a direct influence on the comfort level and are therefore included in the attractiveness model. Exterior noise has been included in the LCC model and quantified with the current value of noise dependent track access charges. In the capacity model noise has been incorporated with the current value of trains that are not allowed to run due to a noise ceiling that is reached.

5.2.2 Changes in baseline scenarios and Data verification process

Besides the actual KPI model also the scenarios, on which the improvements of the Shift2Rail innovations are applied on, are influencing the results.

It was decided that the scenarios for the four market segments High Speed, Regional, Urban (metro) and Rail Freight should reflect scenarios, which could exist somewhere in Europe. The real world use cases described in D3.3 of IMPACT-1 [2], with communicated adaptions, are used for orientation. It was however decided not to use the exact data for these specific use cases for two reasons: Due to the special characteristics of the railway system in every country as well as special cases that apply for specific lines the possibility to extrapolate the results are too limited. Further, as there are partially rather detailed data for the reference scenarios needed, it is prevented to expose data from one Infrastructure Manager (IM) or Railway Undertaking (RU) too much. Nevertheless, in case of a high spread of the input data from the different sources, the data fitting best to the selected real world use cases in D3.3 is preferred.

To stabilise the reference scenarios described in deliverable D4.1 of IMPACT-1 [3] the following process was carried out.

In the first step all needed data for the four SPDs were identified. This list of data was then sent to Railway Undertakings and Infrastructure Manager within Shift2Rail (Deutsche Bahn, SNCF, Trafikverket, Network Rail and Wiener Linien). Everyone was asked to provide the whole set of data as far as their data base allowed it. Additional data was provided by other European authorities and desktop research for the same data was carried out. This process took several months.

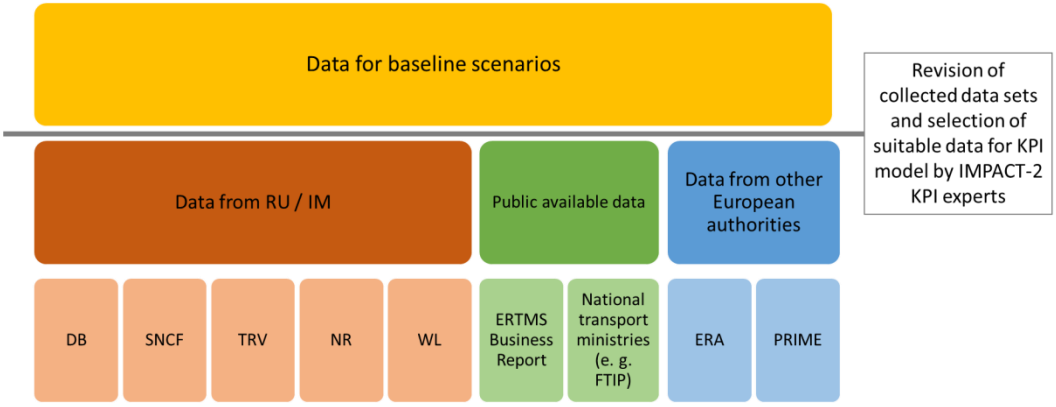

Figure 2: Data verification process

Finally, all the different data sets provided through the different sources were reviewed through the KPI experts in IMPACT-2 including experts from railways, industry and research bodies. Through the exhaustive data collection process, at least two values for every needed parameter of the reference scenarios were available, in most cases even more. Based on these values the experts discussed and determined all parameter values for the reference scenario. This procedure was repeated for every market segment.

Through the comparison of data from different sources, special characteristics and national peculiarities were straightened to provide a certain grade of generality for the KPI calculations. This allows for the results to be applicable to many places in Europe.

The changes made to the reference scenario which has been published as D4.1 in IMPACT-1 [3] are summarised in annex 8.2 of this report.

5.2.3 Restrictions and assumptions

There are various challenges that integrating more than 40 innovative projects into one model and aggregating their improvements to three high level KPIs bring forth. Therefore, some restrictions and assumption to the above shown results need to be kept in mind.

