



2023

ANNUAL REPORT

Editorial



Editorial

Dear readers

The SMA Annual Report was our company's last printed media, but everything comes to an end. We have decided to take the final step towards the complete digitalisation of our communications. We are keeping the visual identity, the usual structure and our three official languages of communication (EN, DE, FR), and are making our annual report available to you from a dedicated section of our website.

This year, our introductory article focuses on the implementation of medium-term capacity planning in line with the new European Union regulations. Stakeholders in this process, especially infrastructure managers, require methods and tools to ensure continuity, consistency and coherence between the different phases of TTR (Timetable Redesign for Smart Capacity Management) process, particularly the capacity strategy and the capacity model. SMA is already supporting various national and international players with these aspects. With our expertise, our ability to innovate and a holistic understanding of the capacity management process, reflecting of course the national and cross-border realities, we help to ensure a smooth transition and effective coordination.

Once again, we are pleased to present you with various activities and projects which have been active throughout the past year from our Consulting and Software divisions.

We hope that you enjoy reading our first 100% digitalised annual report!



Eric Cosandey
CEO, Head of Consulting



Thomas Bickel
Head of Software

Implementing medium-term capacity planning according to the new EU regulation



Strasbourg, 11.7.2023
COM(2023) 443 final
2023/0271 (COD)

Proposal for a
REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
on the use of railway infrastructure capacity in the single European railway area,
amending Directive 2012/34/EU and repealing Regulation (EU) No 913/2010
(SEC(2023) 443 final) - (Text with EEA relevance)
(SWD(2023) 443 final) - (SWD(2023) 444 final)

EXPLANATORY MEMORANDUM

1. CONTEXT OF THE PROPOSAL

Reasons for and objectives of the proposal

Rail is an environmentally friendly mode of transport. In 2020, rail transport accounted for 5.1% of passenger transport between EU countries and 11.5% of freight transport between EU countries, but only 0.4% of greenhouse gas emissions from transport in the EU. This is because rail transport is so energy-efficient – accounting for only 1.9% of the energy consumption of transport – and because most rail traffic runs on electrified lines. Rail transport is so environmentally friendly and has so many other benefits, such as its high level of safety, that EU policy has consistently promoted it.

This proposal is a key action of the European Green Deal and the Sustainable and Smart Mobility Strategy. Its main goal is to lay down a framework allowing rail infrastructure capacity and traffic to be managed more efficiently, thereby improving the quality of services and accommodating more traffic on the railway network. Achieving this goal is crucial for ensuring that the transport sector contributes to decarbonisation.

To guarantee the high level of coordination needed for safe operations and efficient use of the network, rail traffic and capacity must be effectively managed by infrastructure managers. This is mostly done at the level of national networks. At the same time, cross-border rail services require better coordination across networks than is often the case today. To this end, the proposal will set out mechanisms for coordination between infrastructure managers and others involved in rail operations.

Implementing medium-term capacity planning according to the new EU regulation

The new regulation on the use of railway infrastructure capacity in the single European railway area

As we write these lines, the European Parliament has just passed a regulation which aims to improve the use of rail infrastructure capacity. The text includes changes to the rules on the planning and allocation of railway infrastructure capacity. The aim of these changes is to allow rail infrastructure capacity and traffic to be managed more efficiently, thereby improving the service quality, and optimising the use of the railway network, accommodating larger volumes of traffic and ensuring that the transport sector contributes fully to decarbonisation.

More specifically, the regulation includes:

- general rules for domestic and international capacity management aligned to the three phases of the “Timetable Redesign for Smart Capacity Management” project (TTR) developed by the EU rail sector: capacity strategy, capacity model and capacity supply
- obligations on infrastructure managers to work together to develop a European framework for capacity management, with specific provisions for the management of scarce infrastructure capacity in cases of restrictions relating to work on infrastructure and degraded infrastructure
- obligations concerning traffic

management, disruption and crisis management and related cross-border coordination

- a performance review framework, with monitoring tasks for the European Network of Infrastructure Managers (ENIM), and a new performance review body
- the deployment of digital tools enabling better capacity and traffic management.

While a harmonised framework such as TTR enforces the role of the medium-term planning processes among infrastructure managers (IMs), it should also make it possible to ensure seamless and continuous planning and meet the growing capacity demands of passengers and freight railway undertakings

(RUs) on scarce infrastructure. In this context, various factors such as resource allocation, risk mitigation and stakeholder engagement play pivotal roles in optimising the capacity planning processes.

This article focuses on the two phases capacity strategy and capacity model and on how a comprehensive medium-term planning approach addresses these critical aspects to enhance the effectiveness and sustainability of railway capacity planning.

According to the new regulation, the capacity strategy (covering months M-60 to M-36) outlines expectations for future demand and supply on rail infrastructure. It serves as a tool for

communication and coordination between stakeholders and includes information on infrastructure development and the demand outlook.

A strategic route map is prepared within the capacity strategy, which defines the geographical scope and alternative lines to be used in case of infrastructure capacity restrictions (TCRs). Infrastructure managers must prepare, publish, and regularly update the capacity strategy, consulting with applicants and coordinating with other IMs.

Additionally, the new regulation defines a capacity model phase (covering months M-36 to M-18) to refine the strategy based on the outcome of consultations. It provides information on partitioning available capacity for the different market segments (type of rail services) and TCRs. IM's must document any deviations between the capacity model and the capacity strategy and again consult with applicants while coordinating with other IMs.

In alignment with these two phases the new regulation also requires objective measurements of capacity and performance reviews at national and international scale and wants to increase

transparency on these issues in a way to foster trust and collaboration which facilitates informed decision-making.

There is room for interpretation following different situations and needs

The European Commission is taking the lead on the way forward to a new capacity planning and allocation process. After the adoption of the regulation, member states and IMs will need to comply with it. Having said that, the needs of European IMs are diverse and might depend on the specific situation of each national system. The spirit of the new European regulation follows this logic, leaving some room for manoeuvre in its implementation.

The tangible needs for flexibility of freight services and/or TCR's within the medium- to short-term planning process might understandably collide with the possible forms of long-term capacity concepts. While the question of TCRs remains a challenge that often differs significantly between networks, depending on their balance between the volume of development projects (CAPEX), renewal and maintenance needs (OPEX), the nature, the form,

and the binding character of train services within the capacity strategy/ model deliverables is subject to interpretation within the European rail community: Should these be timetables or not? Systematic or not? Should they be binding? While this discussion is ongoing, some networks have already started to implement these tools in their capacity planning and management processes.

Switzerland, although not part of the European Union, has decided to publish its Network Usage Plans (NUPs) as basis for TTR Capacity Strategies. The NUPs are binding for SBB Infrastructure and contain the capacity available in a 1-hour systematic timetable which represents a peak hour. These NUPs are the last stages in a longer-term process in which resources (infrastructure, equipment and rolling stock) are derived and phased from a timetable-based network strategy where the timetable is not the goal, rather it is a means to an end as part of the master-plan. Following the principle that infrastructure, equipment and rolling stock shall be derived from a service concept (i.e. meaning that the functional requirements fulfil the needs of a capacity

plan, essentially a timetable, agreed between all stakeholders in the framework of an institutionalised iterative process), this timetable should be regarded in the later downstream phases, as not doing so would be detrimental to the overall capacity of the system. Working this way, Switzerland complies with the European TTR principles of "semi-pre-planned products" (ready-made capacity products as well as residual capacity for shorter term tailor-made orders) and this supports its planning and network development philosophy.

In Germany, the medium-term concept for optimised capacity utilisation ("mittelfristiges Konzept für eine optimierte Kapazitätsnutzung": mKoK) is to provide the basis for the TTR Capacity Model. Indeed, as a 2-hour systematic timetable, mKoK introduces a new pre-structuring planning deliverable for optimised capacity utilisation in times of increasingly scarce resources and is intended to provide transparency regarding available capacity for each type of transport and thus more planning security for all stakeholders in the subsequent allocation process, be it for frame contracts or ad-hoc provision. In

addition, DB InfraGO is using the mKoK to develop the key process elements that will be essential for implementing the phasing of Deutschlandtakt, the timetable-based rail infrastructure development program in Germany.

In France, reference operating plans (Plans d'Exploitation de Référence: PER) are derived from masterplans (Plans d'Exploitation Émergents: PEE) to provide the basis for the TTR Capacity Strategies. Today, a PER is not intended to be revised for annually, rather only in the event of necessary or structural changes to the capacity offer. The PER are a 2-hour systematic timetable supported by where appropriate, a 24-hour timetable giving indicative values for the type and number of trains for each systematic path.

Currently, the PER creates neither rights nor obligations, either for SNCF Réseau or for capacity applicants. However, compliance with the PER for the subsequent process is good practice that promotes capacity optimisation and the efficiency of the timetable development process, ultimately benefiting everyone.

Another requirement of the European process is the deployment of models and tools to facilitate a common capacity intelligence language that support the implementation of key performance indicators (KPIs) and visualisations which reflect the inherent complexity of capacity planning and allocation challenges. In view of this, a minimum viable product (MVP) project funded by the European Commission and carried out by SMA on behalf of the North-Sea – Med Rail Freight Corridor demonstrated how infrastructure, paths and TCRs data could be compiled and how such KPIs could be calculated and displayed in a comprehensive framework usable over different scales of time and space by the capacity stakeholders involved in the TTR process.

Overall, these tools allow for better and more predictable resource allocation for all stakeholders: international, national or regional authorities, and railway undertakings (RUs). They help to build support, address harmonisation concerns, and foster positive relationships in the institutional planning process.

