

ANNUAL REPORT

30^{YEARS} **sma**  **optimising railways**



2016

The photographs in this year's annual report are not simply showing impressive examples from the railway world. The attentive viewer will also find abstract representations from the 30-year company history of SMA's activities in these collages.

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Introduction

Dear Readers,

The publication of the 2016 Annual Report in 2017 gives us the opportunity to reflect on SMA's 30th anniversary. It is not a question of transforming our traditional annual report into a nostalgia-laden volume which describes the past three decades under the rose-tinted motto "Everything Used to Be Better". Instead, we have decided to follow these 30 years with respect for the many successes of SMA and our customers – customers with whom we have always pursued a common goal: planning tomorrow's transport systems.

Our report this year is therefore twofold. Firstly, in the traditional way it demonstrates the impressive experiences, projects and key figures from the 2016 financial year. However, it also honours 30 years of company's internal developments, key projects for our customers, and in parallel to these milestones from the development of the railway – Developments that SMA recognised, explored and sometimes influenced in some way or other. Of course, these stories do not claim to be a complete record. We could only make a small selection from many! We hope that you will find this collection to be appropriate and representative of the three decades that have passed together – whether you were with us for the entire journey or only a part.

This story will not end here, and has only just begun. We are therefore already looking forward to supporting you and your projects in 2017 and beyond.

We hope that you enjoy reading our 2016 Annual Report.

Eric Cosandey
CEO, Head of Consulting

Thomas Bickel
Head of IT

24. 8. 91



Official Journal of the European Communities

No L 237

COUNCIL DIRECTIVE of 29 July 1991

on the development of the Community's railways
(91/440/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 75 thereof,

Having regard to the proposal from the Commission (1),

Having regard to the opinion of the European Parliament (2),

Having regard to the opinion of the Economic and Social Committee (3),

Whereas greater integration of the Community transport sector is an essential element of the internal market, and whereas the railways are a vital part of the Community transport sector;

Whereas the efficiency of the railway system should be improved, in order to integrate it into a competitive market, whilst taking account of the special features of the railways;

Whereas, in order to render railway transport efficient and competitive as compared with other modes of transport, it is necessary to guarantee that railway undertakings must behave as independent operators behaving in accordance with market needs;

Whereas, in the absence of common rules on railway infrastructure costs, Member States shall, after consulting the infrastructure management, lay down rules for the payment by railway undertakings of the use of railway infrastructure groupings for the use of railway infrastructure; such payments must comply with the principle of non-discrimination between railway undertakings;

Whereas Member States should ensure that existing publicly owned or controlled railway undertakings are given a sound financial basis, taking care that any financial rearrangement necessary shall be made in accordance with the rules laid down in the Treaty;

Whereas, in order to facilitate trans-European transport, States, railway undertakings should be encouraged to form groupings with railway undertakings in other Member States;

Whereas, such international groupings should be granted rights of access and transit rights in order to facilitate the establishment of their constituent undertakings in other Member States, and to ensure that international service concerns the interests of all Member States;

Whereas, with a view to ensuring that it is appropriate that access to the railway network should be granted to the other Member States engaged in the transport of goods;

Whereas, it is necessary to ensure that the railway network is used in an efficient and economic manner;

1987

1988

1989

1990

1991

Werner Stohler,
Martin Meister and
Hansruedi Akermann
found the consulting
company
SMA und Partner AG,
which starts trading on
1st October 1987.

The introduction of the fax machine brings a first acceleration in the communications with our customers.

SMA INTERNAL

SMA contributes to the Gotthard Committee's 10 arguments for the Gotthard base tunnel, which was to be opened 30 years later.

The first planning study for the Beira Alta line is followed by a long-term cooperation with the Portuguese railways.

Our consulting for the cantons of the Jurassic Arc leads to the Y solution for the new line Olten–Berne as part of the Rail 2000 concept.

SMA is commissioned to provide expertise on the Zurich–Stuttgart line, and has continued to supply this to today.

The pilot study
"ITF Südwestraum" for
a clockface timetable
forms a reference project
for various later studies
in other German states.

SMA PROJECTS

The successful referendum on the concept Rail 2000 marks the basis for the successful model of the Swiss public transport system.

In France, LGV Atlantique is launched, the second new high-speed line after LGV Paris-Lyon.

The commissioning of the Zurich S-Bahn and the launch of the Zurich public transport authority ZVV marks the beginning of the success story of the public transport system in the Zurich metropolitan area.

The EU Directive 91/440/EEC requires the legal and organisational separation of railway companies.

In Germany, the high-speed era begins with the commissioning of two new railway lines Hanover–Würzburg and Mannheim–Stuttgart.

MILESTONES

Railway 4.0

Why Railway 4.0?

To start, it is interesting to introduce the generic concept of Industry 4.0 defines a new way of organising industrial production. The basis for this is the use of intelligent production systems that are adaptable and that allow more efficient use of resources. Thus, this should mark the beginning of a new industrial revolution. Such a system is therefore intelligent if it is able to adapt to a new environment or to changed conditions. Furthermore, it is classified as efficient if maximum value creation can be achieved with the minimum utilization of means and resources.

In the context of the railway, the Industrial Revolution 4.0 is highly dependent on its adaptability and efficiency. This brief outlook will contemplate the challenges and opportunities.