Even though the following points should cover the main aspects attached to the results and the IPs and TDs had the chance to provide comments on the above described results, the following remarks do not claim to be exhaustive. Further the restrictions and assumptions to the model described in deliverable D4.3 [6] should be considered too, when interpreting the results:

- The results for the three KPIs are always to be understood as optimisations for the specific KPI. This means that for example the LCC results have to be understood as

having the goal of optimising the baseline scenario towards LCC by introducing the Shift2Rail innovations. Of course there are assumptions about the operational program and therefore about capacity and punctuality considered, but those are assumed constant for the future result. The same applies for the Capacity results and the Reliability & Punctuality results. Thus, there is no optimisation between the three KPIs, but an optimisation towards respectively one KPI with restrictions on the other two KPIs underlying.

- For some of these innovations that cannot be mapped to the KPI LCC, Capacity or Reliability & Punctuality, the attractiveness model has been developed to include all innovations that reduce the barriers to travel by train (compare Annex 8.1). There are however still a few TDs whose innovation potential cannot fully be displayed in the KPI model.
- Another restriction referring to the value of the TD improvements is the timeline. As the IMPACT-2 project is being developed alongside the IP projects, the quantification of the improvement values can change throughout the different IMPACT-2 releases due to a higher level of detail obtained during the lifetime of the projects.
- Some improvements about the cost reduction, especially for passenger vehicles (IP1), are currently uncertain in some cases and rather conservative in other cases. This is driven by the fact that at the current state of development only the cost for prototypes can be estimated. These costs are usually significantly higher than the cost of the end-product.
- It is mandatory for the Shift2Rail future scenario to have a strong IT-Security/Cyber-Security. This however will be a prerequisite tailored to the needs of the future system rather than an improvement of today's IT- and cyber security. Therefore it is not incorporated into the current KPI model.
- As described in detail in D4.3 [6] the approach of integrating IP2 into the KPI model differs in its complexity from that of other IPs. Due to the integrated character of the TDs in IP2, it is however foreseen, that all TDs contribute to the positive improvements of the IP2 innovations.
- Weight reduction provided by the innovations of different TDs has been incorporated in the KPI model at various points, leading to improvements in capacity and attractiveness or a reduction of the LCC (e.g. due to reduction of energy consumption). This however is only possible when the negative effects that a reduction in weight can have on the noise balance and traction of the vehicle is accounted for as well. Therefore, IP1 is working on enabling a decrease in weight without the negative side effects mentioned.

6 Conclusions

The conclusions reached at this stage of the R&I and highlighted in this report are that in comparison to the initial KPI model and its results significant enhancements could be applied. This applies to all key elements of the KPI model.

The calculations from the improvements provided by the Shift2Rail innovations towards the key targets LCC, Capacity and Reliability & Punctuality could be improved by adding more aspects to them and in case of the Reliability & Punctuality result to change to a more accurate methodology.

The baseline scenarios could be further stabilised by carrying out an extensive data verification process with the involvement of several independent data sources.

The improvements provided through the Shift2Rail innovation projects have been more precise, because of the gained knowledge through the further progress in their respective projects.

As these aspects are also foreseen to be continued, it is foreseen that the quality of the KPI results will increase during the remaining project duration.

7 References

[1] Shift2Rail - *Shift2Rail Multi-Annual Action Plan (MAAP)* – 2015
[2] IMPACT-1 – *D3.3 "Use cases for SPDs"* – 2017, Vol. 1
[3] IMPACT-1 – *D4.1"Reference Scenario"* – 2018, Vol. 1
[4] IMPACT-2 – *D4.1 "Initial quantitative KPI model"* – 2018, Vol. 2
[5] IMPACT-2 – D4.2 "*Initial estimation of the KPIs*" – 2018, Vol. 2
[6] IMPACT-2 – D4.3 "*Reviewed quantitative KPI model*" – 2019, Vol. 1
[7] IMPACT-1 – *D4.2 "Subsystem structure and Sublevel KPIs"* – 2018, Vol. 1