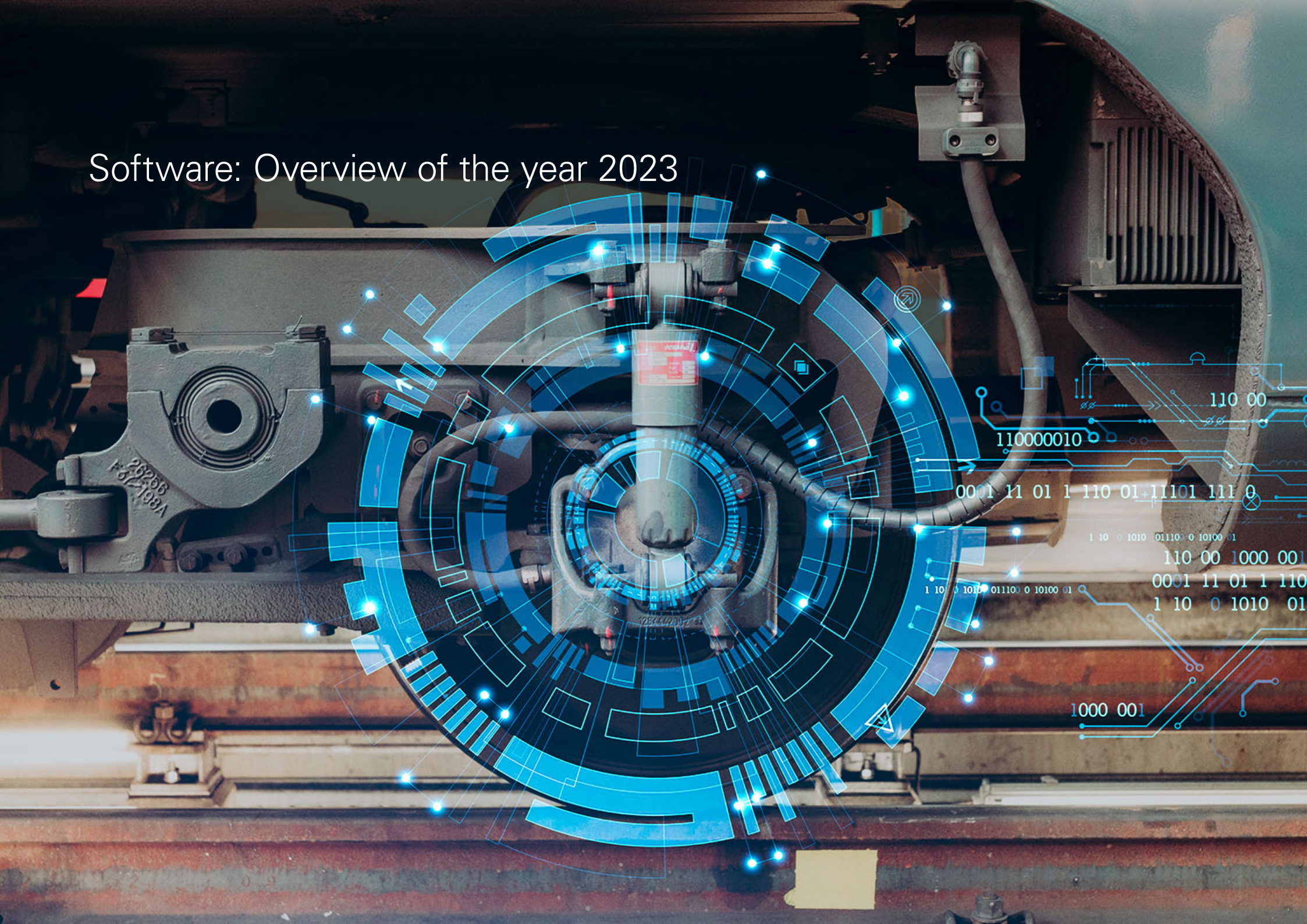
Navigating the shallow waters of medium-term capacity planning

The stakeholders of the medium-term capacity planning process, and particularly the IMs, need methods and tools to ensure continuity (i.e. through continuous model refinement), consistency and coherence across the process phases. With its methodologies and tools, SMA already supports SBB-I, DB InfraGO, and SNCF Réseau on the previously described TTR implementation cases at national levels or the RFC North-Sea - Med for KPIs visualisations at the cross-border level. These implementations are tangible outputs in the European landscape and can serve as examples for other IMs and Rail Freight Corridors depending on their needs and context.

The intricate dance of facilitating seamless transitions across the various phases of the capacity planning process, and effective coordination between stakeholders demands a wealth of experience and expertise. From the strategic foresight needed for long-term network development to the finesse required in short-term allocation, each phase plays a crucial role in ensuring the smooth functioning of the railway

system. To that end, SMA brings a comprehensive understanding, objectivity and innovation to the complexities of the capacity management process, particularly in the light of different national and/or cross-border situations. We will be happy to discuss your needs and challenges on these subjects with you.

Software: Overview of the year 2023



Numbers and facts

The turnover of sma.software is made up of the three pillars of maintenance, projects and licence sales. In 2023, we sold nine licences of Viriato.Standard and one licence of Viriato Enterprise. In addition, we sold licences for the add-on modules MicroscopyOnDemand (5 licences), Vehicle Rostering (1) and Trip Time Analysis (1).

We also rent individual licences or additional modules for shorter periods. Geographically, the majority of sales were made in Germany. Other individual sales were made to North America and France. The ratio between existing customers who purchased additional licences or modules and new customers was about 1:1.

In addition, new long-term contracts for maintenance and further development were concluded with important customers.

As in previous years our customer projects were strongly dominated by the operators in the German-speaking market, supplemented by other projects for Western European operators and infrastructure managers. Together with internal projects, over 900 stories were implemented in 2023 as part of our agile development process.

A total of 58 customer and product releases were delivered for 14 different versions of Viriato, which corresponds to an average of slightly more than one delivery per week.

To prepare our customers in the best possible way for working with Viriato, various training courses were held, which were individually aligned to the requirements and working processes of the individual customers. In contrast to previous years, the majority of training courses were again held on site at the customer's premises.

Number of external training courses	16
Language	German, French or Italian
Number of training days	38
Number of participants	approx. 135

Product Management Review 2023

VIRIATO HIGHLIGHTS FROM 2023

As part of the ongoing development that we undertake to improve the features of Viriato for our users, amongst many tactical improvements in 2023 we have implemented the following functionality:

Replanning trains

- In the graphic timetable, a selection of trains can now be moved to alternative tracks, creating overridden trains if needed. This is useful when diverting multiple trains around a known closure for engineering works, or to take advantage of new infrastructure which was not available when the trains were originally planned. This feature can also be used in Viriato Enterprise on a selection of trains from the train list for all trains matching the selected location.

- Selected train families may be split into separate trains at a node for a given calendar validity. This makes the planning of alternative services, such as replacement buses, much easier when a section of track is closed, as the new service can connect with the unaffected portions.

Vehicle rostering

- In the graphic timetable, trains may now be coloured by the roster that they belong to which allows the vehicle roster to be visualised immediately.
- Automatic linking between activities has been improved to optionally respect the rolling stock types.
- Rosters may be copied between databases allowing the reuse of planned rosters in different projects.

Train configuration

- The train configuration model was improved allowing all members of a family to share a set of rolling stock configurations, simplifying the management of material within a train family to a common pool of defined units.
- This view also now shows how many trains within the family are using each configuration set and provides batch operations for combining duplicate definitions and removing unused configurations.

Trip time analysis

- The trip time analysis now also takes into account commercial trains (i.e. splits and joins where parts of the train may share a common section while travelling to/from different origins/destinations) giving more realistic trip analyses results reflecting whether passengers need to actually change or not when the planned journey involves more complex service patterns.
- The demand assignment module is now also available for Viriato Enterprise users.

Conflict detection

- The conflict detection was rewritten as part of the new robustness module to create a modernised service which could be called by external processes (such as for robustness analysis). Although most of the changes made were internal, as part of the re-implementation additional exports to MS Excel reports were added allowing the conflicts between trains and engineering possessions, and between multiple trains to be saved.

Robustness

- The Robustness module has been reimplemented from scratch to offer improved functionality. The basic analysis principle remains unchanged, where the user can specify where trains experience initial delays, and these are then propagated to determine the consequences on the whole timetable and the time taken to return to the original plan as an indicator of inherent robustness. However, the functionality has also been extended to allow the user to perform more detailed analyses.

The improvements include:

- Improved delay generation methods: The geometric distribution can now be used in addition to fixed probabilities to generate initial delays for trains at all nodes in the model (allowing the modelling of independent events occurring at a constant rate)
- Stochastic simulations: By combining the results of multiple simulations using the Monte Carlo method a probabilistic view of the robustness is generated.

Path search

- A new path search module has been released as previously announced. This finds conflict free paths in an existing timetable for new trains based on the data from existing trains (“template trains”) automatically provided that all the necessary data for the conflict model is stored in Viriato and respects the Viriato model data such as minimum separation times in nodes, train headway times and topology restrictions.
- The module can insert only single trains or saturate a timetable until there is no capacity remaining by inserting multiple copies of trains.
- A track occupation for the visited nodes is automatically performed as part of the process of inserting additional trains. The algorithm maximises the capacity utilisation while minimising the overall journey time of the newly inserted train(s). If necessary, for existing trains a track assignment can optionally be made in the node to improve capacity utilisation.
- To help the user, if the algorithm is unable to insert new train paths due to issues with the infrastructure base data, the algorithm informs the user where the data should be corrected.

MoD (Microscopy-on-Demand)

- The topology viewer has been enhanced and can now simultaneously open and display all nodes affected by a conflict and display the itinerary or multiple trains simultaneously. To assist with this the filtering options have been improved.
- The block occupation and conflict detection over time in the viewer can now be animated to visualise the progress of trains and their potential interactions.
- The calculation performance has been improved by using incremental conflict detection to re-use existing results and only calculating for trains which have been changed since the last run.
- MoD has also been added as an optional module to Viriato Enterprise in addition to Viriato Standard.