A Difficult Equation The railway's industrial revolution is already in full swing. The automation of numerous production processes is already a reality: traffic management, infrastructure and equipment monitoring, or timetable information and ticketing on smartphones are examples of the extent that processes have been digitalised today. Moreover, these systems run in real time, which means that they can control (or manage) a process at a speed adapted to the evolution of the same process. Continuous and direct communication between involved agents, tools and systems facilitates processes and thus leads to an increase in the overall productivity. The system adapts itself and wins efficiency.

Although innovations are also regularly introduced to the railways, the system is nevertheless shaped by technical and organisational principles, which tend to develop more slowly than other competing transport systems. Without going into the intricate institutional processes that vary from country to country, it can be seen that institutional complexity, fixed costs and length of long-term investment and maintenance cycles in the railway system make it often difficult to remain compatible with the principle of adaptability and short-term effectiveness.

The complexity of the problem lies within the fact that for programmed systems such as the railway, the resources (infrastructure capacity, rolling-stock, personnel) are dimensioned in advance over several years and therefore do not always correspond to the system's short-term needs and availability. For years the actors have been baffled by this economic and technical equation and are striving for a solution.

Changing Paradigms in the Production Planning Three basic processes can be distinguished:

- **System Planning:** The investigation of scenarios or several variants, the long-term dimensioning of resources in an evolving political, institutional and macroeconomic context.

- **Production Planning:** The allocation of pre-dimensioned resources into an execution model to meet both the commercial needs as well as the short term production requirements.
- **System Operation:** The use of available resources in real time, which are necessary for the whole or partial execution of the pre-determined production plan.

These three processes call for a systemic approach as new means and technologies contribute to a deeper understanding through better management of data and information flows. For this and for the purpose of improving their flexibility and performance, models and tools should be able to consider and match data that have variable levels of precision to the needs of the process. As a result, the range of possibilities gets larger and the challenges of planning and operations become more manageable.

While the unclear and evolving political, institutional and macroeconomic environment at least partially limits the possibilities of automating the process of system planning, the two other processes are predestined for the Industrial Revolution 4.0. While the automation of operation is already underway, the possibilities for automating production planning are still far from being fully exploited, despite the fact that they have already been largely digitalised. However they raise the question of a paradigm shift: planning in real-time. Two notions a priori incompatible. The algorithms and the systems must be able to solve the equation of an extremely complex system in real time and enable the integration of schedule production and operation in the logic of an optimisation loop.

Innovation and Flexibility of the Systemic Approach The challenges therefore lie in the development of innovative methods and tools which allow all actors in the railway system to be offered the necessary flexibility, without dismantling and considering the competencies, responsibilities and needs of all stakeholders involved in capacity allocation.

In view of this, the best way to automate production planning and operation is through a planning system that allows numerous scenarios and variants to be anticipated and developed through the simplification and systemisation of production. This then allows the presumed incompatibility of real-time planning in the previously mentioned logic of the optimisation loop to be solved.

Because the challenges of the railway Revolution 4.0 require the know-how and expertise, which belong to the core activities of SMA, we are now in a better position than ever to support our customers in the development of the methods and intelligent tools for tomorrow.



1992	1993	1994	1995	1996	
The growing company moves into new and larger office spaces at 28 Gubelstrasse in Oerlikon, Zurich.	Following a pioneering phase with Macintosh computers, a PC with Windows operating system is deployed for the first time.	SMA develops an initial prototype of a database system for the creation of graphic timetables and netgraphs.	SMA decides to develop its own IT tool for clockface timetable planning, the birth of the Viriato timetabling system.	In terms of IT, SMA moves entirely to the Windows world, coupled with the introduction of personal e-mail for all employees.	SMA INTERNAL
SMA undertakes an initial capacity analysis for the very early stages of the Gotthard base tunnel.	The SMA studies of clockface timetables for regional services in Bavaria, Thuringia, the Rhine-Main region and North Hesse extend this concept in Germany. Deutsche Bundesbahn commissions from SMA a study for the entire German long-distance timetable for the first time.		The project for a clockface timetable in North Rhine-Westphalia is the origin of an ongoing consultancy activity for this state.	Viriato, originally designed as an internal tool, becomes a product as the first two customers DB and SBB almost simultaneously start using it.	SMA PROJECTS
The NEAT referendum paves the way for the two Gotthard and Lötschberg Alpine base tunnels. The “Schéma directeur des lignes à grande vitesse” defines the outlines of the high-speed network in France.	A real novelty: the “Allgäu-Schwaben” clockface timetable planned by SMA is the first interval timetable in German regional traffic.	The railway reform in Germany transfers the responsibility for regional transport from the federal government to the states, involving numerous new tasks for the latter. The Channel Tunnel directly connects the cities of Paris and London by rail for the first time.	The planning studies by SMA for clockface timetables in Thuringia, Bavaria, the Rhine-Main region and North Hesse were successively implemented from 1995 onwards.		MILESTONES

A selection of projects from 2016



RNE (RailNetEurope): Redesign of the international Timetabling Process Incomplete harmonisation of timetabling procedures between European countries makes cooperation at the international level difficult. To address this situation, RNE (RailNetEurope) and FTE (Forum Train Europe) launched the Time-Tabling Redesign (TTR) project. The main objectives of the future timetabling process are:

- Clear focus on market orientation which could lead to different deadlines for placing path requests
- Improvement of reliability (incl. planning and execution of possessions)
- Improvement of commitment to the TT process by everybody
- Improvement of efficiency (capacities, resources) in order to avoid double planning/work
- Improvements not in form of new additional infrastructure but in making best use of existing capacity

SMA and Partners Ltd. was commissioned by RNE to manage the TTR project during the development of the draft framework process which provides a high level view on the timetabling process.

