RFC2

CORRIDOR
NORTH SEA – MEDITERRANEAN

Co-funded by
the European Union

Capacity KPIs and visualisations

Deliverable	1, 2 Database creation memo
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Version	4-00

optimising railways

sma

Project governance

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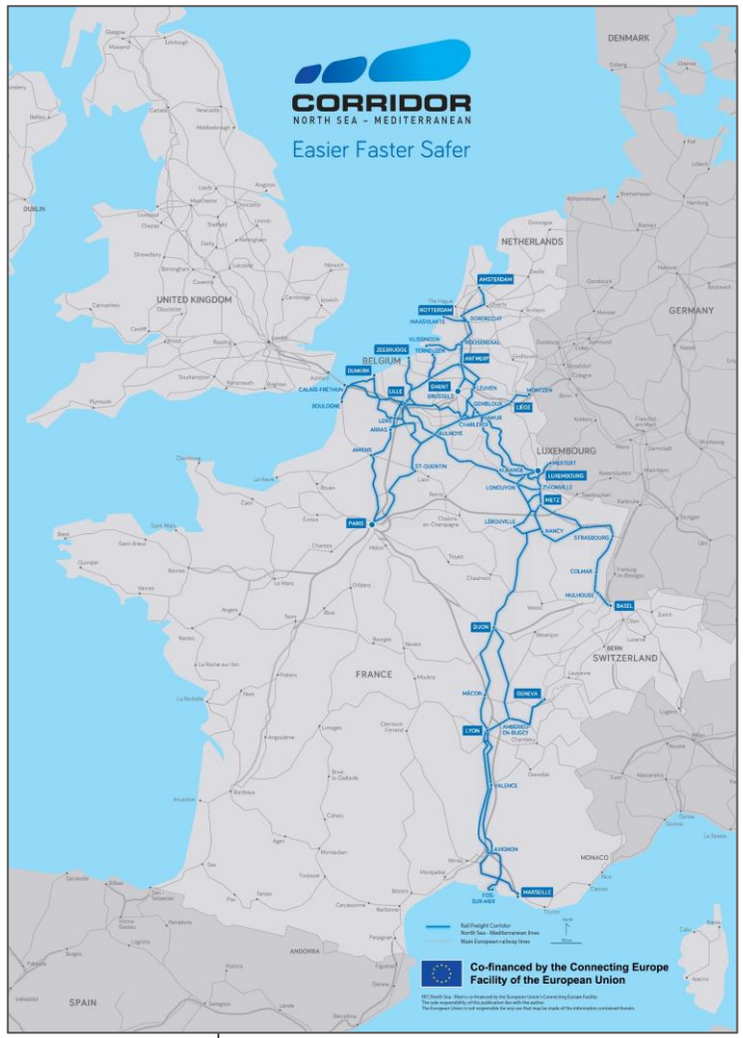
Agenda

1. Context, scope, goals and methodology of the study
2. Collected data
3. Data importation and database creation
4. Assumptions and database corrections
5. Synthesis and recommendations

Presentation of RFC North Sea-Mediterranean (RFC2)



Source : RFC2 website

Rail Freight Corridors deals with the organization of capacity for freight traffic at an international scale.

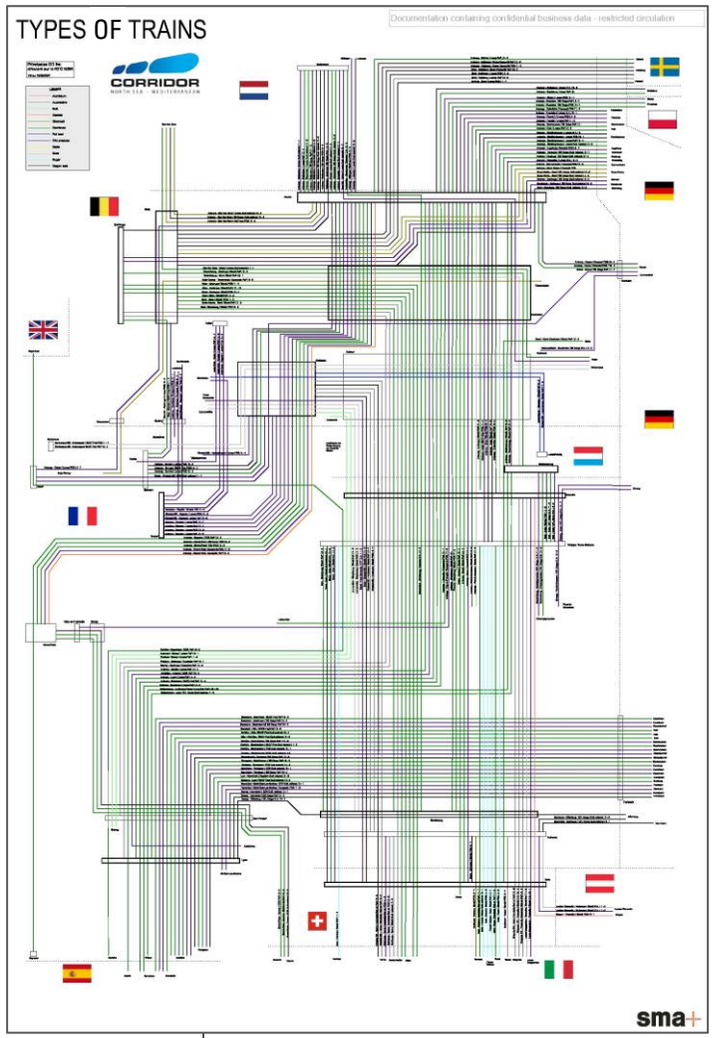
Primary functions

- To coordinate IM's in order to elaborate pre-arranged international path for freight trains and to administrate the RU's requests for those PaPs,
- To facilitate the international coordination process on TCRs.

Additional production functions : to monitor train performance and to launch problem-solving processes where the RFC identify low quality in terms of performance.

Additional support functions : to manage legal, financial and communication matters related with the administration of the RFC.

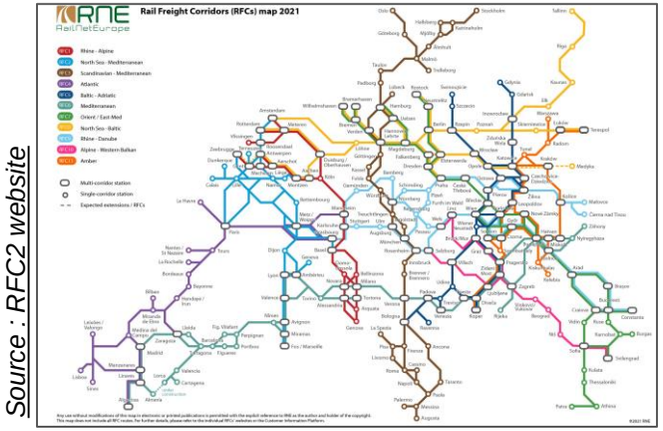
Presentation of RFC2



Source : RFC2 PoC : type of trains, 2021

The RFC2 coordinates capacity issues mainly on :

- The Benelux ←→ Switzerland / Italy routes & South of France routes (more than 90% of the Benelux traffic continues to Italy)
- The Germany ←→ Spain routes,
- The UK ←→ Benelux & South of Europe routes,
- The Belgium ←→ North & Eastern Europe routes.



Source : RFC2 website

Cooperation takes place with other corridors in order to coordinate appropriately the capacity on multi-corridor routes (RFC Atlantic, RFC Mediterranean, RFC Rhine-Alpine, RFC North Sea Baltic).

Context

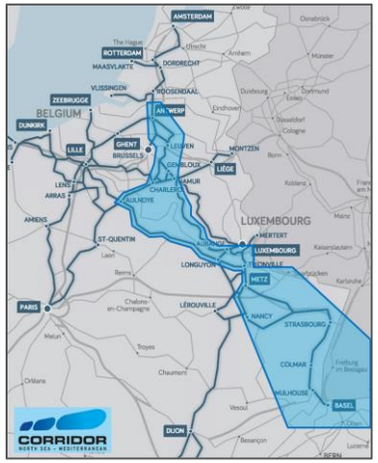
- In the context of climate change, investments need to be done in favour of rail,
- The degraded state of the networks in many regions lead to a lot of works, which have capacity impacts,
- Since traffic does not usually start and end on a specific network exclusively, coordination methods, visualisations, platforms and tools are needed in a way to harmonize the capacity planning and production processes across the borders,
- The stakeholders involved in capacity planning and allocation processes work with a lot of different tools and don’t have the adequate cross-border decision-making tools. Capacity KPIs are often not defined, and not calculated/computed. In view of this, there is a lack of transnational view in KPIs and processes,
- RailNetEurope is working on TTR project, which should lead to a big change of the planning processes across Europe, our initiative takes place in this TTR new capacity framework.

