ANNUAL REPORT

sma optimising railways

2020

The climate change debate has now become an integral part of public life. The photographs in this year's annual report shows why switching to rail is worthwhile for people and nature. We are proud that every day our work contributes in a small way to the protection of the environment.

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Editorial

A few years ago, some external stakeholders asked: What is SMA's USP, our unique selling proposition? Our answer is that *SMA's real USP is the ability to combine two different types of expertise under one roof: consulting and software.* However, it is not about combining consulting and software in a generic way, but how we create a unique area of expertise in a niche that combines synergies between these two forms of know-how. The interplay between these two "professions" and "cultures" complement and challenge each other, constantly driving innovation and favouring it over the routine.

Innovation requires imagination and ingenuity every day. However, innovation is not easy. It is not just about being creative, but also through action putting those ideas into reality and bringing to market new services and products.

Two years ago, in an introductory article to our annual report, we wrote that understanding the railway system means understanding its totality, interactions, organisation and complexity. This understanding is the prerequisite for further steps. Managing complexity, i.e. reducing the inherent complexity of the system, is our mission. "First reduce complexity, then digitalise...". This principle could be the mantra of SMA as an integrated company, as it neatly encapsulates the fundamentals of our business model.

We are pleased to be able to present to you once again the various activities and projects that have been part of our work over the last year.

We hope you enjoy reading our 2020 Annual Report.

Eric Cosandey
CEO, Head of Consulting

Thomas Bickel
Head of Software

The timetable itself

From the offer concept to the operating programme Some time ago, the statement of one of the most experienced expert on timetables and operations in Europe was at first astonishing and then very enlightening: “I can also operate a railway without a timetable”, he said and added: “but then I would lose a lot of capacity”.

The process of timetable construction usually extends over a very long period of time, but ultimately it always aims at delivering a feasible operating programme. On the face of it, however, it is not always easy to distinguish an operating programme from a network development concept.

In both cases, one considers a sequence of operating locations with associated arrival, departure and stopping times. The external similarity of timetables makes it advisable to categorise them not just according to their form, but according to alternative characteristics such as function, variability or available information.

At an early stage of planning, perhaps ten to twenty years before operation, basic parameters such as demand, available infrastructure or future routing may not be known, or if known are still subject to change. Accordingly, the function of the timetable at this stage is largely communicative and serves the system planning of the railway. It is primarily the basis for coordinating the interests of the various stakeholders from politics and society. At this point, the range of possible variants is correspondingly large.

If the desired mobility offer of the future has been determined, the timetable then serves to help dimension the infrastructure. At this point, optimal upgrades are identified and planned with regard to the desired offer. Financing must be secured and legal approval procedures initiated. The timetable also becomes more important for communication with the public, from which ultimately the customers for mobility are drawn.

Later, when the available infrastructure is known, the timetable serves to help optimise the usage of capacity. High frequencies and short travel times between departure and arrival destinations are realised by exploiting network effects with the lowest possible personnel and rolling stock resources. By this point in time, other users of capacity, especially for construction and maintenance work, must already be included, although there may not be sufficient information available for the detailed logistical planning needed.

By this point at the latest, the focus is increasingly on verifying the operability of the network. The public now also expects information on the service aspects of the plan, which are communicated via the timetable.

On the way to the operating programme, the timetable now serves as an increasingly specific framework. For the railway undertakings (RUs), it enables the subsequent implementation of an efficient use of resources, which is characterised by optimised rolling stock and staff plans. For the railway infrastructure managers (IMs), it also serves as an interface for essential studies into robustness and for the design and planning of further users of capacity, in particular construction and maintenance work. The closer the time of operation is, the more accurate the available information on infrastructure and capacity utilisation is. In addition, the range of potential variants is continuously being reduced and finally leads to the daily timetable or the operating programme.

The thing with automation Based on this idealised process sketch, it becomes clear that the timetable fulfils very different functions in the course of processes over a long timeframe, and has to deal with considerable information gaps and uncertainties depending on the progress towards the operating programme. In recent years, significant efforts have been made to automate individual work steps, or even the entire process, in both scheduling and timetable design.

Measured against the industry's ambitions, the successes are currently rather modest. Repeatedly, programmes have been set up with the aim of "automating everything". Considering the multiple functions that the timetable has to fulfil in its lifecycle, such programmes seem not only overly ambitious, but also insufficiently focused in terms of their scope. This may make it difficult to assess progress towards their goals and the results in terms of cost-benefit analysis.

An undesirable side effect of such programmes is that due to their universal solution character, they tend to neglect some necessary steps that would improve the current process support. When it is realised that the programmes eventually do not bring the hoped-for success, a lot of time has usually passed during which more substantial successes could have been achieved with a smaller investment of resources.

If you follow the broader public debate on automation, it becomes clear how difficult it is for non-experts to distinguish what is currently possible from what is not yet achievable. Right now, for example, the promises about self-driving cars are being revised and postponed to the distant future. The structure of the specific function to be automated may differ significantly from case to case, and while some goals are achievable today, others may only have a solution in the more remote future.

In this process, major hurdles often arise in completely unexpected places. For example, it has turned out several times that information that an algorithm absolutely needs for an automation step is not available at a sufficient level of quality or maybe not at all. In this case, a human being can often close this gap with their existing knowledge from within the organisation, but an algorithm cannot.

The early timetable construction process, for example, which is characterised by a wide range of variants and incomplete information, and which primarily serves to coordinate the interests of various stakeholder groups, currently appears to be closed to automation for a very long time to come.

However, even process steps that are closer to the operating programme, where it is essentially only a matter of the automated resolution of operational conflicts, have so far eluded a solution for reasons of the required computing time, depending on the size of the network under consideration. Finally, as has been known for some time, this problem in general is almost certainly not solvable in polynomial time.

To date, only in operations has promising progress been made in automated conflict resolution. This is mainly due to the fact that in operations the conflicts usually only have to be considered over a smaller area, and therefore a localisation of the general problem is realisable. In the network-wide timetable construction process, such an approach is not likely to be possible in the foreseeable future.

The alternative: a continuous process In addition to the general reasons that push for automation in the timetable construction process, this process has a peculiarity that makes the pressure for a relief of resources through the use of algorithms particularly strong. In the typical implementation of the timetable construction process today, the demand for resources increases almost exponentially with decreasing time to the date of operation. This leads to the problem that at the end of the planning process there is a growing need for planning resources, for example due to an increase in the number of engineering works to be considered, that can barely be supplied.

There is a need from society and politics to shift more and more traffic to the railways, since the railway is the mobility carrier with the best CO_2 balance. What can be done if today's efforts to increase automation continue to bear insufficient fruit? Smoothing out the resource requirements, i.e. spreading the planning work over a longer period of time, together with a steady improvement of the results already achieved in order to avoid waste, can be an implementable alternative.

Although there have been repeated attempts in the recent past to implement digital systems to support an end-to-end timetable construction process, this endeavour has not really succeeded to date. Two main problems have effectively doomed these efforts to failure so far:

The first is of a regulatory nature. If the RUs have the right to apply for train paths in the capacity allocation process without regard to overall capacity optimisation, the planning of the infrastructure managers in the run-up to this process step plays only a minor role. This right, due to the idea of increasing competition for transport services on the railways, is contrary to today's need for an increase in transport on the railways. Here a rethink is needed at the regulatory level in order to defuse this conflict of objectives.

The second problem is of a technical nature. Due to the function, variability and information available along the timetable construction process, the granularity of the infrastructure model is a variable that needs to be adjusted. Initially this is in order to avoid excessive waste of resources in the early stages of the process, and then in the later stages to construct a timetable in which the stakeholders have sufficient confidence in terms of feasibility and stability.