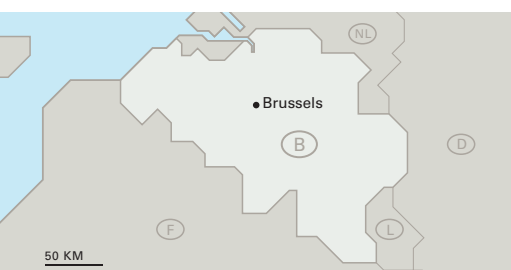
Taking the different requirements into account, an advanced planning scheme with capacity partitioning for traffic to be requested at defined deadlines and for traffic needing more flexibility was designed. Moreover, Temporary Capacity Restrictions (TCR) were taken into account. The new approach improves the structure and harmony of the process between infrastructure managers for middle term planning (from x-36 until x-12 months) and increases transparency for train operators.



Infrabel: Assessment and updating of the method for determining the activity rate of the network The “Network activity rate” document issued by Infrabel is a guidance document used by management bodies for train path requests and framework contracts with operators. Values are established according to an outdated methodology and the computer calculation tool is no longer used. With the National Railway Company of Belgium’s (SNCB) recent and future timetable changes, the time had come to (re)develop a tool tailored to current requirements.

The purpose of the analysis carried out by SMA was to assess the methodology by comparing it to the methods currently used elsewhere in Europe. Then, Infrabel asked to carry out a “proof of concept” on the existing regular commercial train paths (passenger and freight paths) by calculating the activity rate over the entire national network. At a later stage, SMA also developed an additional methodology for identifying the network’s residual capacity. Here too, the methodology was tested on the national network.

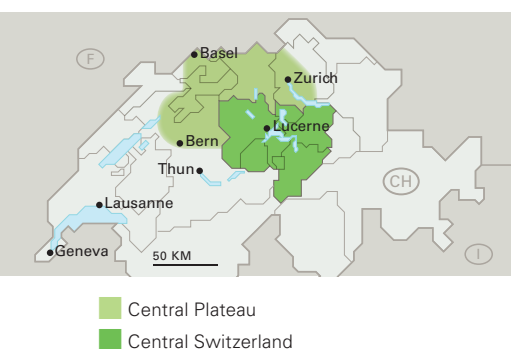
Finally, a new method was developed for calculating the network's activity rate. As the aim is to use this method for future prospects in respect of which a timetable is not yet known, it was possible to propose a method that was completely independent from the structure of the timetable and the sequencing of the train paths. The test on the existing paths produced very striking results with different cards providing an overall view of the activity rate of the network as well as the residual capacity according to several categories of paths (RER, freight, IC and regionals).



Infrastructure imported into Viriato for SNCB To improve efficiency and precision when planning its annual timetable and seasonal variations, the SNCB decided to set up a gateway to import the infrastructure data provided by Infrabel and stored on its data exchange platform.

The infrastructure data import function developed by SMA updates the data for the entire network for each season of the timetable defined in Viriato. This update covers all the information required by the running time calculator, particularly the mileage, longitudinal profile, curvature and speed restrictions. Moreover, much of the data concerning station and branch line topology and that relative to conflict detection is also systematically updated. The infrastructure management functions in Viriato Enterprise formed the basis for organisation of the imported data according to its time-frame and to check its impact on trains.

This ongoing alignment of infrastructure data with that of the network manager facilitates the work involved in preparing the transport plan and improves the coherence of train paths ordered by the railway company. It also allows adjustments to the timetable to be anticipated in line with changes and the state of the network.



SBB Infrastructure: Corridor master plans for the Central Plateau/Central Switzerland

The SBB corridor master plans determine the long-term infrastructure requirements, which form the basis for the evaluation of all future projects in terms of their upward compatibility, as well as formulating the necessary structure plan entries. Based on a range of service concepts, infrastructure elements required to support forecasted passenger and freight growth or travel time requirements were analysed. The evaluation, involved a so-called schedule-based test, in which a number of service concepts were used to assess the suitability of the planned infrastructure for a whole range of different timetable concepts.

SMA is supporting the SBB in the formulation of iterative service options with the widest possible variability, the analysis of capacity bottlenecks and node/target time requirements, as well as the definition and verification of appropriate functional infrastructure. This may entail both local (e.g. grade separation at junctions), as well as superordinate capacity elements (e.g. additional double track between two branches). The planning work is supported by the tools Viriato and ZLR; infrastructure illustrations are created in the program Topovisio.

The work is to take place in the scope of two different projects for the regions midlands and central Switzerland. The compatibility of the plans is to be tested at their interfaces, as well as the linkage to the existing Zurich master network plan, to ensure the targeted, large-scale development of infrastructure.

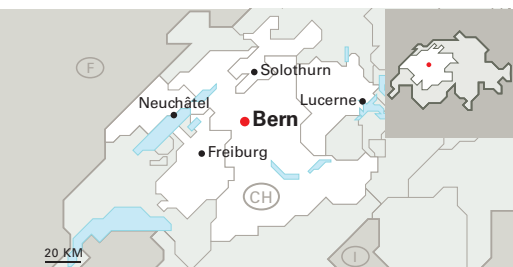


SBB: Project RailFit 20/30 SBB launched the “RailFit 20/30” project against the backdrop of the technological evolution of mobility, where competing modes of transport are growing while reducing their costs. The aim of the project is to reduce costs, ensure adequate fares for customers and public agencies, and meet the growth in demand through improvements in capacity and infrastructure utilisation. In this context, SBB have instructed SMA to support the identification of service-related measures, thus helping build the railway of tomorrow.