The PoC has shown that the import and treatment of trains and TCRs are possible in a single tool, and that the production of capacity KPIs and visualisations is possible with manual or automatic methods. It has also highlighted some hurdles. It is now time to go a step further:

- Apply these methods on real data and larger scale in order to produce results that can lead to real decisions
- Go over the hurdles, especially the ones linked to the processes in order to produce all the capacity visualisations needed
- Work with the different stakeholders on capacity visualisations and help them to understand the differences between their national processes in order to improve the cross-border planning processes of paths and TCRs.

Presentation of the PoC

Goals & steps



Source : RFC2 PoC

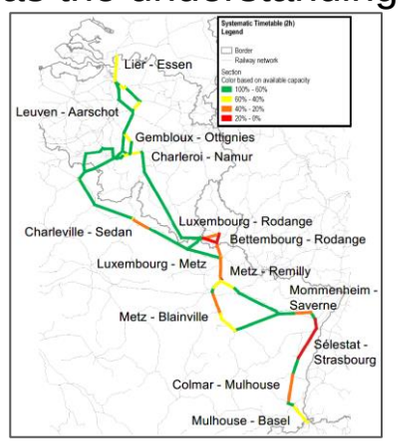
The primary goal was to demonstrate the feasibility of an international freight capacity production process centred around an integrated railway timetabling platform. Highlighting the benefits of such a coordination through original, synthetic and schematic visualisations based on a single database was the main objective.

- Creation of a merged international Viriato database
- Import of 2-hour regular timetables
- Capacity analysis of 2-hour regular timetable
- Saturation by path search in 2-hour regular timetable
- Import of yearly timetables and TCR data
- Capacity analysis of 24-hour timetable
- Saturation by path search in 24-hour timetable
- Production of KPIs and dedicated displays

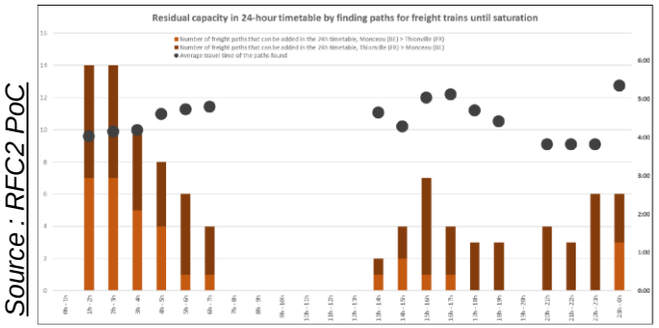
Results achieved

The creation of a transnational merged database (planned infrastructure, trains, TCRs) is possible but some questions related to the IMs data models were raised. Important differences between planning processes which could jeopardise capacity analyses were highlighted.

Using a database with consistent data at the “appropriate level of granularity” allows to produce KPIs, evaluations and visualisations which support the international harmonisation for trains and works, as well as the understanding of capacity stakes.

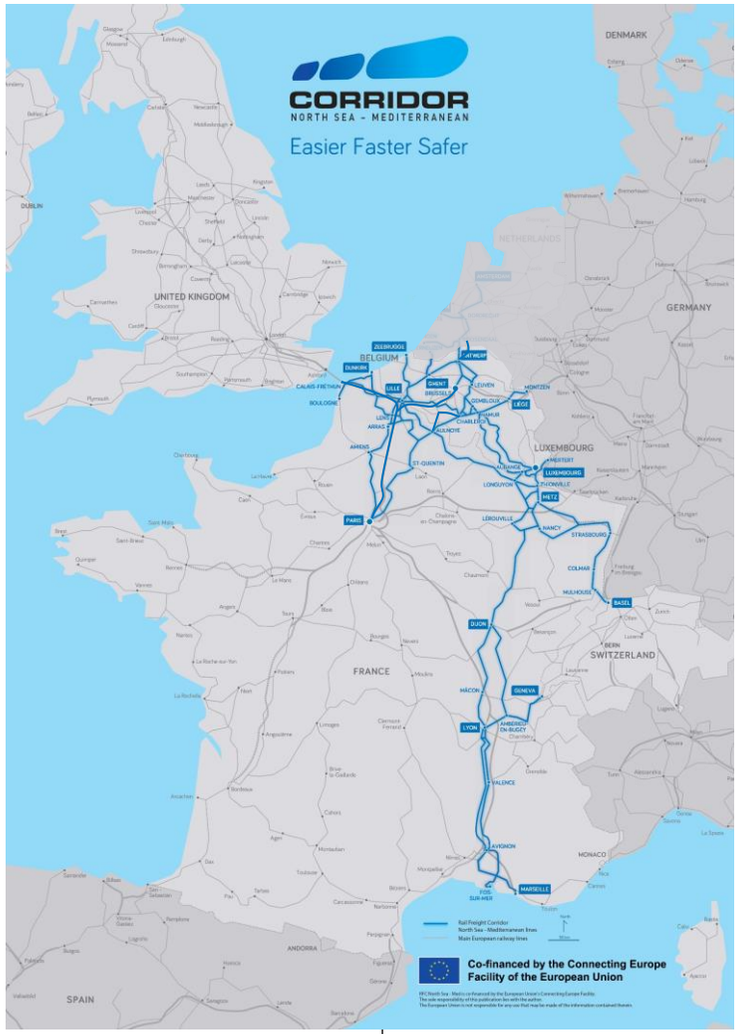


Source : RFC2 PoC



Source : RFC2 PoC

Scope of the study



Geographical scope :

- All the French, Luxembourg and Belgium sections of the RFC NSM.
- Additional sections : Mons –Maubeuge section (via the Quevy Feignie border point),
- The Highspeed lines between the BE/NL Border + Eurotunnel border and Paris
- Alternative itineraries will also be considered if needed/required

Time horizons and data considered :

- Infrastructure : topology and signalling performance
- Timetable : paths with timetables (with added times), track line and station track
- TCRs : closures and time penalties

→ 2021, 2022, 2023, 2024, 2025 : planned (different states) and real

Goals

Produce visualisations to understand capacity issues, and on this basis, suggest process improvements to capacity stakeholders.

- What is the **capacity currently available** ?
- How can the capacity be **increased** in the future ?
- What are the capacity **issues** (where, how much, what kind) ?
- How to **increase** capacity in these points ? How far ?
- How to create a capacity **transnational database** and use it ?
- Are there any **issues** in the capacity **processes** ?
- How can the **decision making process** about capacity be improved ?
- How can stakeholders manage a major **timetable change** ?