In order to have an alternative to automation in the short and medium term, more efforts should be made now to find a solution to these two problems.

The solution to the regulatory problem could be the restriction to system or catalogue train paths that form a pool of pre-constructed paths. Efforts are already being made at the legislative level in this direction.

The technical problem could be solved by very early in the process carrying out the microscopic check of the feasibility, which is of paramount importance as an acceptance criterion of the timetable. This would make it possible to ensure at the level of the timetable study that the timetable created in this way will be feasible, and can thus serve as a draft for more refined later timetables.

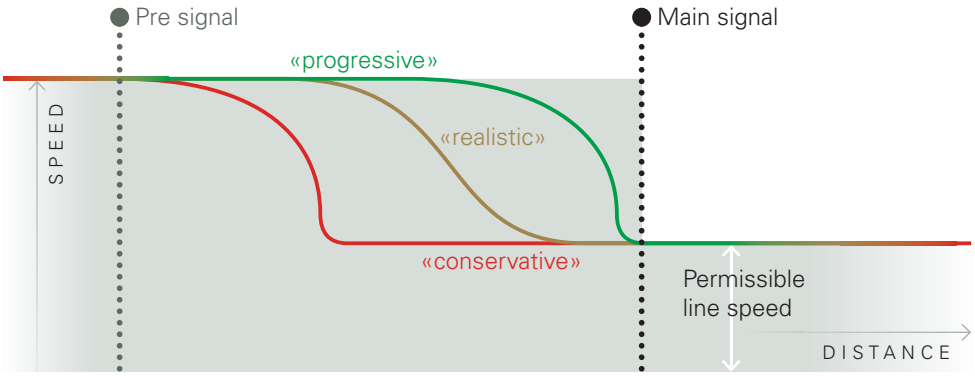
However, an early feasibility check, usually made years before the timetable is delivered as the operational programme, is non-trivial from a technical point of view and often not feasible in a system modelled on purely microscopic infrastructure details. However, a system that is modelled macroscopically and allows for localisation of the microscopic check of feasability could avoid this practical problem and thus support the realisation of a continuous process.

An alternative technical solution could be to replace the microscopic check of feasibility, which only represents one of several criteria for the acceptance of the timetable, with other criteria that include network-wide robustness indicators thanks to mesoscopic approaches. There are already practical trials underway that can be considered proofs of concept.

Okay, so it is - probably - possible to run the railway without a timetable. Due to the urgency of shifting traffic to rail, the limited capacity available and the high costs as well as the long period of time it takes to expand capacity, it is necessary to find ways to make the best use of the available capacity. As long as this cannot be achieved automatically within a very short time, other less spectacular ways to achieve this goal must be sought.

sma.software: a selection of projects from 2020

Addition of a "realistic driving mode" to the train running time calculation (ZLR) For the last five years, it has been possible to choose between a "progressive" and a "conservative" driving mode when calculating the running time using the ZLR running time calculator. In the "progressive" mode, the target is to drive at the maximum permissible speed, to accelerate at the earliest possible moment with the maximum tractive force and to decelerate at the latest possible time using the maximum braking force. This behaviour obtains the minimum required driving time.



The "conservative" driving style differs in the braking behaviour. When a lower speed is indicated (from the next signal), the train immediately brakes to this target speed. When a stop is displayed, the speed is reduced to a pre-determined speed (e.g. 40 km/h) at which the main signal is approached. With these two extreme values, the range of real driving behaviours can be determined.

Thanks to an SBB initiative, it is now also possible to select a "realistic" driving style. As a basis for this newly developed driving style, SBB has taken measurements of real braking curves achieved in practice. By analysing these curves, SBB was able to identify the following two relevant parameters: Reaching the target speed x seconds before the required location and reduction of the deceleration value to y ms^{-2}. With these two parameters, which can now be configured in the ZLR, the actual driving behaviour can be modelled more precisely and a comparison with the two extreme values of the "progressive" and "conservative" driving modes made in order to better assess the relevance of these extreme values.

SNCB: Importing macroscopic infrastructure into Viriato SNCB uses Viriato for the construction of its annual timetable and for further studies. In order to ensure the alignment of the infrastructure elements in its Viriato databases with the data made available by Infrabel, SNCB has requested the implementation of an automatic import of this data. Through a similar implementation in its other tools, SNCB also intends to guarantee the consistency of infrastructure data between its systems.

The import into Viriato is based on an extension of the standard railML 3.1 format. Thanks to the Viriato Enterprise data model, this import can be used to create a new infrastructure basis for a study or new time period, and to take into account the evolution of the network throughout the time period considered. In addition, the import of a new infrastructure and its use by existing trains in a database are decoupled, which allows a check of the imported data before activation.

The automatic alignment of the infrastructure has enabled SNCB to facilitate the calculation of costs and charges associated with a timetable, and thus to compare timetable variants more precisely. It also paved the way for a bulk import of timetables and capacity restrictions due to engineering works published by the infrastructure manager.

SNCB: Import of long-term capacity restrictions On parts of the network with heavy traffic, maintenance work has a major impact on the transportation offer. To manage these consequences better, SNCB would like to work with the Infrastructure Manager (IM) to find solutions before ordering train paths for the annual timetable.

As SNCB orders the paths for the annual timetable using Viriato, it has asked SMA to integrate the capacity restrictions linked to engineering works in order to be able to gauge the impact of these, and to look for appropriate solutions to propose to the IM. This integration is based on two principles: The Viriato Works Planning module for managing capacity restrictions, and an automatic import of the track closures published by the IM. This automatic import is necessary because of the large number of capacity restrictions that exist throughout a given timetable period.

The superimposed visualisation of capacity restrictions and planned trains facilitates the detection and analysis of conflicts between these elements. Following this analysis, Viriato's timetable planning functions allow easy modification of the timetable. In particular, the bulk modification of trains, the transfer of timetables from one day to another and the calculation of new running times support the search for solutions.

By proactively anticipating the impact of works on its transport offer through a process of collaborative solutions with the IM, SNCB not only wants better control its planning of rolling stock and the services of rolling stock staff, but also to communicate stable timetables to its customers and thus improve their satisfaction.

VIRIATO LICENCES

Microscopy On Demand (MOD) at DB Netz Since autumn 2020, the Timetable Concept Consulting and Market Launch Management department of DB Netz AG has been using Microscopy on Demand (MoD) productively. This enables their employees during the early planning phases to carry out partial microscopic level analyses with reduced effort compared to previously. The integration of both micro- and macroscopic modelling worlds has increased their efficiency and planning quality. This is because the integration between

macroscopic long-term planning and microscopic short-term planning avoids awkward switches between separate systems for the user, and reduces or even eliminates the number of iterations passing through both the microscopic and macroscopic worlds. This frees up valuable time for the user that can be used for productive planning tasks.

MoD combines the strengths of microscopic and macroscopic modelling without having to accept the disadvantages of them. At the macroscopic level, the infrastructure can be modelled with little effort and a largely conflict-free timetable can be quickly created for a larger network. However, operational characteristics such as routes with large separation times or overlap conflicts in the stations cannot be easily detected at a macroscopic level and often require microscopic analysis.

SNCF-Réseau: Viriato Enterprise Licence Acquisition SNCF Réseau has upgraded the Viriato Standard licences used by its medium-term timetabling services to Viriato Enterprise.

This upgrade will simplify the management of their tools, improve the ease of data exchanges with the long-term timetable team already using Viriato Enterprise, and aligns with SNCF Réseau's strategy of developing multi-year operating plans providing a single timetable reference for medium and long-term offer and infrastructure development projects.