#openviriato grows out of its infancy

WHAT HAS HAPPENED IN THE MEANTIME

Four years have passed since our last report on the topic and the first invitation to participate in our #openviriato collaboration initiative. During this time, we have continued to work with our partners on the implementation of the programme. We initially focussed heavily on core investments, such as expanding the Algorithm Platform and building an interested network in the academic community. The Algorithm Platform was developed from the outset with the aim of providing the required data for a range of use cases, which was realised through an abstract data model of the interface ("AID model").

The AID model is a generic domain model. Due to its this, development progress was initially slower, but this is now more than compensated for by the fact that work can be carried out in a resource-saving manner in the long term. Hardly any new functionality needs to be developed for each use case, as the basic functionality can be reused. The scope of the algorithm platform has now reached a state of maturity and the collaboration with top-class institutes and universities is beginning to bear fruit.

The resources that SMA can channel into this undertaking are relatively small compared to those of large companies in the railway industry. This forces us to be careful with our resources but also

to promote trusting and long-term cooperation with partners in order to achieve practical results.

Successfully putting research into practice Our approach has a number of benefits: firstly, the prototyping of an algorithm can be started quickly, because the algorithm platform accelerates algorithmic research because it provides the basic functionality required by researchers (data, views, services) and at the same time enables the user to evaluate the results of the algorithms on a state-of-the-art planning system.

In contrast to other approaches commonly used in research, the user works with their familiar timetabling system and not with prototypical GUIs,

which brings the associated advantages: It is more error-resistant, the GUI is more stable, productive data can be reused without data transformations, exports or working on only partial extracts, and the results can be analysed in familiar modules. All of this helps to put research results into practice more quickly because, compared to the usual approach, an agile development process with short feedback cycles can be used to work on real-world cases.

Secondly, time and cost savings can also be achieved when taking algorithms into production, as only one GUI and its connection to the algorithm platform needs to be implemented instead of a completely new development of a data model and the provision of data.

We never focus on automation for its own sake, but rather on the targeted automation of individual use cases of a clearly defined process.

Not everything automated: a realistic focus can take you further in the medium term In recent years, there have been widespread attempts to create automated national service concepts. Such a project requires network-wide conflict resolution, which is known to be a problem that almost certainly cannot be solved in polynomial time. In the meantime, the initial euphoria has been followed by disillusionment and in some places this endeavour has already been abandoned and in others at least it is increasingly being met with realistic scepticism. SMA is focussing its automation efforts on process steps that typically occur in medium-term planning, i.e. 3 to 6 years before operation. In the past, this planning phase was rather neglected in most European countries, with the notable exception of Switzerland. In the past two to three years, the importance of medium-term planning has undergone a strong upturn, driven in part by the FTE/RNE initiative “Timetable Redesign” (TTR), but also by national projects such as the

“medium-term concept of optimised capacity” (mKoK) in Germany.

Microscopic conflict resolution, but only locally! In our work as consultants for the creation of large-scale timetable concepts, in collaboration with our customers, we have succeeded in introducing microscopic conflict detection as early as the medium-term planning stage and have since established this process. However, the manual resolution of these detected conflicts is still a very time-consuming and labour-intensive task in which creative thinking is of secondary importance. This is why the automation of conflict resolution in this phase of the process is currently a key focus of our #openviriato initiative. A first successful internship and student research project have already been completed while work on a further dissertation and a “Co-Pilot Conflict Resolution” prototype which brings the algorithm platform together with MoD, have now been started.

Freight path search is a requirement

The second focus of our research activities is the mesoscopic search for train paths. The use case for this in medium-term planning consists primarily of constructing multiple freight train paths within the available capacity. This is generally a time-consuming task with little creative potential. Viriato’s mesoscopic model makes it possible to consider very large problems and solve them in a short computing time, unrivalled today by microscopic methods. In the future, we will also consider capacity constraints due to worksites and capacity objects in the context of TTR. Additionally, we will analyse to what extent it is possible to extend the path search from a mesoscopic conflict model to a microscopic one using the conflict resolution approach described above.

Robustness also benefits Last but not least, our robustness module is an analysis tool that has already been and continues to be used successfully in consulting projects. The robustness tool is based on a train simulation that can be accessed via the algorithm platform and which has been kept open for extensions so that customers can

integrate their own delay distributions and dispatchers. From our side, the main focus of future research will be on modelling the realistic behaviour of dispatchers and their simple implementation via the interface.

The journey continues In recent years, through perseverance and hard work, our #openviriato strategy has laid the foundations for us to collaborate successfully with partners on future automation solutions for the railway industry. Our strategy aims to tackle the problems that can realistically be solved today in order to advance the railway quickly and achieve efficiency gains. The key to success for us has been that our interface is open to partners and different use cases, which we have achieved through an abstracted domain model and reusable services. The first successful use cases “robustness”, “path search” and “co-pilot conflict resolution” as well as both completed and ongoing collaborations in research projects have validated our intentions.

Microscopy on Demand:

Improved display of microscopic conflicts

This year, we have greatly improved the functionalities for displaying microscopic information in MoD (Microscopy on Demand). This was mainly achieved by enhancements to the topology viewer. The topology viewer is a GUI component in Viriato-MoD that can be used to display the microscopic track topology in the macroscopic client. The information for this is provided via a specific microscopic service.

Previously, the topology viewer was used exclusively to display and select microscopic routes. Microscopic conflicts can now also be displayed in the topology viewer. The routes of all trains that are in an operating centre during the conflict period are displayed and the microscopic elements at which the conflicts occur are shown precisely. It is also possible to play back the chronological sequence of occupancy in a simulation. These functionalities allow a detailed analysis of the conflict constellation.

Further improvements in the topology viewer include the graphic display of additional microscopic elements such as signals, stops, etc. and the option of opening the topology viewer across several operating centres. It was possible to implement all of these extensions without having to extend the microscopic API. This illustrates the power and expandability of the MoD architecture.

The improvements described are already being used extensively for microscopic testing in mKoK 2026ff. The numerous positive user responses to the enhancements not only confirm the suitability and effectiveness of MoD in medium-term planning, but also make it clear that the full potential of this approach is far from being exhausted.

The figures on the following pages illustrate the improvements described above.

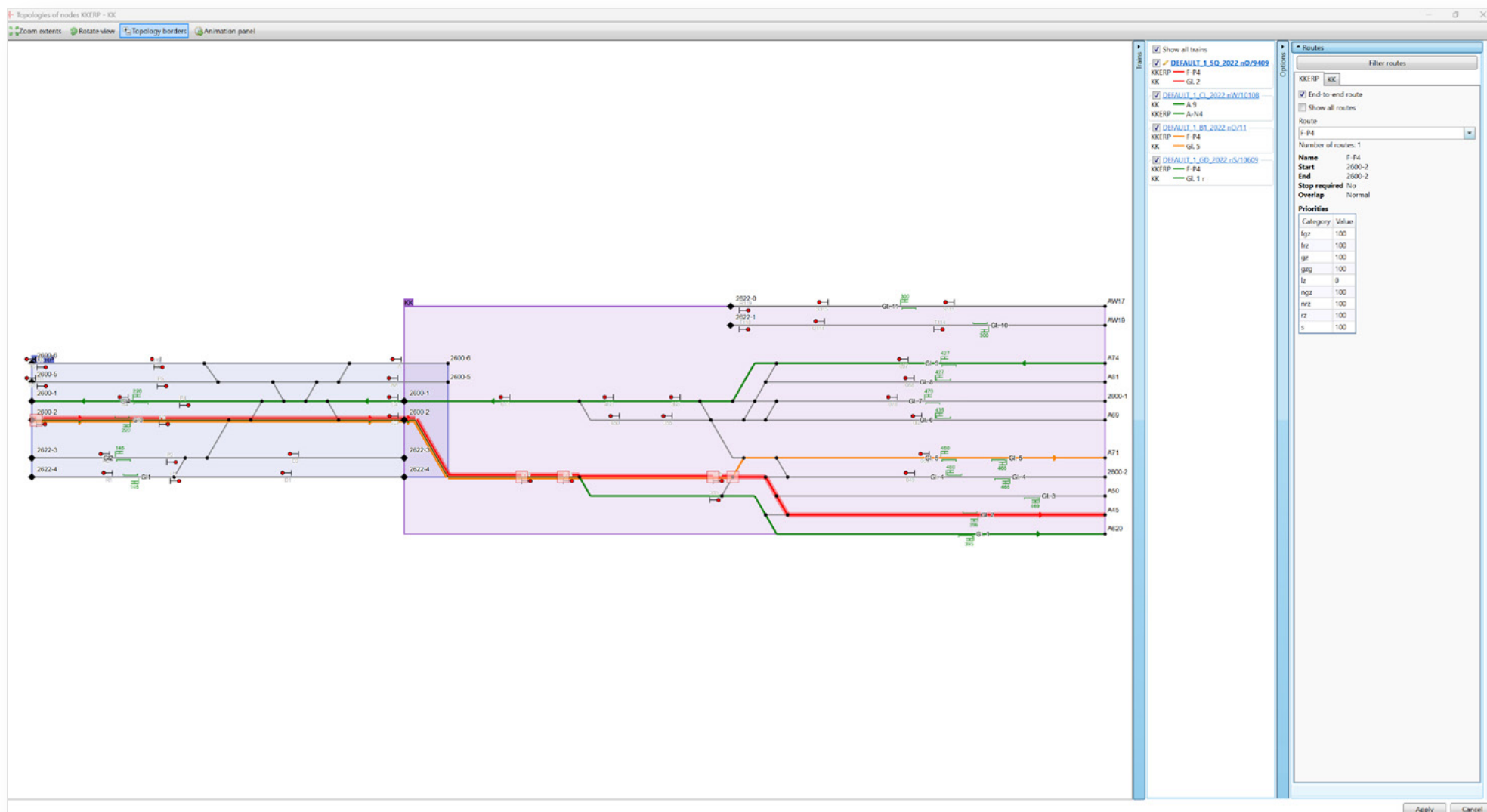


FIGURE 1 Static view with all moves and conflicts in the period of the conflict opened from the view