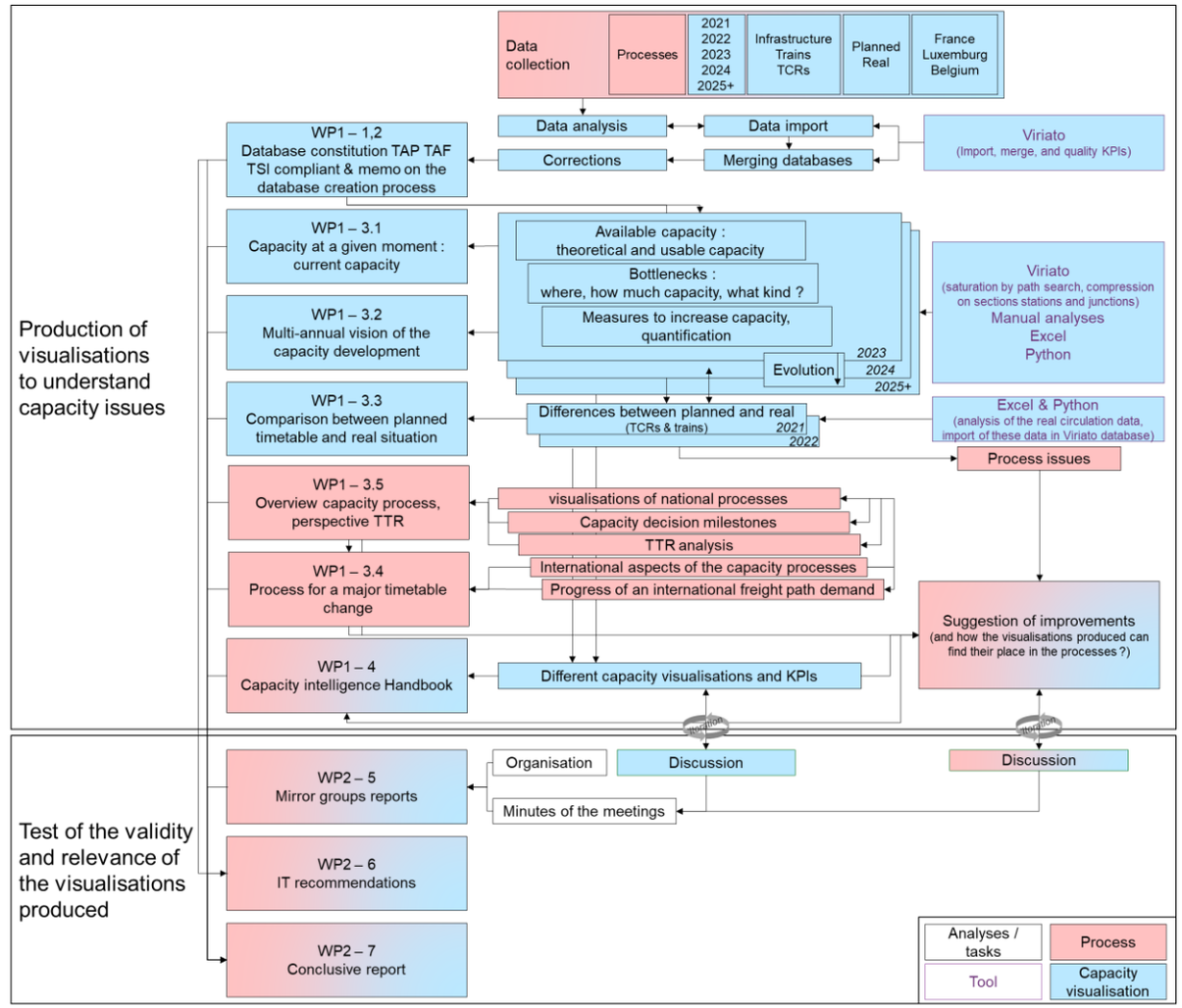
Go further than the PoC

- Work on **official** complete data,
- Add the import and analysis of the **real situation** data,
- Go further on the **365 days** analysis,
- Deepen the analysis on the **stations**,
- Identify some **measures** to have more capacity,
- Quantify the **additional capacity** that could be offered by different **measures**,
- Analyse the processes and the **entire capacity supply** chain, especially the **transnational aspects**,
- **Work with the stakeholders** to improve the visualisations and the capacity processes.

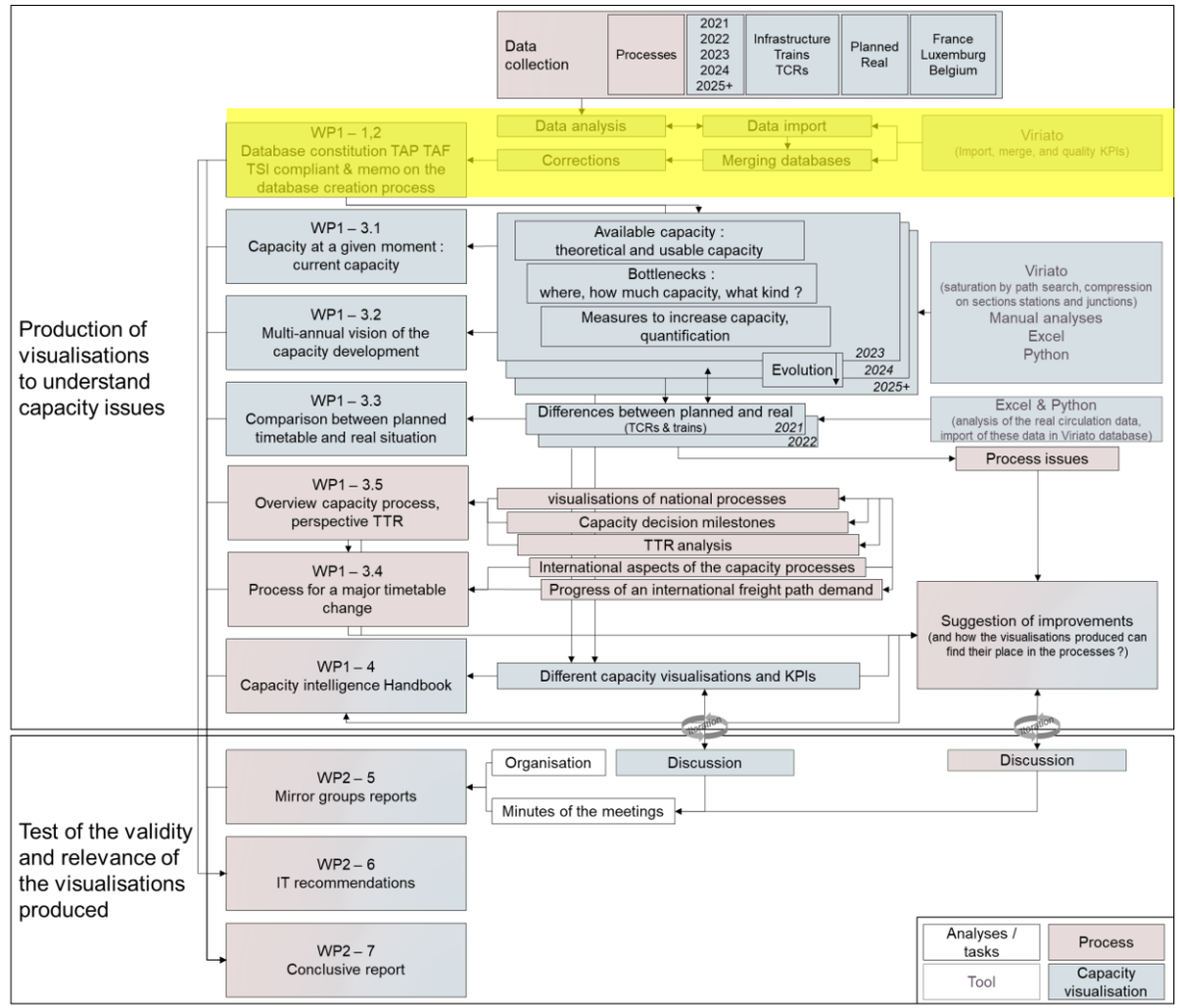
General approach

General methodology phases :

- **Collect, analyse and import** infrastructure, timetables and TCRs data of the 3 countries, of real circulation and TCRs, and planned data for short and middle-term in one single Viriato database,
- **Work on capacity KPIs and create visualisations** in order to characterise current and future available capacity, bottlenecks, and identify measures to increase available capacity,
- **Work on processes**, especially transnational aspects,
- **Discuss with the stakeholders** the capacity visualisations and outline how they can find their place in the different processes and make IT recommendations



Deliverable 1, 2



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Data

Source + (format)

	Belgium	France	Luxembourg
Infrastructure 2021	Infrastructure 2023 : database (Viriato) + manual check if coherent with OpenData (Excel)	Viriato PER (Viriato) + differences /2024 (paper)	PoC + update SMA (paper)
Infrastructure 2022		Viriato PER (Viriato) + differences /2024 (paper)	PoC + update SMA (paper)
Infrastructure 2023		Viriato PER (Viriato) + differences /2024 (paper)	PoC + update SMA (paper)
Infrastructure 2024		Database DAC trame 2h (Viriato)	PoC + update SMA (paper)
Infrastructure 2025		Database DGEX PER (Viriato)	PoC + update SMA (paper)
Headways 2021	Data from PoC	Normes de trace 2021 (paper)	Data from PoC
Headways 2022	Data from PoC	Normes de trace 2022 (paper)	Data from PoC
Headways 2023	Data from PoC	Normes de trace 2023 (paper)	Data from PoC
Headways 2024	Data from PoC	Normes de trace 2024 (paper)	Data from PoC
Headways 2025	Data from PoC	Normes de trace 2024 (paper)	Data from PoC

Data

Source + (format)