In addition, SNCF Réseau has acquired licences for the Works Planning module, making it possible to integrate the constraints from engineering works into the reference operating timetables, and thus have a complete basis for allocating future capacity.

DB Engineering & Consulting USA Inc. DB Engineering & Consulting USA Inc., part of the Deutsche Bahn Group, is a multifunctional consultancy based in California, providing a range of specialist management and engineering consultancy services in support of the rail industry in the United States. Amongst their clients are state and federal agencies, transportation authorities and operators where they deliver a wide range of services ensuring efficient operation of existing railroads and optimal development in new projects. Of particular note is that they are the designated "Early Train Operator" for the California High Speed Rail project, where they are responsible for ensuring that the proposed designs and operational plans will meet the goals of the project stakeholders from the start of service.

Since 2018 SMA has been proud to support DB Engineering & Consulting in their work through the supply of our Viriato timetabling software for use in their consultancy projects. DB Engineering & Consulting have taken established European planning principles, applied, and extended them in the North American context to produce locally focused results for their clients. "In 2020 we had to work at record speed to address our clients' immediate challenges, and to then inform management decisions during an extended period of high uncertainty. Viriato is an important part of our work and we increased the number of experts and licences in our team two-fold last year", says Ulrich Leister, DB Engineering & Consulting's Vice President and Head of U.S. Consulting.

In addition to being users of Viriato, DB Engineering & Consulting are also the Viriato sales agent for the North American market. This allows DB Engineering & Consulting not only deliver plans, but also use projects to empower agencies and railroads to develop in-house expertise and tools Their local presence allows DB Engineering & Consulting to provide first level support and training tailored to their user's needs, with SMA providing additional support and continuing to develop Viriato further based on the experience gained.

There are new challenges for everyone in this business model, and it has required flexibility to find solutions to the problems that can arise when operating in geographical markets with different needs. Examples of solutions needed have included SMA developing an export of GTFS timetable data from Viriato, which is particularly important in the USA for transit operators, and the development of the shared database model pioneered by DB Engineering & Consulting, which shows the way that stakeholders from multiple organisations can collaborate on a single source of planning data. Both of these solutions include concepts that will benefit users worldwide in the future.

SMA and DB Engineering & Consulting have had a good working relationship from the beginning. We understand that they have specialist skills and have developed strong client relationships in a market that is difficult for us to reach, and in return we work hard to be responsive to their needs, and the needs of their clients, always recognising that they have a choice of supplier. We look forwards to continuing to strengthen this partnership in the years ahead.

VIRIATO TRAINING

Number of external training courses	7 – German or French
Total number of training days	21
Number of participants	Approximately 75

Consulting: a selection of projects from 2020

Our business segments

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

Rail Freight Corridor North Sea–Mediterranean (RFC NSM): Proof of Concept – Capacity Visualisation As part of its role in coordinating infrastructure managers in the planning of international freight train paths (PaP) and temporary capacity restrictions (TCR), RFC NSM has commissioned SMA to demonstrate the feasibility of implementing tools and methods for visualising capacity, and their use at the level of international corridors. Using the example of the Antwerp (BE)–Bettembourg (LUX)–Saint-Louis/Basel (FR/CH) corridor section, this "proof of concept" (PoC) investigated the possibilities of combining timetable and works planning data from different countries into a common database.

In this combined Consulting and Software project, SMA developed automated functions to evaluate capacity consumption and the residual capacity of international timetables. Two algorithms have been used during this project with the Viriato Algorithm Platform: The first one determines capacity consumption by compressing the timetable and TCRs on each homogeneous section, junction and in stations. The second algorithm searches for available paths satisfying given constraints and performance goals in the input timetable and TCRs.

To the best of our knowledge, this algorithmic approach is novel and produces a broad variety of visualisations and KPIs that can facilitate harmonisation between IMs. The PoC with RFC NSM is ongoing in the first half of 2021 in a way to demonstrate its compatibility and alignment with The Timetable and Capacity Redesign process (TTR) launched by RailNetEurope (RNE).

BELGIUM

Infrabel: 2021 South-west works area, evaluation of the impact on the timetable
The results of the audit of the network state carried out during the Phoenix project show that considering financial constraints some minor lines will be difficult to maintain. In particular, in the South-West area, which concentrates the majority of access points to the French network, the border point via the Mons–Quévy section of line 96 is little used, but has the potential to be attractive as an alternative route for goods traffic in the event of engineering works.

In this context, SMA carried out a diagnosis of the impact of works on capacity and proposed timetable modifications to make the freight paths compatible with them. This made it possible to assess the usefulness of the Quévy border point as a diversionary route, and to identify the characteristics of the network that would guarantee capacity resilience.

Over a pre-defined study period, the number of paths impacted by each restriction within the study area was determined and the timetable modified for the works. This exercise was performed for cases both with and without the use of the route via the Quévy border point.

The coordination of the works appears to be a major issue. An inventory of infrastructure items needed to ensure capacity resilience was made, whether they are additional, to be improved or to be retained as-is. The level of risk linked to the non-use of the Quévy border point has been assessed based on the criteria of journey times, the number of freight trains to be diverted, and the ability of the other routes to absorb this traffic during a constrained work situation.

SWITZERLAND

Compagnie Générale de Navigation (CGN): Designing New Timetables CGN provides public transport and tourist services on Lake Geneva. Faced with the current saturation of public transport, CGN has invested in new boats with a higher speed, known as Naviexpress, which should enable it to rethink the regular international offer across the lake. In order to ensure this major evolution, CGN asked SMA to assist it in assessing and enhancing its project for a new offer on both public transport and tourist lines, all in coordination with the feeder services.

Following the modelling in Viriato of the entire lake, rail and road public transport network of the study area, SMA proposed new concepts covering different time horizons in order to guarantee the integration of the CGN network into the overall public transport network with improved clarity and optimised operations. These concepts were then iteratively compared and combined with the concepts developed by CGN to arrive at an integrated medium-term scheme including both types of service and proposing a realistic implementation schedule.

SVI/BAV: Increased frequencies of rail services in Switzerland taking into account the node principle Long-distance rail transport in Switzerland is characterised by the hub system, which permits short connections and thus network-wide hourly or half-hourly journey possibilities offer ideal travel times through coordinated timetable times in the node stations. In the context of potential future further increases in the frequency of long-distance traffic to 15-minute intervals or less, SMA has investigated the effects of a partial or complete elimination of the integrated hubs on network-wide travel times and the capacity utilisation of the infrastructure.

The methods applied included an overview of the fundamental principles, analysis of case studies, a theoretical model evaluation, the planning and impact assessment of application cases and a concluding synthesis.

In the case of a future densification of long-distance traffic to 15-minute intervals, the continued development of the node system with distinct connection nodes continues to be an appropriate path. However, the removal of fully integrated hubs for express traffic or the introduction of "conveyor-belt" connections intervals in larger hubs is worth considering. The quality of service across all connections in the network is at least equivalent to a fully integrated node, and although through connections in the node benefit from shorter dwell times, some individual journeys with a transfer will suffer from increased waiting times. Consequently, through trains with the highest demand should have the shortest possible dwell times, and connections with high demand should be planned with a minimal connectional duration. Potentially reduced infrastructure requirements arise in the node, primarily due to the shorter dwell times, and on the wider network due to the greater degree of freedom in the planning of train paths. The increase in the planning freedom through the "unbundling" of the train paths creates the potential to give higher priority to operational stability and quality, but special attention has to be paid to the quality of the freight paths.