8 Annexes

8.1 Description of attractiveness model approach

The source of the attractiveness model approach is an empirical finding: it has been identified that the assessed KPIs capacity, reliability and LCC are not suitable to evaluate IP4 innovations which are directly focusing on the demand of the railway system. Nevertheless, to reflect also the positive effects of innovations focussing on the customer, an approach was developed to quantify the improvement in attractiveness. Based on the assumption that improving the basic offer of transportation (as measured by the KPIs LCC, punctuality and capacity) is one driver of the attractiveness of the whole railway system but not the only one, the overall approach is including "by design" IP1, 2 and 3.

The overall approach is based on 2 major steps, more detailed in the figure below:

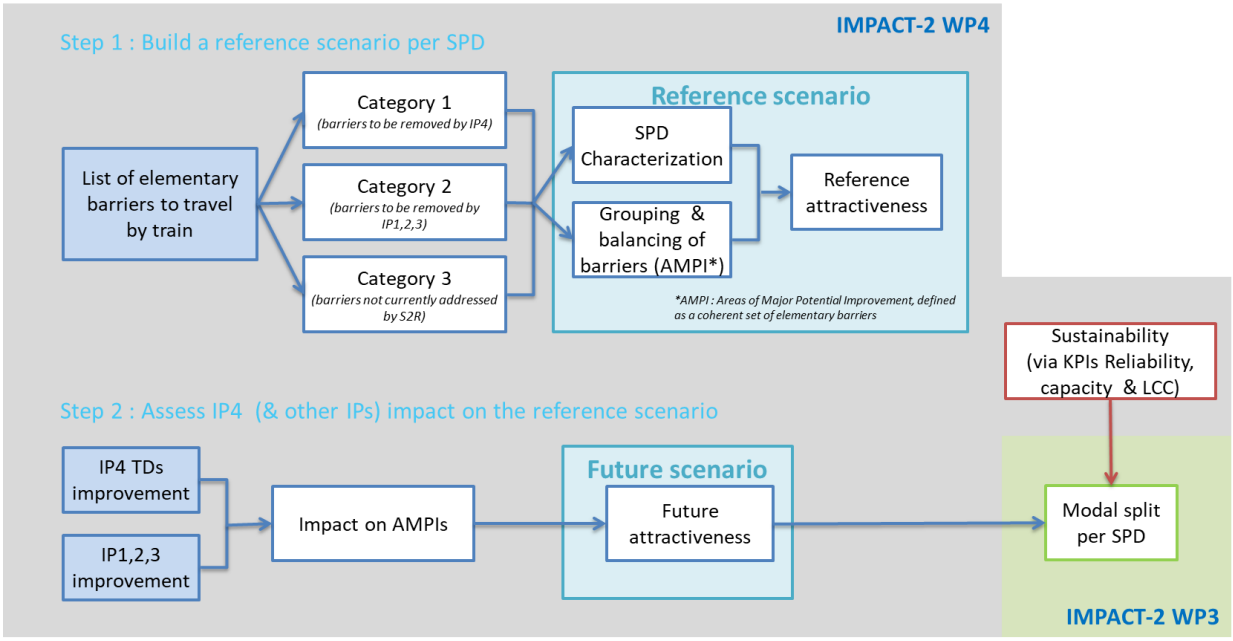

Figure 3: Development of a reference attractiveness scenario for each passenger SPD

First, the most comprehensive possible list of elementary barriers to travel by train was consolidated, using a state-of-the-art review [D] [E] and the capitalisation on other Shift2Rail activities' outputs [A] [B] [C]. To decompose the railway transport attractiveness, this whole list is split in three categories, according to whether the elementary barrier could be addressed by (a) IP4, (b) IP1, 2 and 3 (c) elements, which are not influenced by Shift2Rail activities.