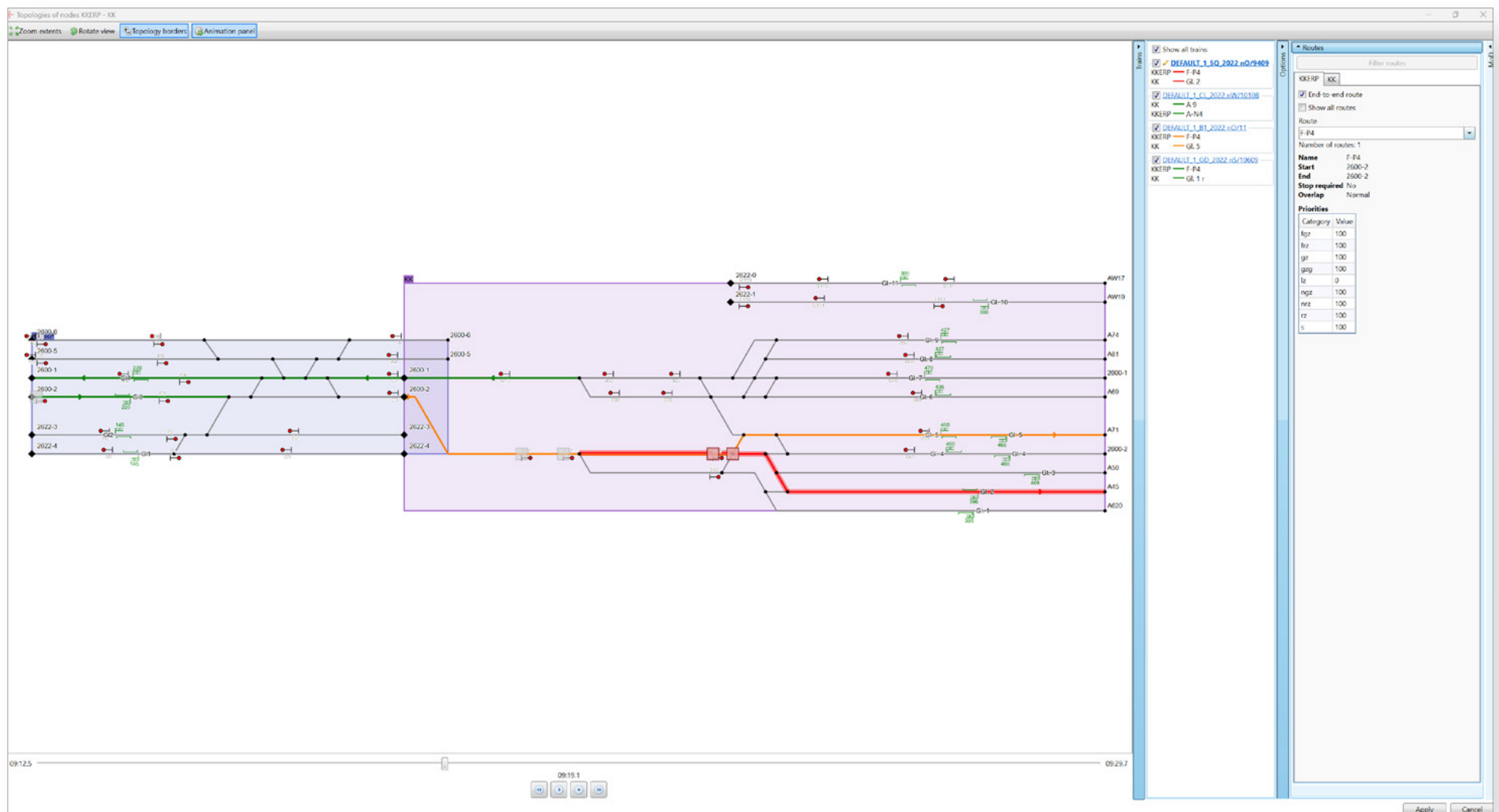


FIGURE 2 Animated view illustrating the temporal sequence of microscopic occupancies and conflicts

Consulting: Project selection from 2023



Consulting: Project selection from 2023

Our business segments

-  Service offer
-  Production
-  Operations
-  Capacity
-  Demand
-  Franchises & Tenders

AUSTRIA



ÖBB Infrastruktur AG Praterstern: 2040 target network – module-based shift planning Austria has one of the densest and busiest railway networks in Europe. As a result, the network is in a very good state of expansion and maintenance and is constantly being

expanded and improved. The necessary infrastructure measures to reduce journey times or resolve bottlenecks by expanding capacity are derived on the basis of timetable-based service concepts. The timetable-based infrastructure derivation procedure is used in Austria in the recently published plans for the 2040 target network.

The core of the services commissioned by ÖBB-Infrastruktur AG were service planning as part of the 2040 target network planning in the form of service concepts based on system train paths, both for the reference case and the planned case. Infrastructure dimensioning is carried out in the 2040 target network as part of the creation of modules for sub-networks.

SMA's consulting activities focussed on supporting and challenging the procedure for setting up a process-based methodology for planning infrastructure sub-modules on the basis of system routes, including identifying the required infrastructure, planning selected modules in the ÖBB network for the overall process of target network planning 2040 and providing suitable support for stakeholder management to ensure market acceptance.

With the chosen procedure, ÖBB Infrastruktur AG's specific approach to the 2040 target network planning has been validated and broadly supported by the stakeholders.



ÖBB-Personenverkehr: Ensuring sufficient rail replacement capacities thanks to construction schedule templates

Many railway networks in Europe are facing increased construction activity and the resulting capacity restrictions. These restrictions can lead to trains having to be replaced by buses in so-called rail replacement services (SEV). ÖBB-Personenverkehr AG recognises that the provision of sufficient SEV capacities is becoming increasingly challenging and that the timely planning of replacement concepts is becoming more important.

The aim of the “Ensuring SEV” project is to estimate the required SEV capacities for a timetable year around 15 months before the timetable change and to prepare the necessary resources together with Österreichische Postbus Aktiengesellschaft (ÖBB Postbus). At this point, an overview of the closures planned by ÖBB-Infrastruktur AG is available.

The approach chosen in the project provides for the preparation of so-called templates, which divide the entire Austrian rail network into suitable blocked sections. The boundary points of these sections are railway stations where the rail service can be interrupted and where it is possible to switch between rail and replacement buses in a suitable manner. In local transport, the sections are more finely meshed than in long-distance transport.

These templates make it possible to industrialise timetable processes for infrastructure restrictions. As soon as the restrictions are known, the resulting bus requirements for SEV services can be estimated using the templates. The template then forms the basis for the development of specific construction

timetable concepts (rail and bus) and for ordering SEV services from ÖBB Postbus.

In the future, the templates can also be used in ad-hoc cases for short-term disruptions and to standardise processes in the sense of an incident concept, reduce the planning work to be carried out under time pressure and create the basis for clear communication with customers.



ÖBB-Infrastruktur AG: Support in the preparation and evaluation of a capacity and quality-optimised 2026 timetable

ÖBB-Infrastruktur AG is developing a capacity- and quality-optimised timetable for the Austrian rail network for the period from 2026, with the national integrated timetable forming the backbone. Due to construction work planned for this time horizon, various timetable variants with different advantages and disadvantages were developed on various corridors. Objective criteria are required to select the most suitable variant in order to be able to compare variants as neutrally as possible.

As part of the project, we answered the following questions in co-operation with ÖBB-Infrastruktur AG:

- What is a suitable evaluation system for assessing timetable variants?
- What are the results of applying this evaluation system to selected routes in the 2026 timetable?
- From SMA's point of view, are there other timetable variants on the routes under consideration?

The work was carried out for the Salzburg–Vienna corridor. In addition to existing variants, we developed further timetable variants for the 2026 timetable year and compared these with the evaluation procedure created by SMA for this project, which includes supply planning, operational and infrastructural elements.

BELGIUM



Infrabel: Evaluation of alternative operation of local passenger lines

As part of a review aimed at optimising infrastructure management costs on the Belgian rail network, Infrabel asked SMA to assess the consequences of a simplified alternative operating mode on certain local passenger lines. In order to be able to objectively assess the impact this would have on the various stakeholders in the Belgian rail system, various summary evaluations were carried out.

The analyses were organised according to a funnel principle in order to be able to focus the study on the lines of greatest interest. The study was organised in several stages; the first stage consisted of an analysis of capacity and enabled

us to rule out lines where simplified operation would involve infrastructure investment, non-robust situations or excessively long connection times. The second stage assessed the impact in terms of operations for the national operator, journey times for passengers, systemic impact on the rail network and reductions in terms of infrastructure management costs.

In the end, an assessment of the lines evaluated showed which would a priori allow simplified operation with limited impact on the various stakeholders in the rail network. More detailed analyses of these lines would enable the subject to be explored in greater depth.



SNCB-TEC-De Lijn-STIB: Evaluation and improvement of the complementarity of multimodal services within the Brussels RER network

As the rail component of the Brussels RER project is now being rolled out, the four public transport operators involved – STIB, SNCB, TEC und De Lijn – have joined forces to study the complementarity between public transport modes and operators within the Brussels RER perimeter. SMA assisted Stratec and Tractebel with various aspects of the study. The objectives of the study were to update and deepen knowledge of current mobility demand and to identify existing and potential complementarities between public transport modes and operators.

SMA's contribution focused on analysing this complementarity, firstly by identifying – through an assessment of the current situation – the potential for improvement (in particular the alignment of service frequencies and amplitudes, as well as the improvement of connections) and secondly by proposing new road public transport corridors to reinforce the RER backbone in corridors where rail is absent. This proposal was then developed into a multimodal service concept organised around this structuring backbone with a high level of service (high frequency and amplitude). The proposed concept includes hubs to facilitate connections between the RER backbone and local and feeder road lines. The proposal fits into a virtually constant kilometre envelope.