SMA supported SBB in the sub-project “long-term service design”. In cooperation with SBB, we formulated ideas and concepts to enable a reduction in overall system costs, increased yields, and thus an improvement of the price-performance ratio for the post-2030 future. We combined these ideas and concepts to formulate an offer variant for this time-frame, proposed a corresponding schedule, and evaluated the outcomes in cooperation with our project partners.

The development of the Swiss railways in recent years and decades has been nothing short of a success story. Thanks to the constant expansion of infrastructure and services, demand has increased massively. In this project geared to ensure the continuation of this success story, we engaged intensively with the philosophy of service design, and quite consciously questioned some of the principles of “Rail 2000” (eg connecting nodes or the all-day integrated service), independently of the policy guidelines.

In the scope of an extreme variant, we were able to demonstrate that lower total system costs are feasible by way of a fresh approach and consistent implementation of new ideas for service design. The advantages of the railway system can thus be exploited fully in the future, thus strengthening the competitiveness compared to other modes of transport.



BLS passenger transport: Workshop support BLS AG operates the entire S-Bahn network in the Berne region, as well as various national RegioExpress lines. The steady growth in demand and the planned service expansion are set to result in a significant increase in operational performance and fleet size in the next few years. In parallel, a modernization of the fleet is also set to take place.

Currently, SBB is operating a workshop (Aebimatt) ahead of Bern train station, which must give way to other expansions in the near future. The Aebimatt workshop is leased by BLS for on-site maintenance. In the context of the restructuring of the BLS workshop landscape required due to the elimination of Aebimatt and other criteria, as well as the goal to reduce the number of facilities, other sites were evaluated.

SMA formulated vehicle use concepts for different site variants, taking into account the requirements of the planned modular on-site maintenance. The respective travel costs were to be determined. Also, the required numbers of workshop tracks for each location per site were determined by means of track occupancy analysis, which was an important decision criterion.

The expansion of feed capacity for the preferred options, which was a possible exclusion criterion, particularly in the vicinity of Bern, took place in due course. A catalogue of possible unallocated tracks between the vehicle locations in the network and the workshops were thus used to quantify the accessibility of the repair shops for comparison of the site variants.

In conjunction with further criteria for the various sites under evaluation, such as space available, the BLS was in a position to select the most appropriate site. The announcement of the site in the west of Bern resulted in resistance, and the formation of an advisory group. SMA supported this advisory group in the reassessment of additional sites and other criteria, finally permitting to contribute to the consensus solution.



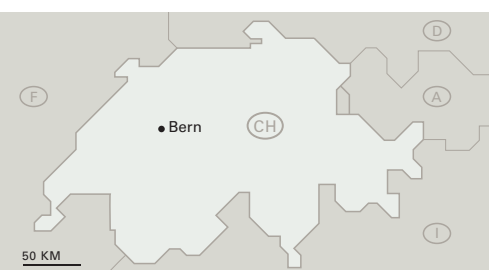
Canton of Valais: 2018–2030 service-infrastructure schedule for the Simplon line

The Simplon line (Lausanne–Montreux–Martigny–Sion–Visp–Brig) is a major route in the Swiss mainline service as it is part of the system of communication nodes connecting the Lausanne and Visp nodes. According to the schedule of the Federal Office for Transport (FOT) up to 2025, the Eurocity Geneva–Lausanne–Brig–Milan Centrale train traffic still causes conflicts in the baseline state.

Against this backdrop, the Canton of Valais instructed the FOT to study timetable variables that allow the railway service to be stabilised on the Simplon Line with traffic from Eurocity Geneva–Milan without resulting in any modification to the timetable of the other passenger traffic, and of the regional traffic in particular.

On the basis of an analysis of the possibilities combining journey time, rolling stock and stopping policy, four scheduling concepts for the traffic on the main lines were established. Based on a multi-criteria assessment, two concepts were further investigated using a timetable variable integrating regional passenger traffic and freight traffic.

Following discussions with partners, the most promising timetable variable from the point of view of the proposed service, the necessary infrastructure and the compatibility with the communications node of Lausanne and with the Plateau route was retained by the Canton of Valais for a more detailed analysis to be carried in a process led by FOT.



SBB: ZLR toolbox development in 2016 The ZLR Toolbox application used by SBB provides a wide range of analysis and evaluation options. Among other features, the software permits the planning of speed restrictions that considers braking distances, as well as the analysis of the impact by travel time comparisons. This functionality has now been completed for production use, and supplemented by an interface to the signaling system.

For the functional aspect of evaluating train succession cases, the evaluation charts were completely redesigned to enable the analysis of any combination of connection, splitting, and encounter situations for trains.

At the same time, the closer linkage with the planning systems for detailed examination of planned track routing, and the flexible selection of standard routes has been implemented by connection of a common route search service.