Within each category, the elementary barriers are then grouped into Areas of Major Possible Improvement (AMPI) as described in figure below to allow dealing more easily with them. To ensure coherence in the grouping, experts of different research fields e.g. Noise and Vibration have been consulted.

For each of the AMPI, the starting point is an evaluation of the current status, which is developed each SPD The AMPIs are balanced according to their contribution to the rail attractiveness, through a double balancing process:

- The three categories (as represented in the figure below) are balanced between themselves so that their sum represents 100% of the rail attractiveness for each SPD.
- Within each category, the AMPIs are also balanced between themselves so their sum represents 100%. Each AMPI weight depends on the SPD. For instance, in the category 1, one AMPI named the "lack of multimodal online shopping" contributes by 9% for SPD1, 11 % for SPD2 and 14% for SPD3.

For finding the right balance between the AMPIs, analysis of the data of customer complaint departments of railway undertakings are done as well as the results of the passenger surveys from former Shift2Rail projects and expert questionings are considered.

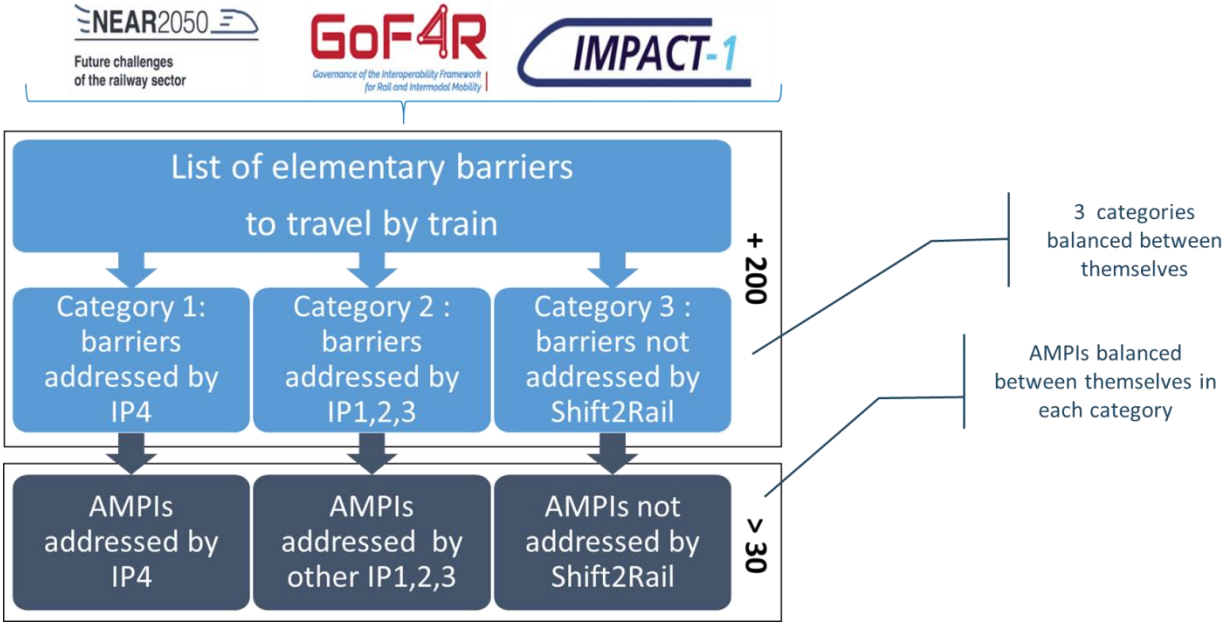

Figure 4: Calculation of the future attractiveness of the rail: impact of IP1, 2, 3, 4 to improve attractiveness

Relative contributions of each innovation to improve the relevant AMPI are evaluated and quantified, both coming from the IP "IT solutions" and from the improvement of the rail offer. The prerequisite to such an impact assessment is to build a matrix of each innovation contribution to the considered AMPIs. Continuing with the example of the AMPI "lack of multimodal online shopping", there are four end-user centric innovations that are improving this AMPI:

- The comprehensive shopping application, which aims at combining all modes of transport, all operators and all geographies in one app, is contributing by 60% to the AMPI improvement.
- The personal and secure travel assistant is contributing by 13%.