	Belgium	France	Luxembourg
Planned paths 2025	No data : 2024 (CDM from UMP database)	Database DGEX PER (Viriato)	RailSYS (not stabilised) (Excel)
Planned paths 2024	UPM database (CDM)	Database DAC trame 2h (Viriato) Préconstruit 24h	RailSYS (not stabilised) (Excel)
Planned paths 2023	UPM database (CDM)	Trame 2h 2023 Viriato ; SIPH : Préconstruit 2023 + HDS 2023 365 days	RailSYS (RailML)
Planned paths 2022	Export from Roman (RailML)	Trame 2h 2022 Viriato ; SIPH : Préconstruit 2022 + HDS 2022 365 days	RailSYS (possible errors linked to the tool change), 2022 DEF non importable but 2022 OK (RailML)
Planned paths 2021	Export from Roman (RailML)	No data	PoC data : 1 single date
Real data trains 2022	20 chosen days (Excel)	Bréhat 2022 365 days (Excel)	Delay data (origin / destination)
Real data trains 2021	No data	No data	Delay data (origin / destination)

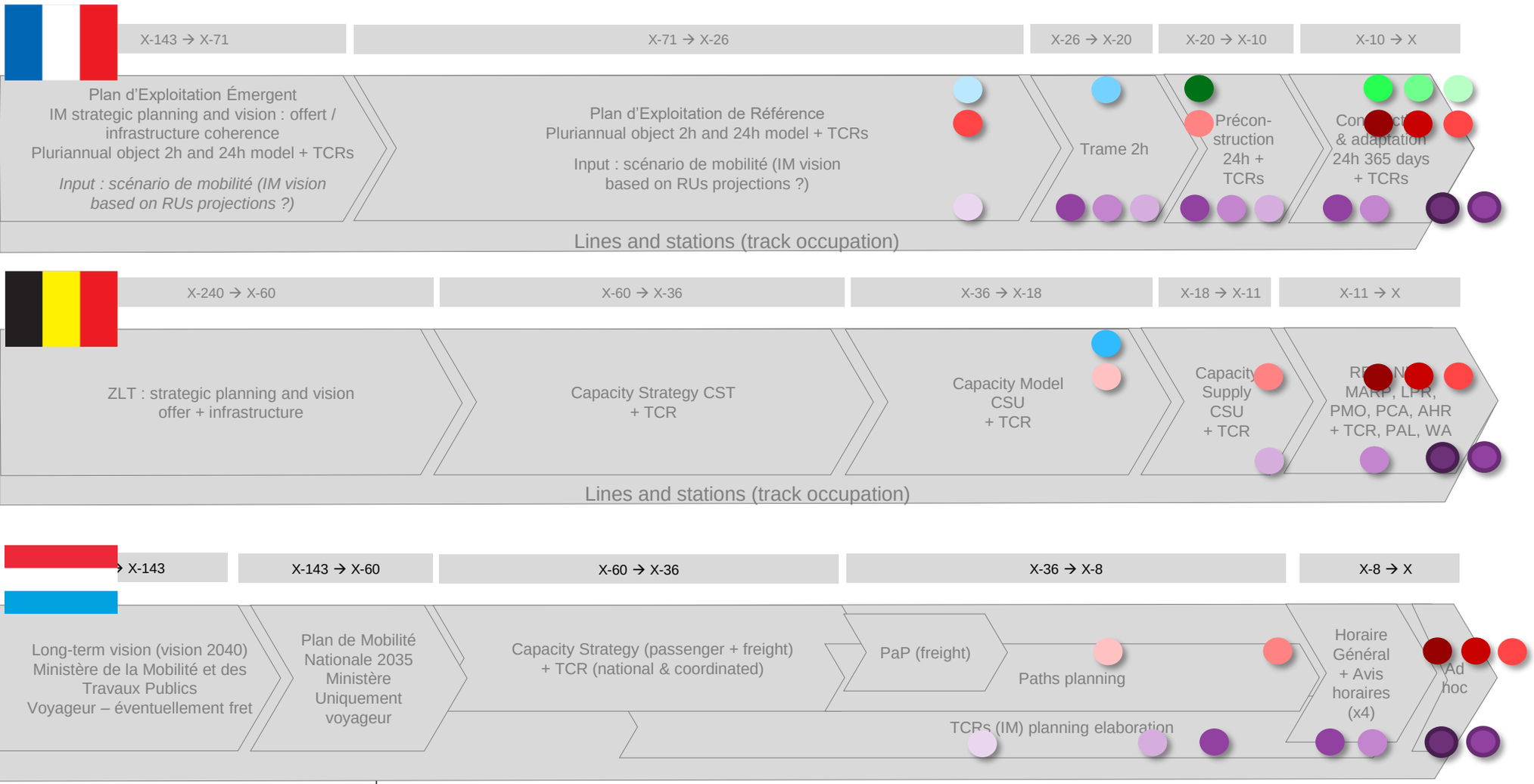
Data

Source + (format)

	Belgium	France	Luxembourg
Planned TCR 2025	COLT (COLT)	Database DGEX PER (Viriato) = 2023 in 1 x 24h	(Excel file)
Planned TCR 2024	COLT (COLT)	TCAP (“PGF”)	(Excel file)
Planned TCR 2023	COLT (COLT)	TCAP (“PGF”)	(Excel file)
Planned TCR 2022	COLT (COLT)	TCAP (“PGF”)	(Excel file)
Planned TCR 2021	COLT (COLT)	TCAP (“PGF”)	(Excel file)
Real TCR used 2022	No data	No data	Changes > 3 months (Excel)
Real TCR used 2021	No data	No data	Changes > 3 months (Excel)
Track occupation plans for chosen stations, 2025+	Data from UPM (CDM)	PER 2025 (Viriato)	POV 2023 (PDF)

Overview

Collected data and the process phases they come from



Legend

- Real
- Planned
- TCRs
- Paths
- Headways
- Infrastructure
- 2021 2021
- 2022 2022
- 2023 2023 […]
- 2024 2024
- 2025 2025

Data collection process (facts and observations)

Here are the lessons learned during the data collection phase.

Data about real TCRs usage weren't provided by IMs.

Real path data (delays) were provided but after a long time.

- 5 data sets were asked to 3 IMs, and the data collection observation is that data is very disseminated : TCRs, paths, real data, different years, etc., within IMs and even sometimes IM and allocation body,
- It was difficult to identify the right interlocutors to collect data, as capacity process phases and the teams in charge are not always clear,
- To support data collection, SNCF-R has a data centre (data gouv.) unfortunately, it proved suboptimal,
- Tools to import data (trains and TCRs) in Viriato exist for a lot of IMs tools but they are not well known across the different IMs teams, so the data is too often exported from the tools with the wrong format,
- The process to export RailML standard data from IMs tools is not well known across IMs teams, as well as the existence of these standard,
- 2021 and 2022 data is often not available, as well as the successive planning states across the capacity process for 2023. Data seem to be deleted after the service and after each step of the allocation process.

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Infrastructure
Infrastructure data exchange

In the 3 countries, headways and separation times (signalling performance, a significant data when talking about capacity) have to be manually implemented.

Belgium : there is currently no tool to import infrastructure data from Roman or UPM although the macroscopic definition of it would quite match the Viriato model, so Infrabel Viriato database is preferred here, and changes are manually done if needed (differences between the planning horizon of the Viriato database and the different considered horizons).

Luxembourg : it's not possible to import infrastructure from RAILSYS, so Viriato database is taken from another project, and some needed adaptions are manually done (planned infrastructure evolutions).