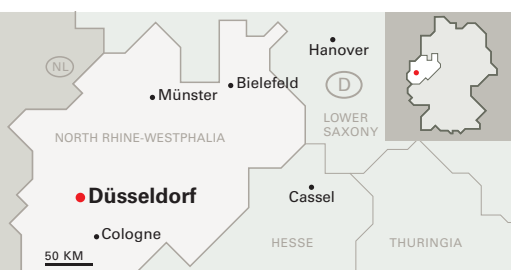
DB Regio AG: Punctuality analysis for the Rhine-Neckar S-Bahn The Rhine-Neckar S-Bahn, which for years stood out for breaking the national average punctuality statistics, suffered a drop in punctuality performance between 2015 and 2016.

As a result of this, DB Regio instructed SMA to perform an analysis of the delay data and current operating program to identify possible delay causes and to formulate improvements.

The focus of the work was on the analysis of delay data provided in the LeiDis format; the following steps were carried out:

- Grouping of delay causes to highlight relevant causes
- Comparison of the route with the overall network to identify local hotspots
- Presentation of causal relationships between the delays
- Presentation of the development of delay distribution in percentiles

Based on this analysis, SMA established theses on the cause of delays for all lines. For instance, analysis of the western extension of the S1 and S2 clearly shows that the increasing spread of delay distribution at Kaiserslautern and Neustadt was not due to scheduling issues, but rather due to construction activities related to the works at POS Nord.



Competence Centre ITF NRW: Framework contract ITF NRW In 2016, SMA was tasked with a number of interesting topics related to the plans for the further development of ITF NRW. One of the focal points was the detailed planning of the DB Station und Service AG station offensive. 120 potential new stations were investigated to see whether they could be integrated into the region's narrow ITF. The study showed the conditions that would allow individual stops or even combinations of stops to be realised.

Another focus was the technical development of the Rhine-Ruhr-Express timetable, which mainly involved the examination of line adjustments on the outer branches. Apart from the purely technical construction of the timetable, operational metrics and vehicle requirements were also determined.

As per usual, the outcomes were presented and discussed in well attended committees in NRW. Our work was complemented by the annual monitoring of the performance volume and updating of the current network schematics.

The accompanying works will continue throughout the current year.



Wunderline: Technical assistance for Groningen–Bremen Following the SMA studies on developments of operational concepts on the corridor Groningen–Bremen, the Dutch Province of Groningen asked us to support the technical team on the further development of the project. SMA has been working on the following topics:

- SMA was asked to evaluate possible measures to increase tight transfer times at the future station of Groningen. Based on our expertise, several situations were analysed; these included light adaptations of the timetable and more structural changes. The robustness of these new scenarios were then evaluated and compared to the existing scenarios. SMA also provided other general recommendations.
- A timetable and infrastructure working group was created and SMA supported the Province and worked with Prorail and DB Netz in additional technical feasibility studies. SMA provided some of the used assumptions and was involved with the project adaptations. Different new solutions were developed based on the newly discovered constraints. Among others, a possible future operational concept that integrated the Wunderline into the S-Bahn of Bremen was evaluated.



1997	1998	1999	2000	2001	
SMA changes its corporate identity with a revamped appearance.	The steady growth of the company requires an expansion of our office spaces. SMA is present on the Internet with its first website.	SMA employs the company's first computer scientist.	SMA invites Viriato users to the first user workshop.	The internet presence of the company is updated with a new, professionally designed website.	SMA INTERNAL
SMA enters the French market for the first time with a consultancy project for the Rhône-Alpes region. The Fahrplan 21 project for DB Long-distance Traffic establishes the service structure for the start of operation on the new Cologne–Rhine–Main high-speed line.	The OpenTrack simulation tool is used for the first time in a project.	SMA receives the first assignment for a service concept in the North of France from the French infrastructure manager RFF.	Viriato manages a breakthrough into the market with a total of seven new customers.	In expanding our range of activities, we receive our first commission for process analysis and business consulting on behalf of a corporate client.	SMA PROJECTS
	The two referenda on FinÖV (Fund for large-scale railway projects) and LSVA (performance-related heavy goods vehicle tax) provide the long-term basis for financing of railway projects in Switzerland. The first stage of the clockface timetable in North Rhine-Westphalia, planned by SMA, commences operation.			The first ICN tilting trains enter into service on the Jura Foot Line in Switzerland. The launch of the high-speed line LGV Méditerranée (Lyon–Marseille) changes the travel times in France.	MILESTONES

- In order to further investigate the feasibility of some variants for a direct connection between Groningen and Bremen (with a physical train coupling), SMA carried out a detailed signalling analysis for the station of Leer. Several types of rolling stock were assessed for their feasibility. SMA also analysed the advantages and disadvantages of variants that combined and split trains.
- In order to feed the passenger demand study, SMA provided the timetable and travel time data. The results of the demand model and reports were shared with us and we delivered an evaluation of the plausibility of the demand study.



Regional transport improvements for the Black Forest Railway corridor between St. Georgen–Villingen The purpose of the investigation was to establish whether and on what conditions the present regional train system (Ringzug) could be expanded from Villingen towards the city of St. Georgen in the medium term. As well as improving the integration of St. Georgen with regional rail transport (Schienenpersonennahverkehr, SPNV), the option of developing the region by construction of additional stations and an extension to St. Georgen was also to be investigated. In addition to St. Georgen, Sommerau and Tribberg are under consideration as potential terminal stations. The NVBW, the purchaser of regional rail services in Baden-Württemberg, required an evaluation of the expected passenger figures for an extension of the Ringzug.