CANADA



ONxpress Operations Inc: Support GO Rail Expansion Project Toronto

SMA has been supporting ONxpress Operations Inc. in the GO Rail Expansion Project (Toronto) since the bidding phase in late 2021. ON-Corridor work includes all activities that facilitate train service. System-wide infrastructure upgrades include adding tracks, expanding stations, electrification of the rail network, new locomotives and train control systems to enable more frequent services.

SMA has been involved in the timetable design and development, with the aim of implementing service concepts at different time horizons (from long term scenarios to the first phase of operation),

testing the proposed infrastructure layout and contributing to defining optimised solutions.

The core of SMA's activities included designing systematic timetables, 24 hour weekday and weekend timetabling, the definition of operational concepts (with particular focus on terminus stations and the high-density scheme at Toronto Union Station), the development of the rolling stock rostering associated with the timetable (including empty runs to/from the stabling areas and depots), and the interface between the timetable deliverables and the simulation tool OpenTrack.

The activities, which are still ongoing, have also been targeting the implementation phases, with the aim of supporting the infrastructure development through a consistent service plan throughout the development phase.

SMA's activities have been performed in coordination with DB teams and Metrolinx, in close cooperation with other partners.

SWITZERLAND



Canton Basel-Stadt, Schweizerische Rheinhäfen: Further development of the BSKH harbour railway, feasibility study and decision on variants

The Canton of Basel-Stadt intends to remove the part of the Kleinhüningen harbour site located on the Rhine from the harbour perimeter and develop it in terms of urban planning. As a result, the affected infrastructure of the Basel Kleinhüningen harbour railway will no longer be required. The harbour railway must therefore be adapted or further developed so that high-quality rail access to the transshipment facilities within the port can continue to be ensured.

In the feasibility study, SMA analysed three variants in terms of track layout, functionality and mode of operation using the performance model. This model makes it possible to depict the relevant operational processes, track usage and resource deployment in a level of detail appropriate to each stage, to coordinate them with each other and to optimise them as an overall system. Due to the efficiency of this method, a large number of infrastructure variants and scenarios can be modelled. In the case of the Kleinhüningen harbour railway, different scenarios for freight volumes, train numbers and technological developments such as digital automatic coupling were tested. The model depicts processes such as train movements, shunting movements, brake tests, coupling, uncoupling, etc. as well as the use and utilisation of resources such as shunting equipment, track groups or individual tracks, humps and individual points.

As a contribution to the comprehensive comparison of variants, SMA provided proof of the operational feasibility of the optimised railway system on the one hand and key figures on the performance, efficiency and cost-effectiveness of

shunting operations on the other. The south quay modified variant emerged as the best variant from the comparison of variants.

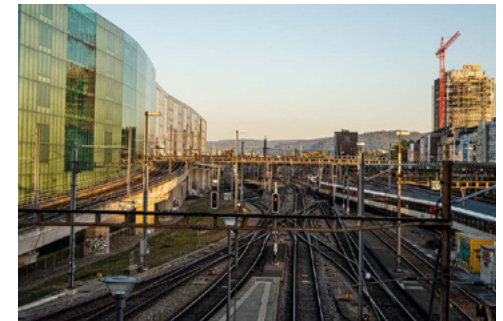


AAGS and ZVB: survey of the ticket structure Auto AG Schwyz (AAGS) and Zugerland Verkehrsbetriebe (ZVB) carry out a structural survey on their bus routes every four years. The last survey was carried out in 2018, so another structural survey was due at the end of 2022.

The main tasks for SMA in the context of this assignment were the preparation of the survey with the planning of the courses to be surveyed and the staff deployment planning, the monitoring of the survey and the subsequent plausibil-

ity check and evaluation of the survey data. The statistical relevance of the data and its possible improvement with suitable measures was an important focus: for example, when planning the survey, care was taken to ensure that the sample was as representative as possible by taking adequate account of the various passenger groups.

The ticket structures collected for each line and day type are primarily used to determine the transport services per ticket category based on annually updated count data. These in turn form the basis for determining the revenue distribution key within the respective fare networks.



SBB Infrastructure: Support for supplementary study AS35 Alternatives for Basel pull-out tracks

The measures proposed to ensure railway production in the STEP expansion step 2035 time horizon in Basel SBB affect protected areas and involve high costs. The federal government therefore commissioned SBB to investigate possible alternatives and estimate their costs.

SMA und Partner AG supported the interdisciplinary team in the search for alternatives and in particular in testing their suitability for safeguarding production.

The starting point for testing production was a five-hour timetable window in the Basel SBB hub based on the AS

2035 timetable concept. On the one hand, this combined the various connection options in international long-distance transport with the clock systems, some of which are only two-hourly, and on the other, it covered two key periods of production, the strongest before and the weakest after rush hour.

For each promising variant, the required production journeys to or from the stabling and service facilities were then planned, as well as additional reserve journeys in both directions required for robust production. In order to enable the production routes, the track occupancy of the commercial trains in Basel SBB was also adjusted every half hour.

In addition to a possible but not easily realisable alternative to the originally proposed measure, the study also impressively demonstrated the complexity of production at the Basel SBB junction.



SBB Infrastructure: Lucerne

realisation sequence As part of the future development of the railway infrastructure in Central Switzerland, SBB Infrastructure has been commissioned to support the preparation of a corresponding study. Previous experience from work on the STEP 2035 expansion step shows that it is advisable to consider the development path for implementation in the densely trafficked Swiss railway network before the parliamentary decision is taken. This point was not addressed in previous studies in connection with the expansion of the Lucerne junction or the through station.

The aim of the ongoing assignment is to find solutions to the most important outstanding conceptual issues and to

draw up proposals for an appropriate sequence of service steps and the resulting infrastructure dimensions. In the process, findings and foundations for further project planning and political discussions regarding consideration in the next expansion stages have been developed.

The first step was to define a regional target concept for the Lucerne region based on various requirements, which would serve as a beacon for the individual realisation steps. From this, more than 20 individual service concepts for intermediate steps could be planned and reviewed, depending on various infrastructure elements. The requirements from the supply and production planning of the individual stakeholders had to be taken into account at all times and an optimal quantity structure had to be determined. This top-down planning methodology ensures that the planned infrastructure elements are always optimally utilised and that no bad investments are made.

As a contribution to the comparison and the definition of an initial realisation step and the resulting development path, SMA provided proof of the operational

feasibility of the individual intermediate steps on the one hand and comprehensive key figures on the other, which quantitatively evaluate the service targets, the stability and the desired journey time targets.



BOB: Second opinion on infrastructure measures for the 2027 timetable

In connection with the commissioning of the V-Cableway connected to Berner Oberland Bahn AG (BOB) (cable cars to Eigergletscher and Männlichen with a shared terminal in Grindelwald) and the new station with Park and Ride Matten, the BOB would like to supplement its services with additional trains at peak times as part of the STEP expansion step 2035.

The aim of the second opinion was to check the plausibility of the timetable drawn up in a previous study and the infrastructure identified for it, and to demonstrate the stability of the planned timetable.

The first step was to check the basic data such as infrastructure, vehicles, stopping and separation times, etc. and to add these to the Viriato database already available at the BOB. The subsequent calculation of journey times in Viriato made it possible to confirm the planned timetable as a rule.

With the help of the robustness analysis in Viriato, various specific delay events such as waiting for a connection, stopping times extended over several hours on peak days with very high demand or operational disruptions were then simulated. It was shown that individual delay entries can be quickly reduced and systematic loads can be transferred to a stable timetable pattern without the need for train cancellations or premature turnarounds. This can also be achieved without scheduling interventions in the sense of adjusting the

train sequence in meeting sections. The planned timetable could therefore be described as robust.

The Viriato model was then used to simulate specific issues relating to optimisation options such as the extension of double track sections or the relocation of a rack and pinion entrance and thus assess their effects

.



RegionAlps: Assistance in preparing the PRODES 2040-45 stage

The Canton of Valais has asked the railway companies operating in the canton to prepare the next stage of the strategic development programme for rail infrastructure (PRODES) in order to identify the most promising projects for developing the service. SMA assisted RegionAlps in the study of the development of the RER Valais | Wallis service between Brig and St-Gingolph.

Firstly, the framework for the study was clarified by analysing the data to provide a clear understanding of current operations. Measurements of train movements on the line (publicly available) were used to understand the main challenges to punctuality. RegionAlps ridership data was used to

target the sections where an expansion of services would be most favourable. On this basis, 3 service plans have been proposed.

For each service plan, a timetable was drawn up and the associated functional infrastructure was identified. Each of these scenarios was then evaluated on the basis of the quality of the service, the rolling stock required, turnaround times as an indicator of robustness and the infrastructure required. After iteration and evaluation, one scenario was selected and recommended to the Canton of Valais.



SBB: Operational simulation of the planned new rolling stock maintenance centre at Aigle

SBB has identified a need to develop rolling stock maintenance capacity in French-speaking Switzerland. In 2022, it announced its intention to expand the Yverdon site and to build a new rolling stock maintenance centre by 2030 in the municipality of Aigle (a project known as NESA).

SBB has defined the site's maintenance requirements, the rolling stock and several possible infrastructure configurations. In this context, a study was commissioned from SMA to verify the compatibility between the maintenance requirements and the configuration of the site and to identify any adaptations to be made to the configuration of the

site (layout) and/or the dimensions of the various sectors of the future NESA maintenance centre.

The compatibility check was carried out and the adaptations identified by establishing the production and operating concept for the site using a simulation based on a performance model developed by SMA. This performance model makes it possible to simulate the operation of the site on the basis of various assumptions, to identify capacity shortfalls and to iterate between the rolling stock and the configuration required to achieve an optimum situation for the system as a whole.