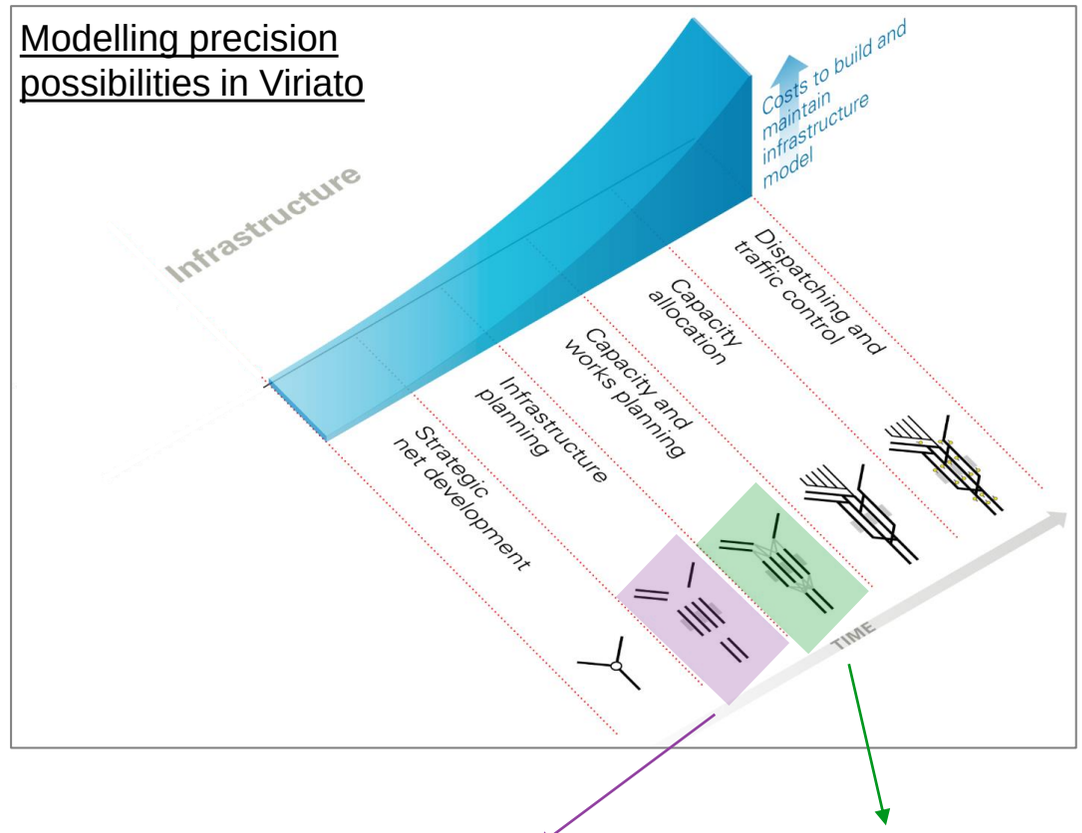
France : it's not possible to import infrastructure from SIPH, so SNCF Réseau Viriato database is used here, and the needed changes are done manually (differences between the horizon of the Viriato database and the different considered horizons).

The building of a common infrastructure database based on the IMs planning tools would be very difficult.

Infrastructure
Infrastructure modelling

Infrastructure objects in Viriato are **nodes and lines**, lines are composed of a succession of nodes. Nodes can be without topology, with a station or a junction topology.

Capacity KPIs are calculated differently in lines (sections), junctions and stations. For example, conflict in switches zones just before stations (station throats) are not considered in automatic KPIs calculation (compression), so if such a zone has to be evaluated, it has to be modelled as junction, or manually calculated as a station with UIC 406 method.



Infrastructure
Data manually added, modelling issues

- **Infrastructure performance (headways, separation times)** : linked to the signalling, and defined by the IMs (see details in chapter 4), except when it's modelled in a Viriato database, is not importable and often not available, and has to be defined manually, section by section, junction by junction, except in FR where a default value has been put,
- Some **topologies** such as **junctions** which were not modelled in the national databases (especially junctions in FR),
- If capacity KPIs in **stations** would have to be calculated automatically, it would have been necessary to model them with topologies,
- As mentioned in D3.1, 3.2, 3.3 in the chapter "Assumptions", **lines with 1 track or more than 2 tracks** have to be modelled manually to prepare the capacity KPIs calculation,
- **Geographic coordinates** are not available in the given data and have to be imported from public databases.

Creation of a merged database

Viriato Enterprise allows to import infrastructures from all 3 IMs databases then easily build a unique infrastructure scenario containing everything.

The process currently requires a manual **post-treatment of the border points** to link those infrastructures together, as each IM names them differently in their own database. This step could be avoided if shared IDs were originally used (at least for border points) by all IMs.

Trains and TCRs are imported afterwards. TCRs only concern each IM network. But for transnational trains, a post-treatment is also necessary:

- Import trains on their complete path from each source,
- Split trains on border points,
- Delete train part received from IMs which are running on other IM infrastructure (this step could be avoided by transmitting only the national part or filtering abroad part during import).

See page “Corrections Trains and infrastructure at the frontiers”

TCR
Creation of an Excel TCRs database

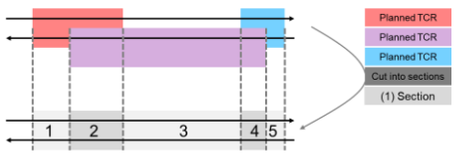
Why ?

Data analysis can sometimes be easier in Excel & Python,

Data were in Excel or PDF, imports in Viriato need to be done from Excel with a unique format,

The TCR databases received can be precise with days, or only volumes. TCRs in Viriato need to have a “validity” = dates, whereas in an Excel database, they can stay with “volumes but undefined days”,

How ?



Find the lowest common denominator in the sections cut : cut the network in sections until every section is homogeneous (should not include a geographical beginning or end of a TCR if we consider the whole year). Add the different TCRs objects for each section and each day if defined (if defined), by understanding the different vocabulary used by the IM, the TCR planning philosophy behind, examples :

TCR on 1 track → the section has 1 track, or more ? → complete or partial closure ?

Unknown validity → how many days ? Which days ? → ignore or make an assumption

TCR all day from Monday to Friday → 5 objects of 1 day or 1 object of 5 days in the model ?

Trains
Usage of the IMs existing tools

- The IMs furnished trains data from their tools, and it was often possible to use existing conversion tools to import it into the merged Viriato database :
  - Roman
  - SIPH
  - UPM
  - RailSYS
- The conversion tools need to have always the same data format, so it’s important to define it precisely and always export in this format.
- These tools exist because they have often been developed in other contexts, if the target tool was not Viriato, they should have been developed for this study, so it’s a real advantage to have built the database in Viriato.

TCR & Trains
Data importation

TCR

The main task is to merge data in the common Excel database (previous page), this Excel database is in a format which allows the import in Viriato : we used here the TCAP import because it was the most optimized.

Data formats transmitted for TCRs are often human-readable instead of machine-readable (especially validity and locations) which makes their conversion into a common Excel database not fully automated.

Planned trains

Different tools exist to exchange with planning tools : UPM, Roman, SIPH, other Viriato versions, RailSYS, by the RailML format or not. Some data need some formatting to be imported.

It’s important before import phase to list what should be imported in the common database and what could be kept and analysed in native data / Excel. Example : French variants number for trains produced after the path request phases, different kinds of runtime margins.

Real trains

Delays data were imported, but the lack of information about the measure and data processing method leads to lack of precision in delays analysis.

Database format TAF/TAP - TSI

Technical Specification for Interoperability relating to Telematics Applications for Freight/Passenger Services
https://teleref.era.europa.eu/

TAF/TAP – TSI aims to define the data exchange. This table shows the database elements as they was received, which explains why it's not on a TAF/TAP – TSI format.

Viriato database	TAF/TAP – TSI	FR	LU	BE
Nodes	Primary Location Codes	CI/CH	Abbreviations	PTCAR
Freight trains shipment	Freight trains shipment	Nothing	Nothing	Nothing
Rolling stock	Traction Details	Internal names	Internal names	Internal names
RUs	Company Codes	Codes which are not listed in RNE CC dictionary	Internal names	Internal names
IMs	Company Codes	Implicit	Implicit	Implicit
Path / Itineraries	Split on border point or handover point	Full path for HS trains only	Full path	Full path
Stops type	Stops reasons	SNCF stop type	Commercial or operational	SNCB stop type
Train numbers	Operational Train Number	Train numbers from IM	Train numbers from IM	Train numbers from IM
Timetable	Dwell times	Dwell times	Stop type reserve	Stop type reserve

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Analysis before database correction

→ see Process Deliverable

The capacity KPIs production need to process complex data, with an understanding of the technical planning method.

1st step before any correction : understand what is planned and how.

For this, the table proposed in the Process analysis covers the main topics.