The reference case, and newly calculated travel times that accounted for possible new stations was agreed with the NVBW in Baden-Württemberg. They were used as the basis to build new concepts with new service offers. Following the evaluation of the optimal solution and a reformulation of the local transport plan, a range of bus concepts were developed from the of the railway's schedule. The improvements in the travel times were analysed as was the structural development of the investigated area. It was concluded that due to the expected passenger numbers, the Ringzug train service should be expanded to St. Georgen only.



Rhein-Main Verkehrsverbund (RMV): 2016 consulting The Rhine-Main area is one of the largest metropolitan areas in Europe; the link to Frankfurt has particularly high demand values that increasingly result in capacity constraints.

The responsible transport authority, Rhein-Main Verkehrsverbund (RMV), has been supported in the further development of the integral interval timetables by SMA for a number of years. In 2016, the main focus of activity was placed on the development of concepts for improving the rail connection for the areas surrounding Frankfurt am Main. In particular, this involved the examination of extension options for the S-Bahn network in the Taunus and Niddertals areas by electrifying branch lines. SMA has developed a few operational concepts, tested them for plausibility, and identified the corresponding infrastructure requirements. Rolling stock requirements were also determined for the preferred variant.

Further work in 2016 included studies on the reactivation of currently disused railway lines in the ever more populous Rhine-Main catchment area, and timetable studies for integration of new stations into the interval timetable.



BMVI: Consulting and support services for the “Deutschland-Takt” in the scope of

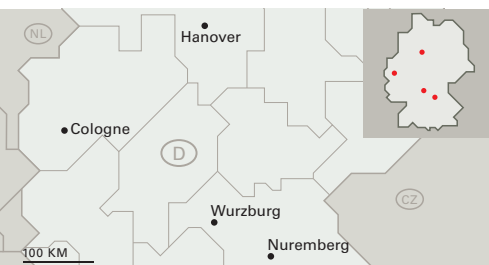
BVWP The German Federal Ministry of Transport and Digital Infrastructure (BMVI) will publish the Federal Transport Infrastructure Plan (BVWP) as a strategic planning document for determining long-term infrastructure needs. The new BVWP 2030 is the first application of timetable-based infrastructure development for the rail network. SMA developed a target timetable 2030 with optimised timed nodes using Viriato for long-distance and regional traffic based on the traffic forecast for 2030. The timetable represents the starting point (reference case) for the development of a nationwide “Deutschland-Takt” timetable for long distance, regional and freight services. The detailed planning phase is set to conclude by 2018. In cooperation with a partner company, we also prepared the microscopic investigation of six major railway junctions, which is also set to be completed in 2018.



DB Fernverkehr AG: Various consulting projects During this reporting year, the long-standing cooperation with DB Fernverkehr AG was focused on quality levels. The corporate programme “Zukunft Bahn” calls for designated production areas to be developed further in qualitative terms. In the area of timetabling, the workshops in cooperation with SMA were primarily concerned with an overhaul of the operating margin allocation to lines and nodal areas, as well as the application of alternative approaches.

Furthermore, separate quality tests were carried out for selected lines, which are currently undergoing testing with pilot trains; depending on results, the scheme is to be extended long the entirety of each respective line.

Another focus was on the scheduled planning of lines in relation to the service offensive for long-distance services. In addition to traffic-related requirements such as integration into the timetables of other countries, quality was a main focal point for the study.



DB Netz AG: Bundling of time supplements at major nodes Delays in the approach to major nodes have a negative effect on the operational processes in the node and commonly lead to secondary delays. This project, carried out by SMA on behalf of DB Netz AG, was tasked with the reduction of delays in the approaches to major railway junctions. The project's aim was to stabilise operational processing in the nodes and to mitigate the effects on the following trains.

SMA investigated the punctuality of the long-distance services approaching the nodes Cologne, Hanover, and the double-node of Würzburg/Nürnberg. A range of analytical methods were applied to show the development of delays or punctuality for up to 100 km of the approaches leading up to the nodes.

Based on this analysis and an evaluation of the connection relationships for the intermediate stops in the approaches to the nodes, SMA listed proposals for changes that could be made to the running time supplements. It should be noted that running time supplements cannot be moved arbitrarily:

- Existing transport concepts and connections must be observed
- The pooling of running time supplements ahead of a node may result in loss of capacity
- Excessive running time supplements ahead of stations may result in inadvertent operational stops during scheduled train journeys

The bundling of running time supplements takes place in the approach to the nodes around stations and permits operational interventions in the case of delays to be made. This helps prevent secondary delays, since the sequence of two lines can be exchanged in the event of delays.

For the node of Hanover, the bundled supplements of 2-5 minutes are arranged around 15-20 km ahead of the node ("outer supplement ring"), e.g. to the east of Lehrte station. In another, "inner" supplement ring, minimal supplements of 30 seconds are arranged immediately ahead of Hanover's central station to compensate for a non-scheduled stops and restarts.



BEG: Reduced travel time Munich–Prague The current railway journey time between Munich–Prague is uncompetitive with the competing modes of transport. The transport ministries in the Czech Republic and Bavaria are looking to reduce travel times to around 4 hours and 15 minutes.

Based on the measures already planned by SMA to reduce the travel time in the section Landshut–Furth im Wald and other development plans, timetable-reduction measures were designed for the section Schwandorf–Pilsen section on a traffic and infrastructure planning study. New concepts based on tilt and conventional technologies were planned for local and long-distance services based on a two-hour interval connection between Munich and Prague. The aim of the study is to evaluate the measures best suited for integration into the existing timetable concepts, at minimum cost.