CZECH REPUBLIC



Správa železnic – Czech Rail Infrastructure Manager / Mott MacDonald CZ: Prague Node feasibility study

As a member of a consortium of six companies, SMA continued to develop the service offer concept in Prague railway node. Following the completion of the “without project scenario” in previous stages of the feasibility study, the focus in 2023 focussed on the design of three “project scenarios”.

These differ predominantly in the configuration of the two proposed S-Bahn city-tunnels. All three project scenarios enable diagonal routing of most of the suburban traffic under the historic city centre, including direct services to Prague airport. To gain greater benefits in the form of time savings in the surrounding Central Bohemian Region, Express-S-Bahn services were also introduced. The proposed solutions integrate and consolidate long-distance service concepts entering the node from the outer network, including future high-speed lines.

A high priority was given to the systematic freight path planning, especially on tangential bypasses with mixed traffic. Service scenarios were evolved iteratively based on recommendations from a passenger demand model. The requirements for the technical solution were primarily derived from the target timetable, however, Prague's topography and historic value posed significant constraints to infrastructure planning. The gradual node development was discussed and optimised in bi-weekly organised stakeholder group meetings whose stakeholders included the infra-

structure manager, national and local transport authorities, service operators, the union of freight transport companies and representatives of the city of Prague and Central Bohemian Region. The frequent exchange of ideas among all stakeholders was a key success factor of the study. In 2024 the project scenarios will be evaluated from an economic and environmental point of view.

GERMANY



Consultancy services to KC ITF NRW and NRW public authorities

In 2023, SMA continued to support the KC ITF NRW (Kompetenzcenters Integraler Taktfahrplan NRW, a public agency specialising in developing integrated interval timetables) and the three public transport authorities in North Rhine-Westphalia (NWL, go.Rheinland (formerly NVR) and VRR) in the further development of the integrated interval timetable for the state of NRW. In supporting the KC ITF NRW, SMA is working in partnership with VIA Consulting & Development GmbH from Aachen.

For the KC ITF NRW, the focus of the work was on supporting the timetable robustness test of the 2040 NRW target network by DB Netz AG (now DB InfraGO AG). This involved coordinating the service concepts developed by SMA in recent years and the necessary infrastructure expansion in detail and making further adjustments to ensure more stable operations. Improvements were also made to the precursor stage, the 2032 NRW target network.

For the 2028 time frame, investigations were carried out into the use of vehicles on various RE lines for which new vehicle concepts are planned (RRX-B fleet). This involved analysing driving dynamics, infrastructure requirements (e.g. platform lengths) and capacity requirements.

In addition to regional rail transport, the focus in 2023 was also on the design of a state-wide express bus network to connect areas away from the rail network.

On behalf of the public transport authorities in NRW, SMA prepared various studies on the operational feasibility of reactivating lines in regional rail transport.

For the NWL area, the operational feasibility of over 90 potential new stations were analysed and their integration into the ITF NRW assessed. Individual potential new stations were also analysed for the VRR area.

In the area of go.Rheinland, the focus of the work was on supporting the tender for the Cologne S-Bahn. A step-by-step concept for the further development of the S-Bahn network was developed for the various infrastructure conditions for the expansion of the Cologne node. In addition, specific tender timetables were drawn up and timetable planning was carried out.

The results of the work in NRW have been presented and discussed in working groups and committees. The work was supplemented by the annual monitoring of the service volume and the updating of the current netgraph.

The work will also be continued this year.



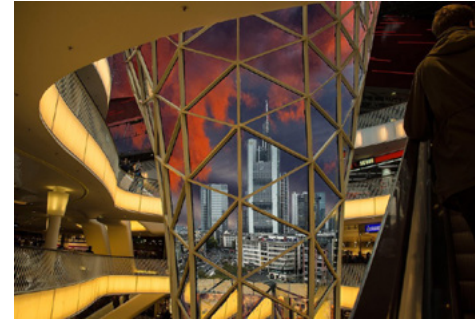
Municipality of Isny – Mobility Centre: Reactivation Leutkirch–Isny

As part of a feasibility study, the companies SMA und Partner AG and Schüßler-Plan analysed a possible reactivation of the Leutkirch–Isny line. The study is intended to provide information on technically feasible, economically viable and affordable options.

Passenger traffic on the 16 km long line was discontinued in 1969. Freight transport was discontinued in 1976, and the German Armed Forces operated a siding between Leutkirch and Urlau until 2001. The entire line has since been decommissioned and dismantled. The line has already been built over in several places. To check the technical feasibility of the infrastructure, Schüßler-Plan developed several variants

for the route between Leutkirch and Isny, with one of the main issues identified as the roads through both towns. SMA und Partner AG then developed numerous service concepts. In addition to various connection options in Leutkirch, different operating modes both with and without freight transport were also analysed. An assessment was also made as to whether it would also be possible to connect the Center Parcs attraction to the railway.

The preferred option was an hourly service between Leutkirch and Isny with a journey time of 23 minutes. The necessary infrastructure requirements were determined with the associated cost estimate and a simplified calculation of the expected cost-benefit ratio based on the standardised assessment.



RMV Rhein-Main Verkehrsverbund GmbH: Further development of the express bus network for the RMV network area

The RMV regional public transport plan (RNVP) is the central instrument for managing the further development of local public transport. The current RNVP identifies around 60 transport axes that are to be analysed for their suitability for express bus services. These transport axes pass through areas with very different structures and therefore fulfil a wide variety of transport functions and differ in terms of their passenger potential.

SMA has developed specific routes and timetables for these 60 transport axes. A utility analysis was carried out on the basis of the timetables drawn up. Several criteria were taken into account,

such as potential passenger demand, journey time development and regional network impact. The application of the utility value analysis led to a prioritisation of the transport axes and can therefore be used as a basis for decision-making for the implementation of the express bus routes. The calculation tables of the utility analysis were parameterised so that the weighting of the criteria could be changed and sensitivity analyses could be carried out.

In a further step, the existing bus service was examined for deficiencies and potential for optimisation. Among other things, it was analysed which municipalities would not be connected to higher-quality public transport lines (regional public transport, express bus lines, etc.) if the new express bus lines were implemented. For these municipalities, additional, specific routes or optimisations of existing routes were developed to improve connections. A further element of this deficiency analysis was the identification of gaps in services between medium-sized and regional centres within the RMV. Additional new routes and timetables were also developed for the identified gaps.

A key element of the results of this report is a network diagram that contains the regional rail transport and the existing or newly developed express bus routes for the entire network area. Using this network diagram, network connections between regional rail transport and express bus routes can be recognised more quickly.



Hamburger Hochbahn AG: Simulation of construction conditions, U3 Nordring closure

In summer 2024, Hamburger Hochbahn is planning a longer closure of the Kellinghusenstrasse–Barmbek (Nordring) section of the U3 line for maintenance work. A sweeping operation will therefore be necessary at Kellinghusenstrasse station. This sweeping operation will cause

potential crossing conflicts with trains on the U1 line.

As part of this study, SMA determined the time required for sweeping the U3 in Kellinghusenstrasse and also analysed the influence of these sweeping operations on the operation of the U1.

Firstly, the existing OpenTrack model was refined in the area of the U1 sections up to the respective neighbouring stop. In addition, SMA extended the OpenTrack model to include the infrastructure and safety elements required for the sweeping process in Kellinghusenstrasse. This made it possible to precisely simulate the approach and departure movements of the U3 crossing the tracks of the U1 into the reversing tracks.

The simulations show that there are reserves in the U3 sweeping process that allow both a 5-minute cycle on the U3 and stable operation on the U1.



Münchner Verkehrsgesellschaft mbH (MVG): Accompanying operational test for increased frequency of the Munich underground

SMA has been advising MVG for many years with regard to a cycle density on the main lines of the U1/U2 and U3/U6. The focus was on the development of different service concepts and their verification by means of operating simulations. In order to prove the feasibility of the preferred variants of these developed concepts in practice, a real operating test was carried out on the two main lines in autumn 2022 and spring 2023. The underground trains ran on a Saturday and on two working days during peak times with a more frequent service.

Despite the lack of experience with the condensed timetable and the short-term unavailability of parts of the infrastructure and rolling stock, the operational trial can be described as successful and the knowledge gained from it as valuable. Important insights were gained, particularly in the areas of minimum train headways, train routing, power supply, dispatching and passenger routing. The weak points identified in the operational trial will be eliminated or reduced as far as possible for subsequent regular operation.



Nahverkehr Westfalen-Lippe (NWL): Feasibility study “Alternative drives on non-electrified routes in Westphalia-Lippe”

There are still some non-electrified railway lines in Westphalia that are currently operated with diesel railcars. As part of the climate debate, there are also plans to reduce emissions and establish alternative drive systems for regional rail transport. In addition to the full electrification of railway lines, the focus here is primarily on on-board solutions using battery-powered railcars (BEMU) or hydrogen railcars (HEMU).

Together with SCI Verkehr, SMA is conducting a feasibility study to investigate the suitability of locally emission-free drive types for the three grid areas “Sauerland”, “Siegerland” and “Ostwestfalen-Lippe”.

A particular focus is placed on energy consumption and the associated energy supply (battery charge level and hydrogen tank filling level) during vehicle circulation as well as possible charging and refuelling processes. Depending on this, the required infrastructure is determined (especially charging facilities or hydrogen refuelling stations) and the feasibility is coordinated with the parties involved.

By means of a subsequent cost estimate of the operating costs (incl. energy costs) and investment costs, an economic feasibility study is carried out, according to which an operating cost rate per train kilometre (performance price) can be determined. A comparison between the variants according to traction type is carried out by means of a net present value analysis. The results are then subjected to a sensitivity analysis and checked for plausibility.

The aim of the study is to determine an optimal drive technology (BEMU, HEMU or full electrification) for each of the lines and to form sensible sub-networks. The feasibility study also provides the necessary infrastructure requirements as well as the investment

costs and operating costs for the planned operating concept. The results of the feasibility study are expected in spring 2024.