Transports publics de la région lausannoise (TL): Robustness analysis and strategic planning of the Lausanne–Echallens–Bercher line (LEB) The LEB line underwent a major change with the timetable change in December 2020 with the introduction of the extension of the 15-minute interval from Cheseaux to Echallens. This new timetable was the subject of a study by SMA for TL/LEB undertaken between 2019 and 2020. The study concerned a verification of the robustness of the 2020 timetable planned for the LEB line. The approach included three stages: an analysis of the timetable project, research into optimisation options and an evaluation of the robustness of the selected options. Because of the critical points highlighted by the analysis, operating solutions were proposed, including those relating to the stopping policy. These solutions were evaluated in terms of their robustness that made it possible to formulate recommendations for modifying the timetable eventually put into operation.

In order to prepare for subsequent developments, a strategic study was carried out with a particular focus on the key horizon of the 2035 Development Stage of the national PRODES project. Within the framework of the strategic planning process, the analyses focused on two aspects in parallel: a study of demand for the 2035-40 horizon and an analysis of operations and capacity for the implementation of a higher frequency between Lausanne and Echallens on the same horizon. The analyses showed the relevance of the targeted development by confirming the expected ridership figures. Several operation-infrastructure-rolling stock concepts have been developed for the 2035 and 2050 horizons, their relationship with the current situation was studied in order to obtain a coherent vision of the actions to be implemented in the different horizons.

Transports de Martigny et Régions SA: Assistance with bus tenders In 2020 the Canton of Valais, in collaboration with the Federal Office of Transport (BAV), has put out to tender the concessions for all the bus services in the Entremont region, near Martigny. The operating concession for these buses, split between PostBus and TMR, will run for a period of 10 years from December 2021.

TMR commissioned SMA to assist them in responding to the tender, with the work carried out in two stages. The initial preparatory phase, prior to the call for tenders, had the objective of carrying out an analysis of the current situation and the competitive context, while gathering the basic elements necessary for the subsequent optimisation of the production elements. After the publication of the call for tenders, during a second intensive phase SMA assisted with the preparation of the response, the execution of operational studies, formulation of optimisation proposals for the running of the vehicles, dimensioning of the necessary personnel requirements as well as the analysis of the feasibility and robustness of the timetable.

The Canton of Valais and the BAV decided in autumn 2020 to award the concession to TMR.

Central Switzerland Public Transport Conference (ZKöV): Updating the demand data for the 2040 expansion stage The ZKöV is currently developing a coordinated offer concept for the planning region of Central Switzerland for the 2040 STEP expansion stage. SMA has calculated the future demand in a first work package. In a second step, this will form the basis for defining the supply.

The known developments of population and employment, the current public transport demand figures and the future offer concept are all taken into account. In order to model the offer, the known offer of the 2035 expansion step was compared with the present one. The cell model built for this purpose includes all stations in central Switzerland and the most important ones in the neighbouring regions. A total of 67,000 origin-destination relationships were analysed in detail with regard to their service quality. The structural growth was examined for all cells in detail. Both higher-level prognoses and cantonal development priorities were taken into account.

The resulting potentials were apportioned to the trains using the Viriato demand assignment module, and differentiated by long-distance and regional transport product classes. For the final step of checking the capacities, the critical sections for the dimensioning were defined. The peak hour loads for these sections were then evaluated and compared with the peak hour capacities in the 2035 STEP expansion step. Both the dimensioning rules of the Federal Office of Transport and an alternative approach based on a lower standing-room density were applied.

Based on the results, the proposal for the 2040 service for Central Switzerland is currently being developed by SMA and will be submitted to the Federal Office of Transport for the design of the 2040 service.

GERMANY

Verkehrsgesellschaft Mecklenburg-Vorpommern mbH: Expansion options for the Usedom railway network The transport services ordered by the state of Mecklenburg-Vorpommern on the infrastructure of Usedomer Bäderbahn GmbH (UBB) are the backbone of public transport on the island of Usedom. Due to the specific features of the island and the massive increase in traffic volume during the holiday season in recent years, both private motorised transport and local rail passenger transport are reaching the limits of their capacities. Applying the current constraints, public transport is not able to meet the demand or to absorb any increase, especially during the peak season.

On behalf of the VMV, an assessment of the current situation and the planned measures, as well as an estimation of the potential demand for the years 2030 and 2040, were carried out for the island of Usedom. This assessment formed the basis for the development of short- and medium-term actions such as increased service frequencies or additional trains. The potentials assessment served as the basis for the creation of a long-term vision in order to design a demand-oriented offer and to derive the infrastructure required for it.

Zweckverband SPNV Rheinland-Pfalz Süd/Région Grand Est: Support to tendering procedures for cross-border transport The federal states of Rhineland-Palatinate, Saarland, Baden-Württemberg, the special-purpose associations for local rail passenger transport in Rhineland-Palatinate South and North as well as the Région Grand Est intend to put cross-border local transport services with multiple unit vehicles out to tender. SMA is supporting this tendering procedure with regard to transport and operational aspects.

Service concepts were developed for the seven cross-border connections and integrated into the nodes in terms of timetables. Future developments in national transport were taken into account and connections were optimised. Due to upcoming infrastructure works, a preliminary stage and a target variant were developed for the cross-border network, which are designed to be upwardly compatible.

SMA then created 24-hour timetables for the different days of the week on the basis of regular interval services. These form the basis for the vehicle rostering, with the help of which the overall vehicle requirements were determined, which was then used to optimise the 24-hour timetables in terms of vehicle deployment.

The work will be continued in 2021.

Federal Ministry of Transport and Digital Infrastructure (BMVI): TransEuropExpress (TEE) 2.0 On behalf of the BMVI, SMA has developed the "TransEuropExpress (TEE) 2.0" concept as a supplement to the Deutschlandtakt. This allows the improved linking of existing international train connections and the increased use of existing high-speed lines by international trains. Based on national regular-interval services and connections, a cross-border European train service can be created with high-speed and night trains, operated by the companies themselves or within the framework of the respective country-specific long-distance transport models and integrated into the national timetable concepts.

Examples of these new international connections are:

- Paris–Brussels–Cologne–Berlin–Warsaw
- Amsterdam–Cologne–Basel–Milan–Rome
- Berlin–Frankfurt–Lyon–Barcelona
- Stockholm–Copenhagen–Hamburg–Brussels–Paris
- Paris–Stuttgart–Munich–Vienna–Budapest

The aim is to involve as many countries in Europe as possible. SMA is responsible for the service concept, and this will be discussed at the newly formed platform for international passenger transport with European partner ministries in the course of 2021, and will probably be expanded to include further lines.

Federal Ministry of Transport and Digital Infrastructure (BMVI): Presentation of the 3rd expert draft for the Deutschlandtakt Coinciding with the signing of the rail pact at the Federal Ministry of Transport and Digital Infrastructure (BMVI) on 30 June 2020, SMA has completed the 3rd and final expert draft for the Deutschlandtakt target timetable. The Deutschlandtakt focuses on the timetable and derives from it the necessary infrastructure actions to create more frequent and faster connections for passenger and freight transport nationwide.

This milestone was preceded by the evaluation of the 2nd expert draft and numerous consultations with the federal states, the Federal Ministry of Transport and Digital Infrastructure and other stakeholders. This was done in order to combine the requirements of all parties involved into a nationwide overall concept for passenger and freight transport and to bundle the interests of the industry in the best possible way in this draft.

The work was supported by detailed documentation, as well as the processing of numerous operational and infrastructural related topics and detailed optimisations. The expert's draft can be viewed on the internet and serves as a planning instrument for the future design and the best possible use of the railway network in Germany.