The work is still being conducted in a joint venture with two partner companies; the outcomes are subject to moderation, discussions, and coordination with a panel of government departments, transport authorities, and railway infrastructure companies.



Bodenseekreis district: Investment costs, operating costs and revenues from the expansion of Lake Constance Belt Railway As part of the electrification of the railway line on the northern shore of Lake Constance – the so-called Lake Constance Belt Railway – two concepts from a previous SMA study were: The long-term concept 2025 of the State of Baden-Württemberg, as well as the region’s preferred variant. The long-term concept has an hourly express service (Interregio-Express, IRE), and an hourly local rail service. The preferred variant of the region includes both an hourly IRE, as well as a half-hourly regional train service with an extended service up to Singen.

In the latest study, SMA calculated the costs and revenues for the two timetable variants on instruction of Bodensee district. In doing so, SMA determined the investment costs for the infrastructure expansion required in each case, as well as the operating costs, potential demand and associated revenue for the two variants. This enabled a comparison of the economic results for the two approaches by costs and revenues. The study thus provides the foundation for the coming policy decisions in the region.



DB Fernverkehr AG: Viriato.FF – process support as a focal point, sensible automation, integrate further DB Fernverkehr has been using Viriato as a central planning tool since 1999. Thanks to the operational implementation of Viriato.FF, the legacy software, which was designed for conceptual planning, could be replaced by a fully scalable and fail-safe production system. The program is integrated into the production chain by way of interfaces, and permits efficient planning work. The interface to the line ordering system track portal network (TPN) is of particular importance. This is used by schedulers to conduct the entire line ordering process from registration to entry of offers to the conclusion of line contracts within Viriato.

The extensions implemented in 2016 were primarily geared at improving communications with TPN. In cooperation with DB Fernverkehr, SMA identified actions that must be performed frequently on the one hand, but do not require manual visual inspection on the other. Users have new bulk features for the efficient entry and confirmation of the offers at their disposal. The implemented solution supports users in comparing of the offers and related orders, by classification of identified deviations into change classes, as well as their representation.

The integration of construction site scheduling into the annual timetable means that the design of trains is gaining in importance. The feature was thus implemented in Viriato.

The automation concept is continued with the planned 2017 extensions to give the schedulers the required time for the increasingly complex business of scheduling.



SNCF Réseau: Capacity and usability studies into the new Paris–Normandy line

The new Paris–Normandy line (LNPN) is one of the largest infrastructure projects currently being studied in France. The purpose of the study is to reduce travel time between Paris and Normandy's principle towns; to increase network capacity, particularly in the most critical zones around Île-de-France and across Greater Rouen; to support the increase in activity in the ports of Rouen and Le Havre by improving rail access to their hinterland and finally to produce the framework for a coordinated transport provision on a regional scale.

The project is currently at the start of the preliminary studies to be carried out ahead of the public enquiry which is due to take place in 2020. In view of this, the SNCF Network has put in place a significant study and consultation plan covering all the issues relating to a project of this nature. SMA was chosen to carry out the capacity and usability studies, which are designed to define the functional programme of the operation by studying contrasting scenarios, in relation to the areas that the new line will cross and to the structure and size of the service. These scenarios, drawn up on the basis of the systematic schedules in Normandy, can help to identify the impact of the project on the existing network, to support the changes in the regional services in line with the radial services to and from Paris or between towns that will use the planned new sections.

This study programme will take place over several years and will enable the steering committee to make choices that will determine the nature of the project, which will be subject to a ministerial decision. In 2016, the principal issues studied related to the stations in Île-de-France, to the comparative performances of the various route zones, and to the question of usability of the large stations, and in particular the new metropolitan area station planned in Rouen and the railway complex around the station of Paris-Saint-Lazare.

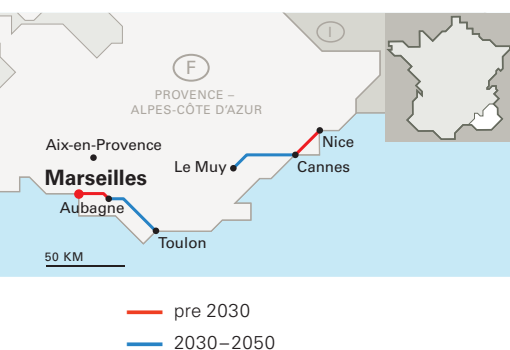


SNCF Réseau: Usability and capacity study into the railway connection to EuroAirport Basel-Mulhouse

The EuroAirport Basel-Mulhouse railway connection project has for several years been included in the various planning documents in both France and Switzerland. A preliminary capacity and usability study led by SMA for SNCF-Réseau in 2010–2012 identified an initial connection configuration.

In 2016, SNCF Réseau began a new study phase in order to update the preliminary study with a greater interaction with the parties involved on both sides of the border (organisational authorities, infrastructure managers, railway companies, Governments) during regular meetings, and to widen the relevant area and finally to optimise and ensure the reliability of the solution identified in 2012. There were many iterations between the different parties in order to fix the study framework and choose the optimal solutions.

In order to achieve this, SMA used all the tools that it currently uses in order to best summarise and represent the service (Netvisio), the infrastructure (Topovisio), to produce the international timetables (Viriato) and to carry out precise signalling and robustness analyses using a dynamic microscopic simulation (OpenTrack).