Criterion (bold = not needed at the database creation phase)	Definition of the products			
Time perimeter	1 year	> 1 year	which year(s) ?	
Geographical perimeter	list of stations, junctions, lines			
Geographical perimeter : interactions with other lines considered ?	yes	no		
Before or after the path requests of April Y-1 (X-8.5) ?	yes	no		
Scale TCRs	2h	2h Peak + 2h off peak	24h	24h x 365 days
Scale paths	2h	2h Peak + 2h off peak	24h	24h x 365 days
Paths, TCRs, both	Paths only	TCRs only	both paths and TCRs	
Level of precision	macro	meso	micro	
Level of stability (linked to internal or external instability)	high	medium	low	
Tool in which the object is built	Excel	Macroscopic capacity tool	Microscopic capacity tool	PowerPoint
Kind of infrastructure topology and signalling performance considered	Current	Assumptions	Result of this capacity step	
Kind of TCRs considered	Current	Assumptions	Result of this capacity step	no TCRs
Scope of the TCRs considered	No	major	medium	high
Duplicates, overlaps	yes	no		
Status	IM capacity structure	Paths request (RU)	After X-8,5	
Track occupation plans	yes	no		
Contains empty runs from rolling stock planning	yes	no	only the major ones	
Level of precision of the characteristics of the paths : locomotive, weight, length, composition	linked to path request	IM assumptions	linked to current	not considered
Level of precision of the train path	only a list of stops	complete list of nodes	nodes with track lines	nodes + lines & stations tracks
Conflicts between paths or duplicates or overlaps and their status (2 requests, alternative route, etc.)	yes	no		
Conflicts between paths and TCRs	yes	no		
Internal IM coordination on paths and TCRs	yes	no		
Production in RUs planned : drivers, rolling stock	yes	no		
Coordination with entities requesting the paths done ?	yes	no		
International coordination with other IMs done ?	yes	no		
Coordination with entities requesting the paths done for the connections ?	yes	no		
Coordination with entities requesting the paths done for the number of seats offered ?	yes	no		

Analysis before database correction

The transnational approach requires rigor : are we comparing comparable data across the countries ?

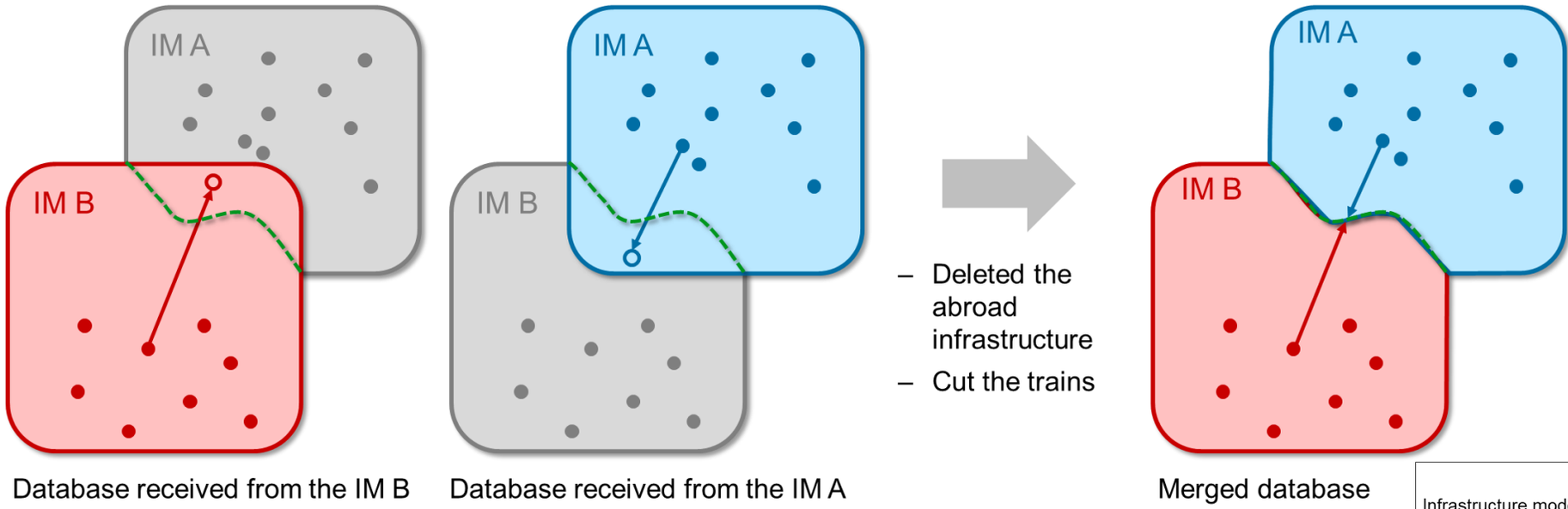
The answers to the table's criteria and the targeted list of KPIs (with calculation method) are needed to know which corrections are required.

Examples :

Table criteria (characterisation of the capacity product)	**Answer**	**KPI targeted**	**Correction to operate in the database**
Contains empty runs ?	In country A : yes In country B : no	Compression in sections (infrastructure occupation rate)	Empty runs have to be eliminated of the analysis
Contains empty runs ?	In country A : yes In country B : yes	Compression in sections (infrastructure occupation rate)	Empty runs are kept but a special type is attributed
Does the timetable contains conflicts between trains ?	In country A : yes In country B : no	Compression in sections (infrastructure occupation rate)	Conflicts have to be eliminated of the analysis
Does the timetable contains conflicts between trains ?	In country A : yes In country B : yes	Quality of the timetable regarding headways and separation times	Conflicts have to be kept

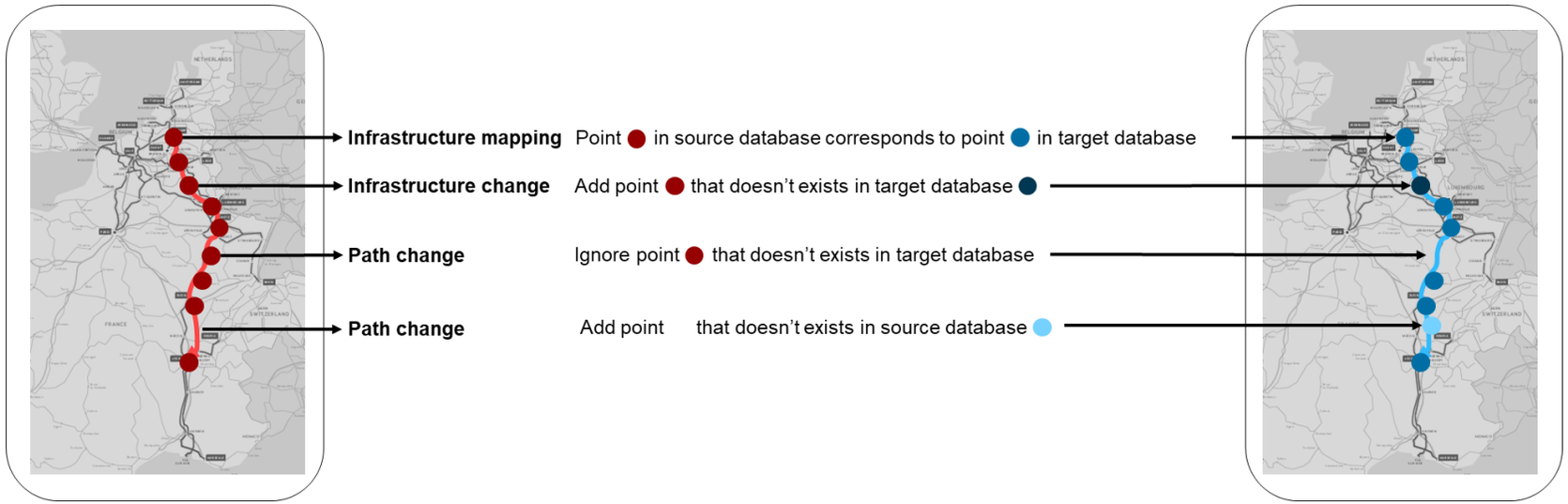
Corrections
Trains and infrastructure at the frontiers

IM can plan trains including abroad stations (it's easier to plan a Paris – Brussels knowing the arrival time at Brussels station whereas the Wannheain frontier passing time). Theses abroad stations have to be cut, so that the trains can be correctly merged. The control of the concordance of timetabling and TCR planning across borders is done afterwards.



Corrections Trains

- Import function automatically corrects the easiest discrepancies.
- Trains need further manual correction as when inconsistencies remain, such as stations or passing points from the IM tool not recognized in the target database (as it comes from another tool of the same IM),



- Some import formats do not reference the section (line) or section track used by the trains. In case of parallel sections, some trains might be imported on the wrong sections which will impact compression results.

Assumptions

Stations stop time

If no track occupation plan is transmitted, passenger trains will be affected 10 minutes at their 1st and last station, to consider the material reuse or evacuation / empty arrival of the train before departure.

The average used separation time between 2 stopping trains in the stations will be cut off, to calculate the capacity consumption rate.

Delays

In Luxembourg, data is too aggregated : delay is provided only at 2 points : departure and arrival of the train. To calculate the KPIs (delay increasing / elementary section) it’s necessary to have more detail. These data were created by interpolation.