This 3rd draft and the infrastructure measures relevant to the demand plan deposited there will be evaluated as a whole in 2021 in accordance with the federal transport infrastructure planning rules.

Heilbronner • Hohenloher • Haller Nahverkehr GmbH (HNV): External evaluation of the fares and tariff cooperation between the HNV and the KreisVerkehr Schwäbisch Hall (KVSH) In the Heilbronn-Franken region, there are two large transport authorities, the HNV and the KVSH. They have already implemented several joint projects and tariff schemes. Now a more extensive cooperation is planned with a common interconnected area and a uniform tariff. This study included the development and analysis of different zone divisions (small, medium and large) for the entire area comprising the three districts of Heilbronn, Hohenlohekreis and Schwäbisch Hall as well as the city of Heilbronn.

The tariffs of the two authorities, which still differ in some respects, had to be harmonised and simplified. At the same time, further tariff options for strengthening public transport in the region were examined. The new price levels of the individual ticket types (single tickets, day tickets, season tickets) had to be defined in such a way that there would be no major distortions compared to both the previous tariffs of the two authorities and to the regional tariff.

Based on the change in prices for all selected routes, the demand induced by the fare reform and the effects on fare revenues could then be estimated. The basis for this was the ticket sales data of the two authorities.

In the preferred variant, a reduction in the number of zones by more than 90% creates attractive, simple and, for most passengers, lower fares for the integrated tariff area when compared to the current situation.

Nahverkehrsgesellschaft Baden-Württemberg mbH (NVBW) and Ministry of Transport Baden-Württemberg (VM): Revision of the Stuttgart 21 offer concept The focus of the work in 2020 was on the development of a commissioning timetable for the Stuttgart node with Stuttgart 21 and all feeder lines. The overall concept incorporated various findings from railway operational studies undertaken by DB Netz AG, as well as requirements from the existing transport contracts and rolling stock principles. Requirements for line connections, passenger demand, train category and certain route specifications had to be taken into account. The concept was worked out from Stuttgart to the next major node or end point of the "Metropolexpress" system (MEX). The overall concept not only takes into account the systematic trains, it also integrates the individual long-distance services as well as the peak-hour increases to the regional services. Special attention was given to the track occupancy of Stuttgart station, taking into account the necessary working times as well as the feeder and shunting runs. The work on the timetable concept has not yet been completed, and so the commissioning timetable is therefore not yet available.

Beyond the Stuttgart 21 commissioning timetable, further developments will take place in terms of both services and infrastructure. It was therefore necessary to develop upwardly compatible concepts for various feeder lines. In doing so, care was taken to ensure that it is possible to react flexibly to the sequence in which elements change, and still continue to implement the developed concept in principle.

However, the work not only concentrated on the areas and feeder lines directly affected by the commissioning. If necessary, the concepts or variants were also extended in the outer areas in order to ensure the upward compatibility of the various concepts with the long-term expansion concepts on the corridors outside the direct feeder lines, and to present further possibilities and boundary conditions for service extensions or service changes.

Bavarian State Ministry for Housing, Construction and Transport (StMB): Munich Region Rail Expansion Programme The "Munich Region Rail Expansion" programme contains the foundations for the future design of local rail passenger transport in the Munich Metropolitan Region. The programme currently comprises 28 actions that are already in the concrete planning or realisation stage, including the 2nd main line for the Munich S-Bahn as the centrepiece of the programme.

With regard to the detailed definition of the programme, a further 42 individual actions (as of the end of 2020) are to be assessed in the "Feasibility study for rail expansion in the Munich region" with regard to their traffic impact and their construction and operational feasibility. The individual actions can be classified as follows:

- Improvements in the core network as the basis for a phased expansion concept
- Multi-track extensions and other performance-enhancing measures
- New lines including new stops and stations
- New stops in the suburban and regional railway network
- Service-oriented improvements (e.g. the introduction of additional regional S-Bahn lines)
- Smaller measures (e.g. the extension of platforms)

The traffic impact based on service concepts in relation to infrastructure and operating costs shows which actions should be pursued further. With the recommendations for follow-up, the target concept for rail expansion in the Munich region is consistently extended. A phased implementation plan derived from this towards the target concept will be developed in a later stage.

Competence Centre Integral Timetable NRW (KC ITF NRW) and public authorities in North Rhine-Westphalia (NRW): Further development of the integrated interval timetable In 2020, SMA again supported the KC ITF NRW and the three public transport authorities in the further development of the integrated interval timetable of the state of NRW.

In 2020, the design of the 2040 target network was a focus of the state-wide service planning. These plans are based on the Deutschlandtakt and additionally expand the capacities offered. In addition to re-opening lines, selected corridors were analysed and planned with regard to possible optimisations, for example the Wupperkorridor or the corridors on the left bank of the Lower Rhine and in the Ruhr region. The infrastructure required for implementation was derived from the timetables.

The 2032 timetable has been specified, which represents a first step towards implementing the 2040 NRW target network. Emission-free vehicles play a special role in the future service concepts.

Another focus was the development of an S-Bahn network for East Westphalia-Lippe. The aim of this concept is to improve the links between the services on the routes and to expand the amount of train services.

For individual corridors, analyses were carried out to improve quality, and operational and infrastructural upgrades were derived to improve punctuality. In addition, timetable integration tests of potential new railway stations for individual routes were undertaken.

In addition to the state-wide work for the KC ITF NRW, numerous other topics were dealt with within the framework of individual studies for the respective authorities, for example:

- The tendering procedure for the Rhein-Sieg urban rail system
- Vehicle roster planning
- Studies on reopening lines
- Technical questions regarding ETCS in the Ruhr region

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

This work will be continued in the current year.

Munich metro: Development of long-term target concepts The passenger volume of the Munich underground has been steadily increasing for years. The Münchner Verkehrsgesellschaft mbH (MVG) has been planning the gradual conversion of the main lines of the U1/U2/U7, the U3/U6 and the U4/U5 to a service every 2 minutes for some time. Several years ago, SMA developed service concepts for this purpose, which provided for such an increase in frequency. MVG has commissioned SMA to update the service concepts of the U1/U2/U7 under changed input conditions, including:

- Extension of individual stopping times
- Extended minimum turning times
- Modification of the train deployment (i.e. partial consideration of overlapping turnarounds)
- Consideration of the connection at Scheidplatz and Innsbrucker Ring with the other underground lines

SMA developed several timetable variants for the full extension of the U1/U2. The preferred variant agreed with MVG was then simulated in OpenTrack with various operational incidents applied. An iterative approach was used for the simulations: In this process, a slow-speed section was extended gradually until the timetable becomes unstable.

SMA also investigated increasing the frequency on the U4/U5. Due to the long section from Ostbahnhof to Innsbrucker Ring, a 2-minute train sequence is not easily possible on this section. A frequency increase of the U5 analogous to the U3/U6 or the U1/U2 is therefore currently not feasible. Previously a solution with a 4-minute frequency on the U4 and U5 was studied. However, this proposal did not take into account sufficiently the different passenger demands of the two lines. SMA developed a new preferred variant that addresses this aspect with different frequencies of the U4 and U5 lines and the corresponding timetable adjustments at the interface between them. Subsequently, this variant was tested for feasibility using OpenTrack and multiple operational incidents simulated.

DB Netz AG: Support for the development of a long-term concept in the Weser-Ems network with pilot use of the "Microscopy on Demand" procedure The "Microscopy on Demand" concept developed by SMA was used for the first time in the preparation of the long-term service concept for the Oldenburg–Cloppenburg–Osnabrück and Bremen–Vechta–Osnabrück routes in Lower Saxony. Microscopic services such as journey time calculation or conflict detection can be called early in the process from Viriato in order to obtain a high level of information regarding feasibility during the conceptual development of service variants.