- The interoperability framework is contributing by 13%.
- The integration process of all the above-mentioned innovations is contributing by 14%.

After collecting all the improvement values of AMPIs due to Shift2Rail innovations, the attractiveness improvement (e.g. obstacle reduction) is calculated on a before/after basis for each rail segment, based on:

- The weight of each category of elementary barriers.
- Each AMPI weight within its category.
- Each innovation contribution to improve the considered AMPI.
- Each innovation current improvement of the considered AMPI.

The figure below synthesizes the approach for the calculation of the future scenario

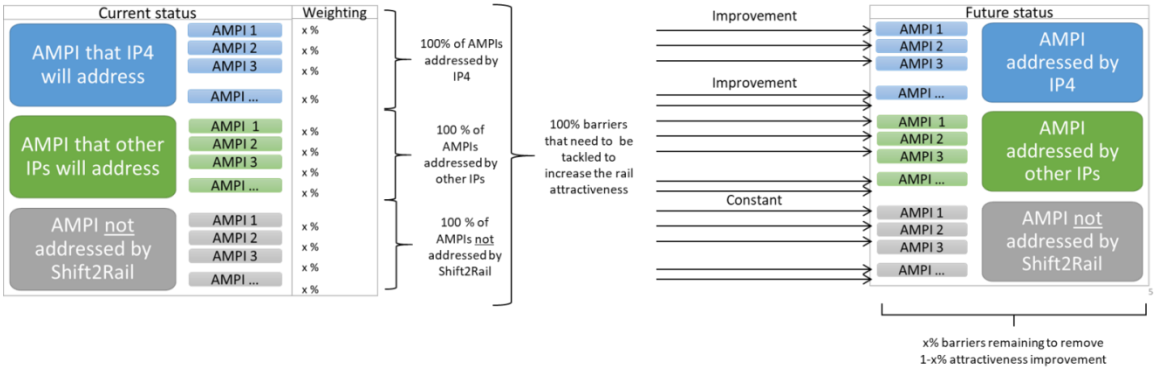

Figure 5: Initial results of the attractiveness model

Based on results of the NEAR 2050 project (F), the balance of the 3 AMPIs categories is the following:

Current distribution of the 3 AMPIs categories	**SPD1 High Speed**	**SPD2 Regional**	**SPD3 Metro**
IP4 related AMPIs	45%	39%	38%
AMPIs related to other IPs	10%	9%	13%
Not S2R AMPIs *(non-technological AMPIs)*[1]	45%	52%	49%

The future attractiveness is calculated for a future in which Shift2Rail innovations have been implemented. Unfortunately, due to time restrictions, attractiveness improvement values are not available for AMPIs related to other IPs. As for the non Shift2Rail related AMPIs, there is no improvement.

[1] Not S2R AMPIs are the following : Cleanliness (vehicle & station), Physical connexion with other public transportation, client personal preferences, RU's service offer, security, safety, staff (RU & station), public policy incentive

Attractiveness improvement	**SPD1 High Speed**	**SPD2 Regional**	**SPD3 Metro**
IP4 related AMPIs	44%	45%	46%
AMPIs related to other IPs	Available in a future release		
Not S2R AMPIs *(non-technological AMPIs)*	0%	0%	0%

Results regarding IP4 should be understood as follow: regarding high speed segment, obstacles addressed by IP4 represented 45% to all the obstacles to travel by trains. Current improvement values for IP4 shows that those 45% could be reduced by 44%.