DB InfraGO: KaZu Novum – Creation of mKoK 2026ff

The Deutschlandtakt is the leitmotif for the infrastructure of the rail network of the future in Germany. While the target timetable “Deutschlandtakt” thus represents the long-term perspective of infrastructure dimensioning, coherent intermediate steps should be developed in an industry-wide transparent planning process along the way. DB InfraGO AG has started down this path and is consistently pursuing it as part of the KaZu Novum (Capacity Planning and Allocation of the Future) project. A hierarchical planning

approach has been developed together with the market in order to implement the most optimised capacity planning and allocation possible, with capacity distribution for the three modes of transport – long-distance, local and freight – and has been tested as a prototype with the medium-term concept for optimised capacity utilisation (mKoK) 2024.

The procedure will be transferred to the 2026ff timetable horizon in the current project for the mKoK 2026ff. The commissioning of the new Stuttgart 21 underground railway station will trigger substantial service adjustments with an impact on the entire German rail network. Due to these fundamental changes to the transport offer, the medium-term concept for optimised capacity utilisation (mKoK) must be updated and redrawn for the timetable years following its commissioning. SMA’s task here is to support DB InfraGO AG in the internal development of the timetable and process-related aspects of stakeholder management, taking into account the mix of transport modes.

Technically, the work is carried out in close cooperation with DB InfraGO AG using macroscopic and microscopic timetable tools, which are implemented by Viriato MoD in combination with LaaS, taking into account the DB design rules with regard to buffer times, transition times, standard surcharges and construction surcharges. Since 2016, SMA has developed the Microscopy on Demand (MoD) concept, which supplements the Viriato software with access to microscopic services, which in this application case are based on the track plan model. The MoD method significantly reduces the time required for microscopic validation compared to the previous method of transferring the macroscopic planning completely to microscopic models and checking it there, as time-consuming and error-prone system breaks are avoided.



BMDV: Updating the target timetable for Germany

The “Deutschlandtakt” target timetable is the guiding principle for the infrastructure development of the rail network in Germany. The target timetable for Germany will improve the coordination of rail passenger services, improve connection and travel times and provide continuous capacity for rail freight transport with short transport times. Based on the target timetable, the necessary expansion and new construction projects for the rail network can be derived from the timetable.

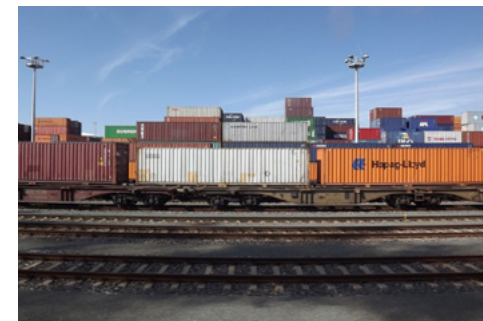
The “Deutschlandtakt” will be regularly updated to take account of new economic and traffic developments.

The aim of the study in the context of updating the target timetable is to adapt it to the results of the federal government’s long-term traffic forecast for 2040.

The work on the update includes a comprehensive stakeholder participation process, a coordination process with the neighbouring states and the review and modification of the current target timetable for Germany based on and the results of the 2040 traffic forecast, taking into account the feedback from the participation process.

The work began in 2023 with a comprehensive process to collect stakeholder input, clarify assumptions and various coordination processes and will continue in 2024 with the planning of the update of the target timetable. The updated target timetable for the “Deutschlandtakt” is expected to be available by the end of 2024.

FRANCE



Rail Freight Corridor North Sea-Mediterranean: Cross-border capacity knowledge study

The stakeholders involved in cross-border capacity planning and allocation activities potentially work with different processes and software programs without adequate decision-making tools. This means that there is a lack of a transnational clarity of the capacity conditions by all actors through common metrics and visualisations. The European Parliament is currently discussing a regulation which will set general rules for capacity management aligned with the TTR process which aims to improve transparency and harmonisation at European level.

In this context SMA assisted the RFC North Sea–Med to produce and share capacity KPIs and visualisations enabling all stakeholders to have a clearer view of potential capacity issues.

The first phase consisted of data collection, analysis, and database creation. Infrastructure, paths, TCR (Train Capacity Restrictions, i.e. works) data from planned future and actual as-run services, and from different planning steps were collected from the infrastructure managers (IMs) of France, Belgium and Luxemburg. These were then compiled into a single transnational database.

In a second phase, capacity KPIs and visualisations were calculated and displayed in a comprehensive framework usable by the capacity stakeholders for different time and geographic scales involving three main steps: bottleneck identification and prioritisation, capacity consumption analysis and a toolbox for KPI's and visualisation.

National processes were also analysed to understand their differences and the specific national TTR implementation plans. Finally, the capacity KPIs and

visualisations were shared with “mirror groups” made up of representative of IMs, RUs and institutional bodies.

The two key outcomes of the study were a deployment of the methodology on the entire perimeter of the North-Sea Med corridor, and a set of recommendations to any stakeholders who would like to:

- Facilitate data harmonisation and a common capacity description language,
- Deploy model and tools that support the implementation of capacity KPIs and visualisations which reflect the inherent complexity of the capacity planning challenges,
- Foster objective measurement of capacity at an international scale, increase transparency and harmonisation on the capacity planning and allocation processes.



Occitanie Region: Study of systematic timetable scenarios on lines in the north-east quarter of Toulouse

The Occitanie Region has commissioned SMA to study alternative timetables for the lines in the north-east quarter of Toulouse, in order to improve the quality of service on these single-track lines (from Toulouse to Albi, Rodez, Capdenac and Mazamet) and to make the service more legible. These changes should help to meet the growing demand in these areas and contribute to improving the modal shift towards rail. The study has a short-term horizon, using current infrastructure and rolling stock. The study was therefore conducted in close collaboration with SNCF Réseau. It has incorporated an analysis of the work being carried out in

parallel by the infrastructure manager in order to produce a proposal that reflects the interests of all stakeholders.

Several scenarios for a systematic 2-hour timetable were drawn up, then the most promising were extended to 24 hours in order to measure the impact on rolling stock and crossings, in particular for the addition of peak reinforcement trains. The different scenarios were then assessed in detail in terms of rolling stock requirements, service quality (volume, distribution of stops) and robustness.



**Ministry of Transport (DGITM):
Study of scenarios for developing
the overall service on the Toulouse–
Tarbes–Pau–Bayonne–Hendaye
route**

The French Ministry of Transport's Directorate-General for Infrastructure, Transport and Mobility (DGITM) called on SMA to study scenarios for developing the overall service on the Toulouse–Bayonne–Hendaye line. The aim of the study was to analyse the potential for optimisation that could arise from pooling resources and services between the regional services of the Nouvelle-Aquitaine and Occitanie regions and those of the regional balance trains contracted by the French government, which are currently combined on the various sections of this inter-regional route. SMA has drawn up several scenarios

based on this pooling of resources, offering more frequent end-to-end services in line with the travel needs of the various catchment areas crossed by this line, which have been shared between the three organising authorities concerned and then improved.

The most promising scenarios were refined in the form of a 24-hour timetable, making it possible to validate their consistency with the different travel needs on the route, and to assess the associated operating costs by establishing rolling stock schedules. The various scenarios were compared with the line's current situation. Finally, a simplified traffic and demand model was used to assess the traffic and revenue gains generated by the improved service, in order to determine the net cost to the organising authorities.



**Syndicat Nouvelle Aquitaine
Mobilités (NAM): Drawing up a
multimodal transport plan**

The Nouvelle Aquitaine Mobilités syndicate brings together all the mobility organising authorities in the Nouvelle Aquitaine region. It has commissioned SMA to help it draw up a multimodal plan for the whole region, with the aim of improving the complementarity of the various public transport services: regional rail services, inter-urban road services and urban services. The first phase involved an analysis of current services and a series of regional workshops bringing together representatives from different parts of the region to identify the main issues and needs.

SMA then drew up proposals for the development of all the services in order to improve their coordination around transfer hubs while maximising the productivity of the resources deployed. The proposed changes to the structure of the lines were accompanied by development proposals to create continuous coordinated travel chains throughout the day between the main regional centres, based on a basic service with a two-hourly interval and meeting the needs identified during the workshops.

The proposed changes were then the subject of a detailed assessment, making it possible to estimate the changes in resources mobilised and operating costs, with a view to maximising the use of resources and creating an offer at the lowest cost. These data were combined with the results of traffic modelling to estimate the net cost for the organising authorities, and in particular for the Nouvelle Aquitaine Region.



SNCF Réseau: Development of TER services in the Savoie Metropolitan Area – Study of the operation and feasibility of rail stops

SNCF Réseau has commissioned SMA to study scenarios for developing TER services in the Savoie Metropolitan area around the Chambéry rail hub. These scenarios include the opening of 4 new stations serving major employment areas, and define developments to the rail infrastructure in order to increase train frequency. These developments will improve services to the region, attract new rail users and relieve congestion on the road network around Chambéry. The study covers 3 time horizons: in the short term, with the simple opening of stops; in the medium term, with the development of a TER service compatible with the opening of the Lyon-Turin base

tunnel (increased freight traffic); and in the long term, with the development of a TER service compatible with the opening of new access routes to the Lyon–Turin base tunnel on the French side.

Several scenarios for a systematic 2-hour timetable and a 24-hour timetable for a basic working day have been produced in Viriato in order to meet the needs of the Region and its territories, with a focus on station operations (particularly at Chambéry) and attention to interfaces with surrounding development projects (Lyon node, Grenoble node, Aix Annecy and Alpine Access) and interfaces with border networks (Switzerland and Italy).



LISEA: Study of the operation of a maintenance and storage site

LISEA is the concession holder for the Sud Europe Atlantique high-speed line between Tours and Bordeaux. In order to support the arrival of new operators on its line, Lisea has launched a project for a rolling stock maintenance and storage site (SMR) located south of Bordeaux at Marcheprime. LISEA has asked SMA to assess the suitability of the planned facilities in relation to the needs of several railway companies, and in particular in the context of carrying out maintenance operations on the site for new rolling stock used on certain regional lines.