In the joint approach of the two lines to the Osnabrück node, separation and train sequence times could be determined according to the official systems of DB Netz AG and suitable offer concepts and infrastructure actions could be derived. In addition to the actual offer concept, a major objective of the study was the elaboration in the intermediate and target concepts of opportunities and risks regarding vehicles with alternative forms of motive power, such as hydrogen or battery propulsion.

With the help of this new procedure, a large number of variants could be tested and evaluated for the Weser-Ems network and finally a sustainable overall concept with several implementation stages found. The findings from the application of the new Viriato module "Microscopy on Demand" flow directly back into its further development.

Ministry of Transport Baden-Württemberg (VM): Baden-Württemberg Public Transport Strategy In terms of the contribution of the transport to climate protection and the achievement of the 1.5°C target, the state of Baden-Württemberg would like to double the demand for local public transport by 2030 (compared to 2010 as the reference year). To achieve this goal, a collaboration between all relevant stakeholders in local public transport is necessary. A broad-based dialogue process, which SMA is supporting in the first phase, has been launched for this reason. In this process, the 2030 Public Transport Strategy of the state of Baden-Württemberg will be developed for later implementation in focussed meetings where suitable measures will be discussed.

Together with the company civity Management Consultants, the first step was the development of actions that are organised into 10 fields of activities (including infrastructure, offer, operation and vehicles, public transport priority, tariffs and distribution). In addition to the expertise of the two companies, the assessment of other parties was also included in the development of the actions via expert interviews with best-practice companies and the specialist departments of the ministry.

Subsequently, all of the actions, sub-goals and activities were discussed and developed in six working sessions with the Public Transport Future Commission – an expert committee consisting of about 20 representatives of public transport authorities, municipalities and districts, transport companies, transport associations, passenger associations, trade unions and academia.

In this iterative process between the Public Transport Future Commission, the Ministry and the experts, 130 actions were developed for the 10 fields covering 30 sub-objectives, coordinated and recorded in a catalogue of objectives and actions. Supporting documents include the mission statement, which depicts the desired target state of public transport in 2030, and a compilation of the politically most important actions.

The final results of the Public Transport Future Commission were presented in January 2020 as part of a high-profile online event and examined in detail in a panel discussion with ministerial participation. The deliverables form a sound basis for further strategy development starting in spring 2021.

Zweckverband Ringzug (ZVR): Ringzug 2.0 Implementation planning The Ringzug, a successful public transport product in the Schwarzwald-Baar-Heuberg region, today connects the regional centre of Villingen-Schwenningen with the medium-sized centres of Rottweil, Tuttlingen and Donaueschingen. Due to the medium-term replacement of the diesel-powered multiple units and the desired improvements in the timetable, the ZVR was able to identify various options for the further development of the service and the vehicle strategy in a study carried out in 2017.

The aim of the new "Ringzug 2.0" study was to revise the 2017 results based on modified framework conditions and new requirements for improving the Freiburg-Stuttgart connection. The focus was on the development of new long-term concept variants as well as an upward-compatible medium-term preliminary stage in cooperation with the ZVR, the Ministry of Transport, the NVBW and DB Netz AG. Attention was paid to the robustness of the timetable and the delivery of stable connections, which should contribute significantly to increasing the attractiveness of the services in the region in the future. The work also included the consideration of possible infrastructure upgrades that contribute to punctual operation as well as the provision of the necessary capacities on the line and in the stations. In addition to the planning work, SMA was able to successfully mediate between the individual stakeholders at the political level and thus contribute to finding a joint solution and to selecting a target variant supported by all partners.

A detailed review of the concepts as well as the elaboration of a traffic and operational task definition as a basis for preliminary planning will be carried out by the infrastructure manager. SMA is representing the interests of the ZVR and supports it in the further steps on the way to implementing the concepts.

FRANCE

Région Nouvelle-Aquitaine: Study of the 2022 TER offer As part of the reworking of the national timetable for 2022 carried out by SNCF Réseau, linked to the search for more capacity in the Atlantic sector, several timetable structure scenarios were proposed by SNCF Réseau to the Region.

SMA assisted the Region in the analysis of these different scenarios, as well as in the evaluation of the financial impact of the proposed timetable changes, and worked on ways of optimising the use of the chosen timetable.

A comparative analysis of the proposed systematic timetables was carried out from the point of view of offer, robustness and operating costs. Following the selection of one of the options, SMA proposed several scenarios for daily variations of the regional offer. These scenarios were compared with each other and with the current service. Criteria of quality of service, operability, resource productivity, and total operating costs were used. These scenarios were then optimised from the point of view of productivity and revaluated, and the limits of this optimisation determined.

It was found that it was possible to optimise daily regional services so that the cost per train-kilometre could be reduced by increasing the productivity of human and material resources, in particular through the selection of timetables. This work was carried out at a high level of detail, in order to verify that the productivity gain could be obtained without degrading the quality of the rail service.

Région Occitanie: Ministry of Transport – Study of new day and night regional balance train lines The Mobility Orientation Law, approved by the French Parliament in December 2019, instructed the Ministry of Transport to present a report on the development of new day and night regional balance train (TET) lines, with a view to developing a rail offer capable of offering a mobility alternative to the private car and the plane. This law this concerns not only national but also international links.

Within a framework contract with the Ministry, SMA conducted a technical study for several identified connections based on an analysis of current demand for all modes and existing rail services. This study identified three new daytime lines and the extension of an existing line, as well as a network of complementary overnight services. An operating model was created for each of these lines to estimate the economic balance.

For the overnight lines, an international comparison made it possible to identify the main success factors for the reintroduction of services that have been largely abolished in France in recent decades. This analysis served as a basis for defining the main principles of marketing the service and for drawing up a coherent operating plan for a network, making it possible to identify the levers for controlling operating costs and maximising revenue. Eight groups of lines with several combinable carriage segments were proposed for domestic services, as well as new international lines to the main European cities on

this basis. At the same time, the study made it possible to establish the framework for the corresponding rolling stock requirements, the characteristics of which will be an essential factor for the success of such an offer.

Région Occitanie: Study of metropolitan service scenarios for the Toulouse hub
As part of a partnership approach with the local transport authorities, the Occitanie Region has initiated a study for the deployment of a metropolitan express network on various lines of the Toulouse rail hub. The aim of this study was to develop several scenarios and to compare them, before undertaking more detailed studies that will be carried out in partnership with the public rail operator.

SMA has studied seven alternative scenarios for the development of such a network, based on contrasting service assumptions, both in terms of structure and volume. These different scenarios were linked to the planned developments of the urban transport network, in particular a new metro line creating numerous connection points with the rail network. The studies focused on analysing the consistency with the development of national train paths resulting from other major projects planned elsewhere, identifying the main infrastructure upgrades capable of enabling the network to offer the necessary capacity for the establishment of such services, and finally evaluating the comparative investment and operating costs.

A number of features have been identified across the hub. Some of them were common to several scenarios, while others corresponded to specific characteristics of individual cases. This analysis made it possible to establish possible phasing of the various scenarios as well as potential combinations, some of which could constitute development phases for more ambitious scenarios.

Finally, all of this work was the subject of a detailed presentation to the stakeholders of the public rail operator to enable the knowledge accumulated to be shared with a view to its use by the partners in the rail sector and the continuation of the studies.