There are two complementary components – sustainability and attractiveness – that are necessary to induce a modal shift to rail (see figure below). These two components are evaluated within a Shift2Rail project through the development of two models:

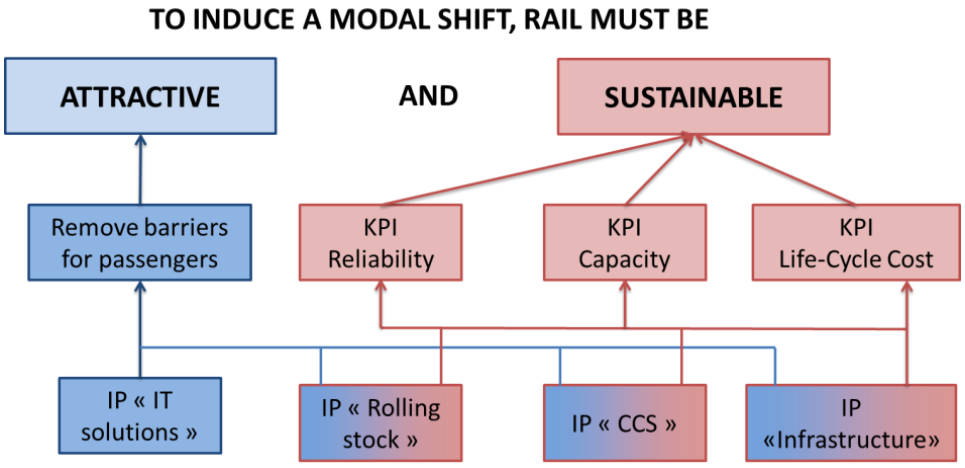

Figure 6: Connection between attractiveness model, KPI model and mode choice model (IMPACT-2 WP3)

- The offer-focused KPI model, i.e. the KPI model (in red the figure above) mainly aims at increasing the railway system competitiveness and its sustainability. The three IPs Rolling stock, CCS and Infrastructure contribute mainly to the offer-focused KPI model, but also have an impact on barriers of travelling by train. For instance, Rolling Stock innovations are mainly focused on competitiveness-related topics, but they also have a strong impact on on-board comfort which is one of the attractiveness driven subjects.
- The passenger-focused attractiveness model (in blue in the figure above)) targets an increase of the rail attractiveness, composed of (a) innovations allowing passengers to book and experience a one-click multimodal trip and (b) improvements of the offer, such as the train layout, services provided in the stations, the stations design at controlled costs. An attractiveness increase will then impact trains load factor which will make an increase from the offer-side necessary.

The results generated by the KPI model and the attractiveness model are inputs to the mode choice model developed in WP3 of IMPACT-2.

References

[A] Project NEAR 2050 (GA 730838), final conference, March 6th, 2018
[B] Project IMPACT-1 (GA 730816), Deliverable 2.4 “Obstacles and requirement list”
[C] Project GOF4R (GA 730844), Deliverable 2.1 “Analysis of the demand of travellers for the TC”
[D] TIS, Leigh Fischer, Rand Europe & Systra, Rail Demand Forecasting Estimation – Final report, November 2016
[E] Dr Roberto Palacin, Railway Passenger Satisfaction: How good is good?, 2018

8.2 Changes to D4.1 "Reference Scenario" of IMPACT-1

This subchapter gives an overview of the parameters in the reference scenario that have changed from D4.1 of IMPACT-1 [3] to this deliverable for each SPD.

For SPD1 the following parameters have been updated:

Number of infrastructure assets:

- 300 switches & crossings
- 231 structures (225 bridges and 6 tunnels)

The lifespans of the different infrastructure subsystems:

- Switches & crossings: 20 years
- Passenger stations: 80 years

Operational characteristics:

- Fleet adquisition: 30 trains (This value is currently evaluated and might still be adapted)
- Staff/train: 1
- Load factor: 64 %
- Punctuality: 85 %

For SPD2 the following parameters have been updated:

Number of infrastructure assets:

- 70 switches & crossings
- 52 structures (50 bridges and 2 tunnels)

The lifespans of the different infrastructure subsystems:

- Switches & crossings: 20 years
- Passenger stations: 80 years

Operational characteristics:

- Fleet adquisition: 24 trains (This value is currently evaluated and might still be adapted)
- Staff/train: 1
- Load factor: 42 %
- Punctuality: 90 %

For SPD3 the following parameters have been updated:

Vehicle characteristics:

- train capacity (nº of passengers): 900 pass
- vehicle weight tare: 200 tons

Number of infrastructure assets:

- 4 switches & crossings

The lifespans of the different infrastructure subsystems:

- Switches & crossings: 20 years
- Passenger stations: 80 years

Operational characteristics:

- Fleet adquisition: 32 trains
- load factor: 70 %

For SPD4 the following parameters have been updated:

For freight, the values of the three train categories have been updated concerning their distribution, the average transport distance and the yearly kilometres:

	Distribution in %	Average distance [km]	Yearly km
Single waggon trains	25	600	25.000
Block trains	40	600	30.000
Combined traffic trains	35	600	35.000

The waggon parameters have been differentiated between two types of waggon, a core market waggon and an extended market waggon to better capture the different characteristics of freight waggons for container transport and bulk products.
The following reference waggon characteristics have been changed:

- Average waggon length core waggon (Habbins345): 23m
- Average waggon length extended market waggon (wagon pair Sggrms715): 34 m
- Average tare core waggon weight: 26.5t
- Average tare extended market waggon weight: 30t
- Max. waggon pay load core waggon: 63.5t
- Max. waggon pay load extended market waggon: 64t

Due to the change of the waggon characteristics, the average train length changes as well:

- Train length average 450m; max. 740 m, limited by the length of sidings for overtaking

Number of infrastructure assets /100km:

- 100 switches & crossings
- 77 structures (75 bridges and2 tunnels)

The lifespans of the different infrastructure subsystems:

- Switches & crossings: 20 years

Operational characteristics:

- Average transport distance: see table
- Loading factor (incl. empty wagons):

- Single waggon train 50%
- Block train 40%
- Combined traffic train 60%

9 Antitrust Statement

While some activities among competitors are both legal and beneficial to the industry, group activities of competitors are inherently suspect under the antitrust/ competition laws of the countries in which our companies do business.
Agreements between or among competitors need not be formal to raise questions under antitrust laws. They may include any kind of understanding, formal or informal, secretive or public, under which each of the participants can reasonably expect that another will follow a particular course of action or conduct. Each of the participants in this initiative is responsible for seeing that topics which may give an appearance of an agreement that would violate the antitrust laws are not discussed. It is the responsibility of each participant in the first instance to avoid raising improper subjects for discussion, notably such as those identified below.

It is the sole purpose of any meeting of this initiative to provide a forum for expression of various points of view on topics

- (i) that are strictly related to the purpose or the execution of the initiative,
- (ii) that need to be discussed among the participants of the initiative,
- (iii) that are duly mentioned in the agenda of this meeting and
- (iv) that are extensively described in the minutes of the meeting.

Participants are strongly encouraged to adhere to the agenda. Under no circumstances shall this meeting be used as a means for competing companies to reach any understanding, expressed or implied, which restricts or tends to restrict competition, or in any way impairs or tends to impair the ability of members to exercise independent business judgment regarding matters affecting competition.

As a general rule, participants may not exchange any information about any business secret of their respective companies. In particular, participants must avoid any agreement or exchange of information on topics on the following non-exhaustive list:

1. Prices, including calculation methodologies, surcharges, fees, rebates, conditions, freight rates, marketing terms, and pricing policies in general;
2. any kind of market allocation, such as the allocation of territories, routes, product markets, customers, suppliers, and tenders;
3. production planning; marketing or investment plans; capacities; levels of production or sales; customer base; customer relationships; margins; costs in general; product development; specific R&D projects;
4. standards setting (when its purpose is to limit the availability and selection of products, limit competition, restrict entry into an industry, inhibit innovation or inhibit the ability of competitors to compete);
5. codes of ethics administered in a way that could inhibit or restrict competition;
6. group boycotts;
7. validity of patents;
8. ongoing litigations.