SMA therefore modelled the services of the corresponding operators in order to determine the times when the various

trainsets would be on site according to a pre-defined maintenance plan, in line with commercial requirements. This analysis also took into account the capacity constraints of the line on which the site will be sidelined. Next, a detailed model of the operations carried out, their sequence and the resulting occupancy of the various components of the site (maintenance, washing, storage, etc.) was drawn up, making it possible to measure the site's capacity to accommodate all the necessary equipment and carry out all the necessary tasks. The model was used to highlight bottlenecks within the site in terms of the residual latitude to adapt the operating plan thus established. In this way, it was possible to validate the overall design of the site before embarking on the detailed engineering and construction phases.



SNCF Réseau, 24-hour national freight timetable models

The Services and Infrastructures system, steered by the State, enables SNCF Réseau to plan capacity and adapt infrastructure consistently over the medium and long term. Within this framework, the reference and emerging 5- and 10-year operating plans are essential tools.

SMA is assisting SNCF Réseau in drawing up the 24-hour national freight models based on these operating plans. The objectives are to link the structuring of capacity in 2-hour timeframes and the target national freight transport plan over 24 hours, to work on the hourly systemisation of freight train paths, and to identify capacity issues for the

targeted timeframes. SMA is also involved in finalising the production process for these 24-hour models.

A simplified modelling method for national freight traffic has been developed. For the reference operating plan, the paths of the target transport plan have been modelled using a 24-hour variation of the paths of the 2-hour grid, taking into account the capacity planned for the works. For the emerging operating plan, this modelling of the target transport plan's train paths over 24 hours will be used to size the 2-hour grid.

The work carried out in 2023 was prototypical in nature, and helped to clarify the method and the issues for the next generation of operating plans. Iteration between capacity modelling at national level and regional modelling using the 24-hour national freight model has made it possible to resolve some of the capacity issues identified, in particular mismatches between territorial timetables and the target transport plan seen at national level. Any residual capacity issues have been shared with SNCF Réseau.

NETHERLANDS



Eurostar: Assessment of Amsterdam PHS construction phases

The central station of Amsterdam is undergoing an in-depth renovation which involves complex simultaneous works in and around the station until 2029. This will eventually allow the current Eurostar terminal to be moved to another location underneath the existing tracks. However, the construction phases will involve a closure of the Eurostar terminal for several months between the summers of 2024 and 2025, making it impossible for Eurostar to offer direct services between Amsterdam and London. No solution to this has been found, despite discussions between the stakeholders out for more than a year.

Given this difficult situation, it has been agreed by the stakeholders (Eurostar, the Dutch Ministry and ProRail) that SMA – in collaboration with a partner – will challenge the outcome of the discussions and to evaluate if any potential solution was missed which could shorten or even avoid the full closure of the Eurostar terminal.

SMA organised several interviews and workshops with the stakeholders to understand the constraints and to identify possible alternatives. The last-minute nature of the study didn't allow the overall phasing of the upgrade works to be challenged, but it was able to clarify the opportunities and identify the risks related to changes of specific work phases.

A systematic evaluation of different variants has identified possible modifications of the planned works phases that should be able to strongly reduce the operational gap of Eurostar. However, some of these changes to the plan increase the risk of delay of the renovation works of the station, which lead to the decision to integrate only a part of SMA's proposal in the final solution.



ProRail: Oude Lijn The “CitySprinter Oude Lijn” project aims to eventually develop a high-frequency train service between The Hague and Dordrecht via Rotterdam. The rail line will then act as the “backbone” of the regional public transport system. The envisaged frequency of 12 or even 16 trains per hour and direction, and the opening of new stations is likely to require large-scale infrastructure upgrades to keep the CitySprinter section as independent as possible from the rest of the rail network.

ProRail has asked SMA to examine its work to ensure that no ideas were missed during their assessment. In particular, the question was whether other operating models are possible and if a first step without major infrastructure works would be already possible in earlier stages of the project.

SMA’s challenge of ProRail’s work provided several new insights. For instance, possible alternatives were given in addition to the proposed operating models. Some alternatives are at the limits of the study’s principles and constraints. This raises the question in how far these requirements are appropriate and whether they could be adapted to offer higher frequencies or open stations sooner, while also considering other projects that may create opportunities or other choices that need to be made.

Communication



Communication

SOCIAL AND ECOLOGICAL RESPONSIBILITY

Social and ecological responsibility has always been firmly anchored in SMA's values. Today, ecological, social and ethical behaviour – in other words, sustainability – is a key factor for the future viability of a company.

For this reason, we set ourselves a new challenge in 2023 and had our sustainability performance assessed by EcoVadis. SMA was awarded a bronze medal by EcoVadis (result: 75th percentile).



PUBLICATIONS AND LECTURES

ZEV Rail November/December 2023	Dimensioning of maintenance facilities from the timetable Michael Elsner (ÖBB Passenger Transport), Lukas Regli (SMA)
Hamburg-Harburg University of Technology Germany January 2023	Deutschlandtakt, Vorgehen und Ergebnisse Marten Maier
Dresden University of Technology Germany February 2023	Deutschlandtakt – Railway planning developments in Germany Frederik Ropelius
École des Ponts ParisTech Paris, France February to May 2023	Cours TRFER - Lecture Railway Systems Pascal Joris, Henri Saisset
Séminaire intégration des transports publics Brussels, Belgium May 2023	Le système intégré des transports publics en Suisse Luigi Stähli
Swissrail Mobility Day Baden, Switzerland May 2023	Robustness in railway system planning Luigi Stähli
Webinaire du Conseil central de l'économie Brussels, Belgium December 2023	Le système intégré des transports publics en Suisse Luigi Stähli

Key figures



Key figures

2023 continues the trend of the last decade, in which we have seen stable and robust growth in both our consulting and software services, despite an increasingly strong Swiss Franc against other currencies. This is why this year we are also showing the development of our sales priced in Euros for the first time.

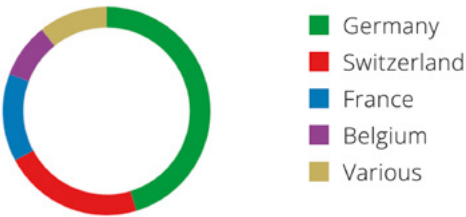
The 2023 results confirm this trend in our traditional markets and are proof of the quality of our services and the sustainability of our customer relationships.

Key figures*

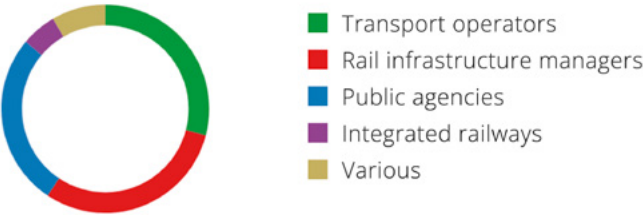
	2023	2022
Gross turnover (CHF million)	14.6	14.2
Employees (full time equivalent)	75	75

*incl. Subsidiaries

TUNOVER BY COUNTRY

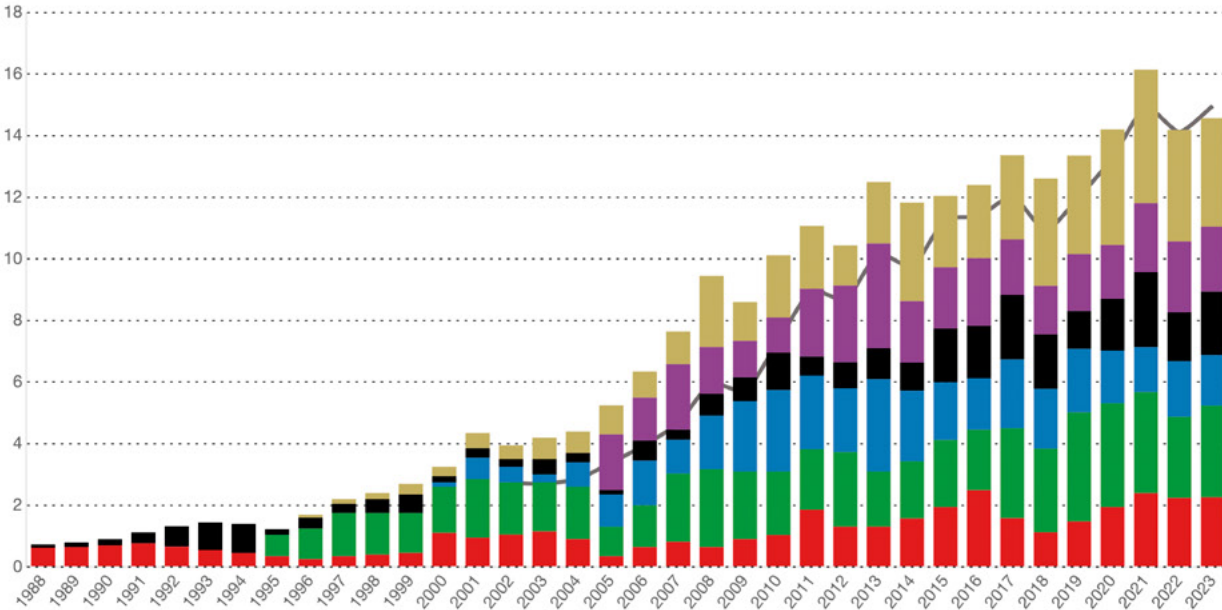


TURNOVER BY CLIENT CATEGORY



DEVELOPMENT OF TURNOVER 1988-2023 (CHF MILLION)

- Consulting**
 - Switzerland
 - Germany
 - France
 - Various
- Software**
 - Software Services
 - Viriato and ZLR
- Conversion**
 - Sum EUR



Imprint

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