SNCF Réseau: Assistance for strategic planning of the Morocco High Speed Line
As part of the project management support awarded to SNCF by the ONCF for the Tangier–Casablanca–Marrakesh high-speed rail line, SMA helped SNCF Réseau to plan timetable and infrastructure variants.

For the Kenitra–Rabat–Casablanca–Nouaceur (Airport) corridor, an extension to the Tangier–Kenitra section that went into operation in November 2018, feasibility and preliminary design studies have identified two fundamentally different variants in terms of infrastructure topology and therefore of service and operation. This has led ONCF to consider which final scenario should be selected. SMA examined the problem from a strategic planning perspective, consolidated the project objectives, identified and evaluated variants of service concepts and associated infrastructure, and developed solutions based on a systematic structure.

The results of this work enabled an integrated concept for high-speed services with the local trains in the Casablanca conurbation, the identification of capacity issues related to these contrasting infrastructure scenarios, the identification of alternative infrastructure variants and the delivery of objective information to SNCF Réseau for evaluation and recommendations towards the selection of the final variant.

SNCF TER: Assistance in responding to the TER South Region call for tenders
As part of a project to assist SNCF Voyageurs, SMA assisted the TER Sud Provence-Alpes Côte d'Azur teams in preparing its response to the Southern Region for the lots put out to tender, i.e. the Marseille–Toulon–Nice axis and the Azur axes (Nice hub).

SMA reviewed the timetable specified by the Southern Region to guarantee its feasibility, to analyse the positioning of the allowances along the lines and possible relaxations, and to ensure compliance with the minimum headway requirements and general robustness. The number and quality of possible connections with the Region's road services in Marseille, Ventimiglia and major intermediate stations were studied. SMA proposed a series of possible actions to reduce the consequences of delays, including the establishment of standard contingency plans defining the actions to be taken according to the amount of delays and their location.

Finally, SMA developed several alternative scenarios to propose modifications to the offer in certain areas. These scenarios were evaluated in terms of the quality of the service, the rolling stock fleet, the capacity of the infrastructure and in terms of overall robustness.

SNCF Réseau: Development and evaluation of scenarios for metropolitan express services in Lille The aim of the study on the development of Metropolitan Express Services (MES) around the Lille rail hub is to transform Lille's rail transport system into a mass transit model that will significantly increase the attractiveness of rail transport and encourage a modal shift from road to rail.

As part of a multi-partner project led by SNCF Réseau and involving the State, the Hauts-de-France Region and the city of Lille, SMA developed and evaluated contrasting high-level scenarios to define the principles for structuring the service of Lille's inner and outer rings.

The study was based on an international benchmark describing the organisational principles and operation of metropolitan networks corresponding to the various functional scenarios envisaged to bring about the targeted change to rail services at the Lille hub.

The high-level scenarios developed all make it possible to meet future demand and to significantly increase rail services. They differ in the way that the service is structured around a new underground station or in how the routes bypass the heart of the city. The study was based on "extreme" scenarios that were then combined to produce development scenarios shared by the partners.

Each scenario was illustrated by a service diagram to visualise the options studied. They were then evaluated and compared based on a multi-criteria analysis integrating the quality of the proposed service, the saturation of the infrastructure on the line, at the junctions and in the stations, and the infrastructure investments required. Each scenario was collated in matrix form allowing a qualitative comparison of the options to be made.

SNCF Réseau: Study of the operation of the terminals of the Bordeaux Metropolitan Express Network The Bordeaux metropolitan express network (EMN) project is structured around three lines, two of which are planned to be diametrically opposed: Libourne–Arcachon and Saint-Mariens-Saint-Yzan–Langon. The main improvements identified during previous studies concern the four terminals of these two lines. It appeared necessary from these studies to refine the capacity analyses in order to specify the operating plans for these facilities, in particular the parking and maintenance areas for the rolling stock and their access conditions.

The objective of the study therefore was to determine and compare different designs for the terminals. The study also defined the access conditions of these areas and the consequences for the operability of the associated track plans. A 2-hour timetable was first established to determine the impact of this metropolitan service on the current timetable structure, and then the 24-hour timetable variations of the metropolitan routes, associated with their rolling stock rosters, were studied. The non-commercial movements of rolling stock were also modelled. The resulting parking and maintenance requirements at the various terminals, together with a detailed analysis of the existing infrastructure and its usage, enabled development of functional infrastructure diagrams for each of the sites.

The timetable structure of the metropolitan train paths proved to be very constrained, as they had to fit into a timetable with a high degree of traffic heterogeneity, coupled with timetable links to the Bordeaux hub imposed by single-track operations outside the study area. The results showed that it could not fully meet the initial service objectives, although two of the four sites have sufficient storage capacity, the Langon and Libourne sites are very constrained in terms of space and available infrastructure. All four sites will require varying degrees of modification of track layouts and signalling to accommodate these new services. For each of these sites, several infrastructure schemes have been proposed and analysed based on operability, robustness and technical feasibility.

SNCF Réseau: Addition of train paths on the right bank of the Rhône As part of the Phase 2 studies for the project to reopen passenger trains between Pont-St-Esprit, Avignon and Nîmes via the Right Bank of the Rhône line, SMA carried out an operating study for SNCF Réseau. The aim of this project was to verify the capacity of the network to accommodate the additional services without penalising the current service, particularly for freight, and proposing solutions for modifying the service or infrastructure should they prove necessary to operate the service.

SMA reconstructed the reference offer by importing the 24-hour timetable into Viriato and carried out a saturation analysis aimed at determining the volume of freight paths that could be found in the residual capacity. A series of robustness tests were carried out at critical points in the network during the busiest hours. Several target timetable variants were produced to determine the impact on surrounding traffic and the feasibility of inserting these additional trains, particularly at the Avignon and Nîmes stations.

The operational study identified a high degree of risk in the ability of Nîmes to accommodate new traffic originating or terminating there. Saturation and robustness analyses for the target timetable similar to those carried out for the reference were produced, using the functionality integrated into Viriato, in order to produce an objective comparison between the different scenarios.

SNCF Réseau: Planning of 2022 timetables for the South-East sector A possible third TGV train path per hour in the 2022 timetable between Paris and Lyon is needed to meet the demands of new entrants to the high-speed market. SMA assisted SNCF Réseau to search for this path through determining the possibilities offered by the structure of the 2021 service while minimising the impact of the TGV system on TER and freight traffic.

An analysis of the network usage was carried out to determine the possible scope for freeing up capacity on the Paris–Lyon LGV. Each identified time slot was analysed to study the feasibility of inserting a TGV train path from Paris to Lyon, investigating the consequences on the regional and freight systems in the Lyon area and in particular the track occupations in Lyon Part-Dieu.

Several scenarios were developed based on the available slots and these were assessed in terms of the impact on the high speed and regional timetables and the overall robustness of the system.

GREAT BRITAIN

Network Rail: Timetable Technical Strategy – European Benchmark on timetabling process Network Rail was interested in understanding how leading European railways plan, prepare, and deliver their railway timetables. The current process, led by the infrastructure manager (Network Rail), relies heavily on a "bid" and "offer" model where multiple operators submit applications, often conflicting, to access the railway. This requires significant effort from Network Rail to deconflict.

SMA has contributed to the Timetable Technical Strategy contracted to Steer by Network Rail, with a benchmark activity to show how leading European railways plan, prepare, and deliver their timetables.

Five countries were selected (Switzerland, France, Germany, Belgium and the Netherlands) and information collected about different topics, covering the general context of their timetable cycles, investment planning and delivery, service specifications, roles of different stakeholders, technology and foreseen developments.

The results has been integrated in the wider strategy to align and integrate technology to support timely production of world-class timetables as required by Network Rail.