Manual corrections

A lot of manual corrections have been done in the database :

- Infrastructure
  - Sections > 2 tracks, analysed and modelled on case-by-case,
  - Junctions : almost no junctions modelled in French database, and a lot of missing junctions in the Luxembourg database
  - Only 1 version of the infrastructure database per country, but the work on 2021 > 2025 needs to have the different infrastructure versions
  - Headways and separation times have been implemented manually
- Trains
  - A lot of “inconsistent” trains, which were manually corrected (almost always itineraries)
  - A lot of “inconsistent” trains, which would need manual corrections train by train, were deleted of the database, because they could not be manually corrected, and it can lead to bias in the KPIs

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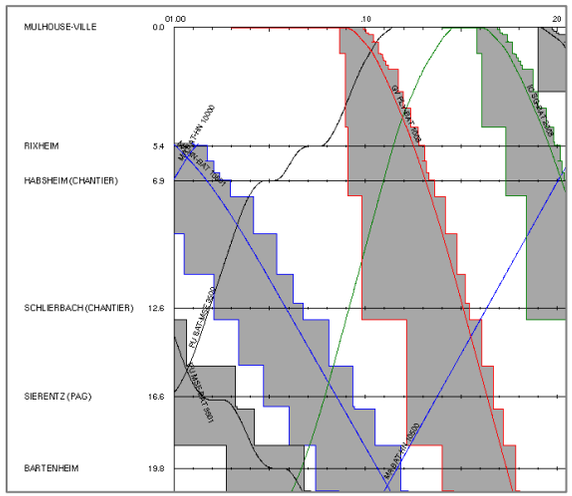
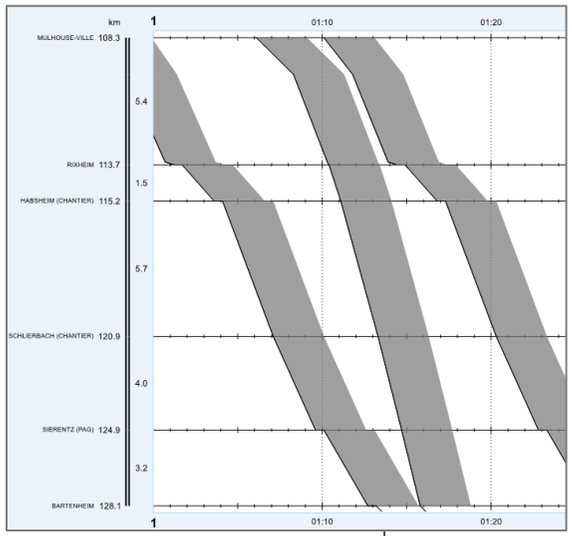
4. Assumptions and database corrections
5. Synthesis and recommendations

Headways and separation times



Example of block occupation stairs calculation to determine headways and separation times, with a microscopic tool where all track elements are modelled.



Example of headways and separation times modelled with a fixed value per section, with a macroscopic tool. (same section but not exactly the same trains as above)

In this study we aim to consider the headways and separation times used in the capacity planning phases by the IMs.

In some cases, middle and short-term capacity planning is done by IMs with **microscopic tools** (see chapter 3 of the "Overview processes" deliverable).

At this time, the headways and separation times given by such tools are **too detailed** to be used in our macroscopic tool to calculate KPIs, and they **can't be imported** in the tool automatically.

For the computation of the considered KPIs, **the accuracy** of the planning rules as described in chapter 2 **is adapted.**

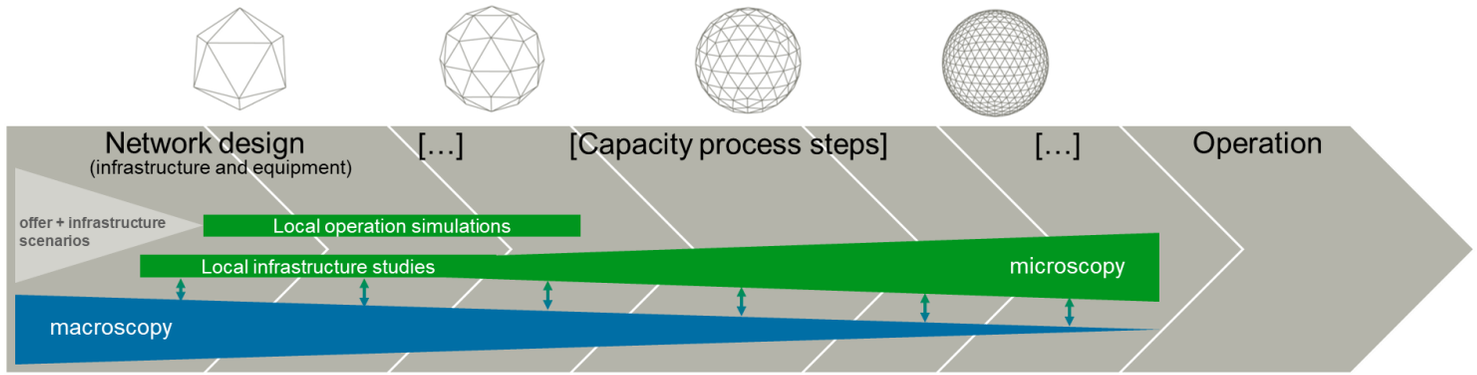
Headways and separation times

Why is the macroscopic level adapted to the constitution of a transnational database and to the capacity KPIs production ?

* The level of precision can always be decreased, but it can't be increased if data is missing.

** The number of offer + infrastructure scenarios is too high at this step to be planned at a microscopic level. The signalling can't be modelled as it's a result of this planning phase.

- Macroscopy is the common denominator of the infrastructure models *,
- For now, algorithms to calculate automatically capacity KPIs only exist in macroscopic tools,
- Some capacity KPIs would require extremely high computing power if they had to be implemented into a microscopic tool,
- Macroscopy is the only way ** to plan jointly and strategically the offer and the infrastructure and equipment (functional requirements), with a continuous refinement approach across the capacity process steps, so it is and will continue to be used in upstream phases :



Headways and separation times

Microscopic tools are widespread and highly heterogeneous across capacity planning processes and stakeholders, which leads to the disappearance of normative rules or documents compiling the headways values per line and station.

The ambition of this project to deploy the calculation of capacity KPIs within the IMs capacity planning processes for the next years will raise the question of the sufficient **legitimacy** and **sustainability of the methodology developed in the current and former study (PoC).**

Legitimacy : see deliverable “Capacity KPIs” : estimation by sampling of the differences in capacity KPIs results between microscopic and macroscopic approaches.

Headways and separation times

Sustainability of the methodology if no more headways and separation times per sections, junctions and stations are published / available

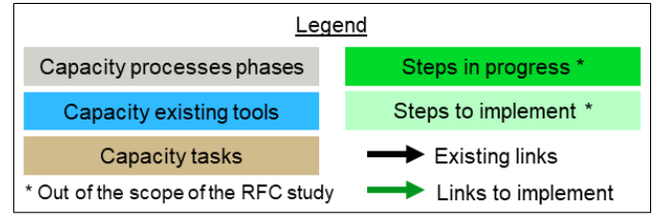
This page is about IT recommendations, the tools mentioned are not developed in the current study.

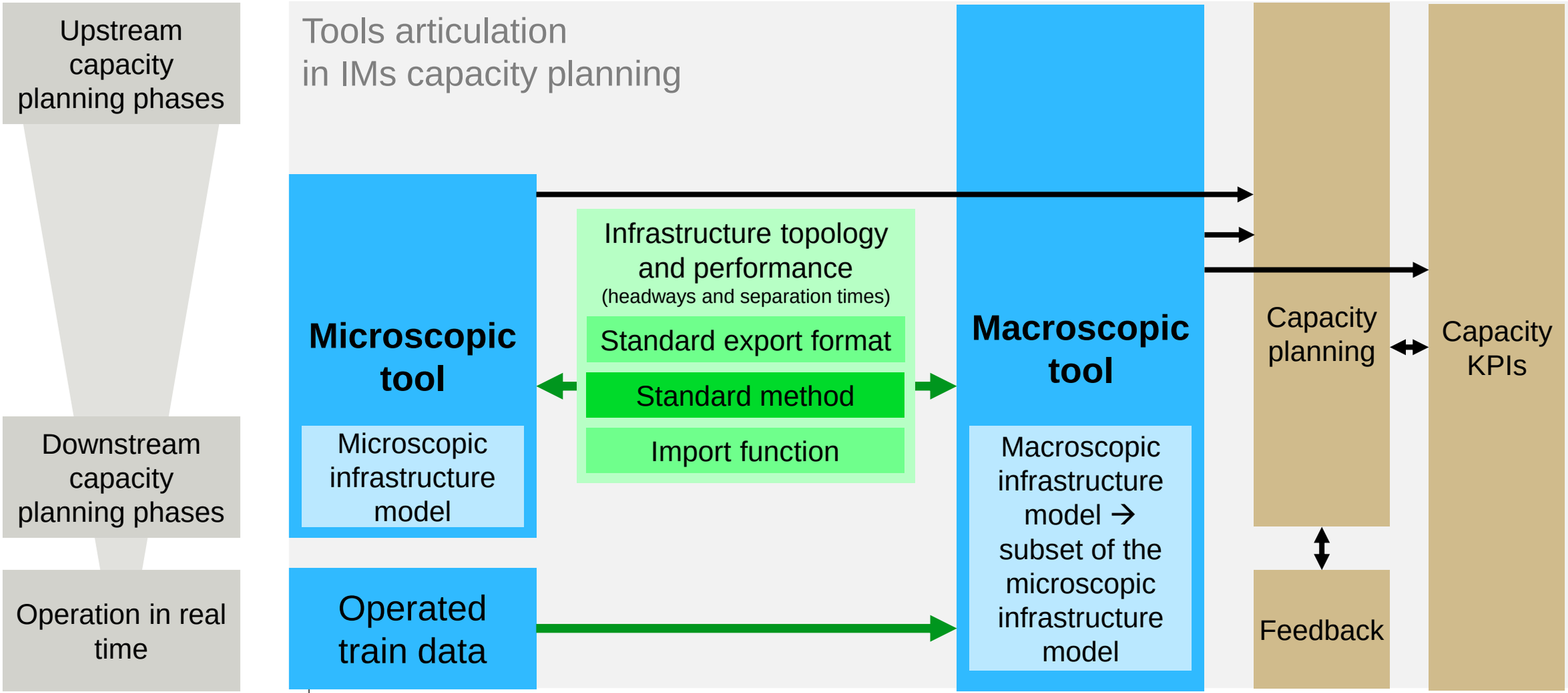
Planning headways and separation times should be calculated once in advance in an official microscopic tool, imported and persisted in the macroscopic tools, to work on planning and calculate capacity KPIs.

This method requires :

- The standardisation of a format to export headways and separation times from microscopic tools,
- The standardisation of a method to aggregate the parameters to feed the macroscopic tool : which level of detail should correspond to the one chosen to model the infrastructure, trains, and TCRs ? This step is linked to the infrastructure data exchange subject detailed in the next pages,
- A functionality to import such values in the macroscopic tool.

Headways and separation times





Overview

Legend

In Viriato environment

Not available	Not importable
Not exportable in this context	Importable after formatting
	Importable with manual treatment
	Automatically importable

		France		Belgium		Luxemburg	
		Line	Station	Line	Station	Line	Station
Past (real)	Trains	Not imported	Not imported	Not imported	Not imported	Not imported	Not imported
	TCRs						
Past, current & planned short-term	Infrastructure topo.						
	*Infrastructure perf.						
	Trains					Imported	
	TCRs			Imported	Not imported	Imported	Not imported
	Speed restrictions						
Planned middle-term	Infrastructure topo.						
	*Infrastructure perf.						
	Trains					Imported	
	TCRs			Imported	Not imported	Imported	Not imported
	Speed restrictions						
Planned long-term	Infrastructure topo.						
	*Infrastructure perf.						
	Trains					Imported	
	TCRs			Imported	Not imported	Imported	Not imported
	Speed restrictions						

* Signalling performance : headways, separation times

Relevant points

Real data (delays)

IDs

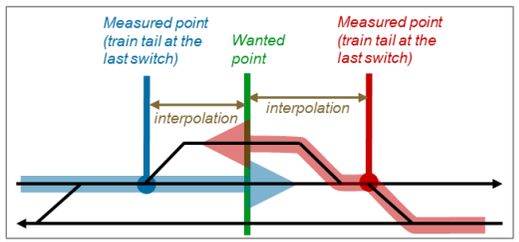
*** Train number + version number form a complete train ID**

- Trains ID : only train number is given in real data, whereas it would be necessary to also have the version*, or another complete ID,
- Geographical points IDs are not harmonised across countries and data,

Precision

- There are differences in the levels of precision (times and locations),
- Some wrong values and borders discontinuity persist,
- Some data (LUX) are too aggregated, and important points are missing,

Method, link with planned



- The information about method is missing (measures, database building),
- Measure point can be different from given point (interpolated) → if it's the case, it would be interesting to have the real measured point, or the delay value directly at the wanted point (ex. : given by board systems),
- Planned path are calculated on the basis of delays → it would be better to have the real planned paths (with 1 second precision).

Relevant points

Availability
Export
Collection
Import
Processing

– Relevant point appeared in the study
→ **Proposed solution**

– Real TCRs data (usage of planned TCRs) is an area for improvement

→ **Add this measure in capacity processes, use a common format**

– Exchanging infrastructure data is difficult, particularly signalling performance, linked to modelling choices and lack of standards to make microscopic and macroscopic models work together,

→ **Define standards in infrastructure modelling**

– Implementations of standard trains formats differ across countries and tools,

→ **Continue the work on standard formats (RailML)**

Relevant points

Availability

Export

Collection

Import

Processing

– Relevant point appeared in the study

→ **Proposed solution**

– TCRs data format is very variable (speed restrictions or additional runtimes, and headway differences) data exchange is an area for improvement,

→ **Work on a TCR and speed restriction standard format**

– Complete timetables are transmitted by all IMs, although only part of the network is relevant for international corridor analyses and exchanges

→ **Filtering data transferred would improve import process and control as well as data handling (this could be done through functions existing or to be developed either in the export or import tool)**

Relevant points

Availability
Export
Collection
Import
Processing

– Relevant point appeared in the study
→ **Proposed solution**

– For trains & TCRs, validity (application days) is often a problem when transmitted through attributes open to interpretation (text descriptions, weekly bitmasks with start and end date but times over midnight, etc.),

→ **Yearly validity bitmask with a common semantic regarding times over midnight would help import, especially for TCR**

– Stations and freight yards are modelled in a non-importable format so track occupation plans are hardly importable,

→ **Use default RailML attribute to exchange station tracks and make sure station topologies in IM and common databases are identical**

– Building a common database is quite fast, but correcting it to match the format of transmitted trains & TCR is time consuming,

→ **Build a persistent common database and tools to update it from IM data**

Relevant points

Availability
Export
Collection
Import
Processing

– Relevant point appeared in the study
→ **Proposed solution**

– Databases must be corrected to join each national infrastructure on common border points,

→ **Using standardised European node ID for borders could solve this problem**

– Transnational trains are sometimes transmitted beyond their national perimeter by each IM and must be cut,

→ **Using standardised exchange rules or more flexible import options could solve the need of a post-treatment,**

– Some lines, junctions and stations have been changed because the way they were modelled did not allow to calculate KPIs automatically (3rd track, stations throat as junctions, etc.),

→ **Always do 1st step : what are we putting in the database, and why ?**

Relevant points

Barriers to the construction of databases to process capacity KPIs at an international scale and at different milestones in the capacity processes

- **Characterisation of the data** and **underlying method** should be transmitted with all the exchanged data. Without the assumptions, data can't be processed to produce KPIs,
- Is the data **available** ? Planned or not, this refers to the **capacity processes** of the IMs,
- Is the data **exportable**, in which format ? This refers to the **capacity tools** of the IMs, and to the **standard formats**, currently in progress,
- Is the data **automatically importable** ? **Level of modelling** used to plan trains, TCRs and infrastructure, which can be **micro. or macro.**, is a hurdle to the data exchange : at this time, a macroscopic model is not automatically a subset of a microscopic one.

→ **Detailed and tangible capacity processes have to be harmonised in parallel to the progress in data exchange formats (see D 3.4, 3.5), and transmitted with the data,**

→ **As micro. and macro. levels are complementary in capacity processes, it's necessary to define standards in modelling, and continue the work on data (infrastructure topo. and perf., trains, TCRs) exchange standards to enable automatic communication between them,**

→ **Intelligent API's between macro and micro models could solve this challenge.**

European Union

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