LUXEMBOURG

Chemins de Fer Luxembourgeois (CFL) and SNCF Réseau: Creation of Metz–Luxembourg Timetables with ATO GoA2 Automation As part of an analysis of the advantages and possibilities of an ATO GoA2 (Automatic Train Operation) system, CFL and SNCF Train Autonome are studying the impact of this system on timetable planning and the possibilities for optimising infrastructures in the medium and long term. SNCF and CFL agree that the Metz–Luxembourg corridor, with its growing passenger demand and the need to guarantee freight capacity within the framework of a European corridor, is an interesting context for testing and evaluating the impact of this new operating technology. SMA was contracted to conduct an exploratory study on this corridor to assess the performance improvements (in capacity and robustness) provided by GoA2 automation.

The impact of a GoA2 ATO system on the two countries' timetabling standards was evaluated and the theoretical gains that this system would bring to timetabling were calculated. The identified theoretical travel time gains were applied to existing timetable concepts on two time horizons, and then tested through dynamic simulation with a microscopic model in order to evaluate their robustness.

Despite its exploratory nature, with a number of simplifying assumptions in the simulation, the study has highlighted the magnitude of expected potential gains from the deployment of a GoA2 ATO system; it has also highlighted the need for further analysis to explore a broader range of potential gains in operation.

NETHERLANDS

Provinces of Zeeland: Noord-Brabant and Limburg – Validation of the long-term rail development The southern Dutch Provinces of Zeeland, Noord-Brabant and Limburg wanted to define a coordinated rail development agenda for the three provinces and especially to be able to position themselves for the (inter)national public transport network. The service intentions of the southern provinces differ slightly from the national rail development planning and some regional goals were not included in those studies. The development of a regional service concept is intended to objectively assess these objectives and provide better access to the proposed network. This creates a better foundation and reasoning before entering into the discussion with the national authorities.

The validation of the rail network in the south of the Netherlands has provided a service concept that clarifies the relationship between service offer and infrastructural upgrades. The development of a service concept has also provided more information about the possible integration of the intended services and identified some potential win-win situations on the national and international level, in relation to work in Germany (e.g. the Deutschlandtakt) and possible developments in Belgium.

In addition, the study has been used as a basis for the expert evaluation of various options for the international accessibility of Breda and the possible alternatives for the development of the high frequency corridor between Eindhoven and Amsterdam.

Finally, SMA has proposed a service-infrastructure roadmap for 2030-2040, based on the identification of specific opportunities and traffic forecasts undertaken by another party.

PORTUGAL

Infraestruturas de Portugal (IP): Strategy for the development of the national rail network The implementation of the infrastructure investments recommended in the 2030 National Investment Program (PNI 2030) calls for the railway to become a structural mode of transport at all levels (international, national, regional and metropolitan). To achieve this challenging goal, IP intends to create a national strategic plan to meet the needs and challenges of the coming decades, by launching an integrated strategic planning process which allows the identification and optimisation of the infrastructure needed to support given service goals.

Several projects for railway infrastructure development have been studied in the last decade, with the aim of solving bottlenecks, creating additional capacity and new connections creating the conditions for upgrading services. These projects concern the whole of the country and include strategic projects such as the new high speed Porto–Lisboa line, the new crossing of Douro River and the Third Bridge on Tejo river (TTT) amongst others. These proposed infrastructure projects were studied under different circumstances and conditions.

IP has commissioned SMA to define a methodology that establishes the basic elements of a master plan for the development of the national railway network. The study, carried out in cooperation with IP, considers major railway investments to be made under the PNI 2030 and the related levels of service provided at international, national, regional and metropolitan level. These elements take into account high-level service concepts, nodal schemes opportunities as well as service intentions. The resulting service plans will be used as an input for the next steps of the master plan.

Communications

Due to the pandemic, 2020 was of course mainly characterised by postponements, cancellations and alternative online events.

In 2020 we expanded our social media activities. On SMA's LinkedIn profile, we regularly post news about interesting consulting projects as well as exciting news about new products and our software research & development activities.

Follow us on LinkedIn:

Publications and lectures

EUROPEAN TRANSPORT REGULATION OBSERVER Policy Brief – Edition 2020/01 Robert Schuman Centre, Florence January 2020	**Digitalisation of the (International Freight) Capacity Planning/Production Process: Challenges and Solutions** Eric Cosandey
Järnvägspolitiska strategigrupp Stockholm, Sweden March 2020	**TAKT – A vision for Sweden (online)** Frederik Ropelius
Haute École d'Ingénierie et de gestion du canton de Vaud (HEIG-VD) Yverdon-les-Bains, Switzerland March 2020	**Conception de l'offre en réseau et cadencement CAS Transport Public** Clément Haller
EPFL Lausanne, Switzerland April 2020	**Online lecture: Timetable Saturation in Practice with Methods from Operations Research** Matthias Hellwig
Haute École d'Ingénierie et de gestion du canton de Vaud (HEIG-VD) Yverdon-les-Bains, Switzerland May 2020	**Planification des dépôts (sites d'entretien) & ateliers de maintenance CAS Transport Public (online)** Clément Haller (with SBB-P)

Key figures

SMA Group's 2020 gross sales once again showed good growth compared to the previous year, despite the operational constraints imposed by the global pandemic.

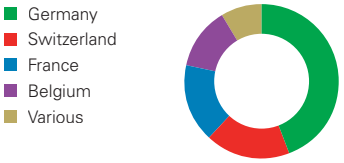
The Consulting division was able to sustain a healthy and solid continuation of their growth of the previous years. Our diversification in terms of geography, client types and business areas underpins the robustness of this trend.

Our software division experienced a strong increase in revenues in the area of maintenance and licensing with sales of both Viriato Standard and Enterprise licences as well as add-on modules. This is evidence that the investments made in R&D over the past few years have been directed at right areas. Our software services continued to be mainly undertaken for our large customers and remained stable.

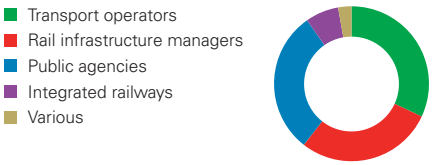
Key Figures*	**2020**	2019
Gross turnover (million CHF)	**14.2**	13.4
Full-time employees	**67**	64

*incl. subsidiaries

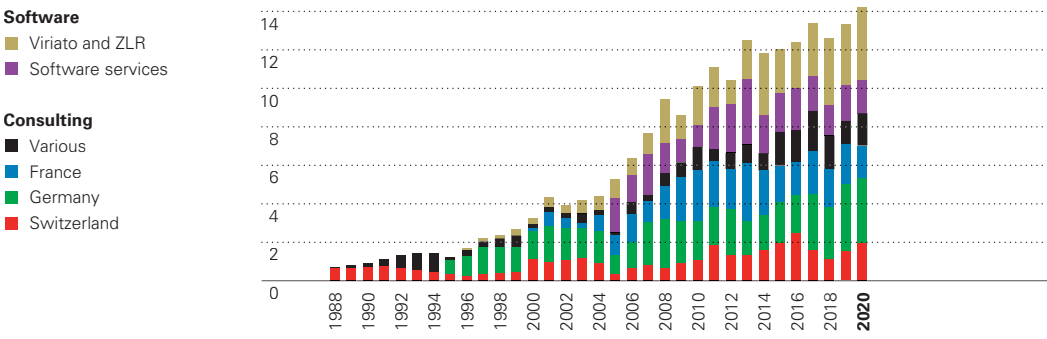
Turnover by country



Turnover by client category



Developement of turnover 1988 – 2020 (million CHF)



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