SNCF Réseau: Capacity studies for Phase 2 of the preliminary studies of the New Provence–Côte-d'Azur Line project In 2013, the Mobilité 21 commission selected the New Provence–Côte-d'Azur Line project as priority rail project. The project is the result of a political and technical maturation process which began in the 2000s and which turned the initial idea of a high-speed railway line into a project that maximises utility across the region and integrates into the area. The aim of the project is to decongest the railway node of Marseille and the Cannes–Nice line, in order to develop and ensure the reliability of the regional transport service in the metropolitan areas of Marseille and the French Riviera, and to increase rail links between the principle towns of the French Riviera.

The preferred route having been approved in 2014, the technical studies now focus on the details of the route and the infrastructure's functions, in order to support the survey file for the Declaration of Public Utility (DUP).

SMA has been tasked with analysing the railway capacity of the project variables, which is necessary for the Preliminary Studies ahead of the Public Utility Enquiry (EPEUP). The analyses cover the near-totality of the railway network of the Provence–Alpes-Côte d'Azur (PACA) region and are carried out from two perspectives: firstly, starting the priority works (which the Public Utility Enquiry will relate to), and, secondly, carrying out the additional sections of new line needed to ensure the coherence of the project in the long term.

The study follows an iterative process in several stages, and aims to achieve an overall improvement of the system. As such, several versions of the regional and national timetables (corresponding to the catalogue of regular train paths) have been drawn up: on the one hand they meet the local authorities' service objectives and on the other, they enable the infrastructure's functions to be checked (and, if necessary, adapted) in relation to the scheduled service and the objectives that were initially formulated.

The study also includes an assessment of the scheduled service, scheduling the daily use of the catalogue of train paths and producing the time frames for the project implementation works.



2002	2003	2004	2005	2006	
		SMA participates as an exhibitor at the world's largest railway fair InnoTrans in Berlin for the first time.	The 4 th Viriato user workshop is combined with a symposium, forming the basis for future events under the title ITxx.rail.		SMA INTERNAL
SMA develops an interface from Viriato to the DB Netz portal for ordering train paths. SMA supports DB Regio in the provision of an offer for transport services within the scope of a tender for the first time.	SBB Infrastructure introduces a functionally expanded Viriato as their new timetable construction system.	SMA business analysts support two SBB IT projects RCS and UNO.	SMA develops the ZLR service for the calculation of running times as part of the RCS dispatching system. SMA plans the first clockface timetable in France for the Région Rhône-Alpes.	DB Passenger orders more than 30,000 train paths directly from Viriato via the extended path portal. SMA assists Thalys as well as the infrastructure managers and railway undertakings of the four affected countries (France, Belgium, Netherlands and Germany) in the planning of the 2009 timetable.	SMA PROJECTS
The new line Cologne–Rhine-Main starts operation with a new German-wide long-distance timetable.		Following an extensive planning and construction period, Bahn 2000 starts operation in Switzerland. The timetables of more than 90% of trains are changed.			MILESTONES



SNCF Mobilités: Analysis and proposal for improving the performance of certain lines of the TER Aquitaine

The region of Aquitaine is getting ready to undergo a major restructuring of its timetable in 2017 following the launch of the high-speed LGV SEA (Sud Europe Atlantique) railway line. The backdrop to this transformation are the operational difficulties facing the rail service; the current 89% punctuality rate indicates a level of service that is inferior to the national average.

The aim of SMA's task is to provide an independent and outside vision in order to carry out an operational diagnosis and propose an action and improvement plan. SMA also provides comparative data from other regions, such as PACA, for whom a similar analysis was carried out.

The study began with an analysis of punctuality, regularity and causes of incidents. This analysis enables to focus on the spatial and time zones, and on the causes of disruptions and their aggravating factors. As the Bordeaux rail hub appeared particularly critical, a detailed analysis of the itineraries was carried out there and interviews relating to the maintenance and management of the hub's resources were conducted. All the analyses were pulled together in a diagram showing how disruptions are linked and propagated. Expert recommendations were then made, which are able to be implemented thanks to an integrated service and production schedule. The study concluded with the production of schedules demonstrating the proposals and with an estimate of the benefits of these proposed new schedules compared with the causes identified.



SNCF Mobilités: Reconfiguration of the TGV Nord and TERGV services and adaptation of TER Hauts-de-France

In view of the structural failings of the services, SNCF Mobilités considered a new model for the North. The existing high-speed TGV Nord service is based on a radial domestic service and on the planning requirements of the area, and is related to the TERGV service (the regional express train running on high-speed lines) which is co-financed by the regional organisational authority. With this finding in mind, SNCF Voyages considered a new operating method, in keeping with the Regional plan, that could be introduced to sustain the TERGV.

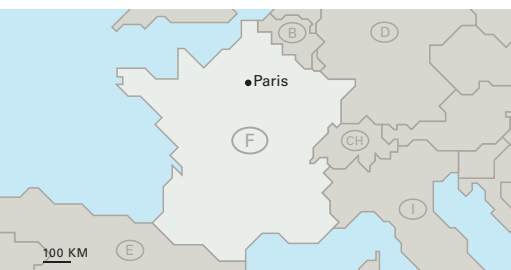
The aim of the study was to construct and assess scenarios for the radial TGV services and TERGV services based on various operating system diagrams that differed from the existing model while complying the institutional and technical constraints. This aim was pursued by taking into account the renegotiation of the 2014-2015 contract for the regional TER Nord Pas de Calais train, the arrival of competition on the LGV Nord and the constraints on the TGV stock of trains.

The study introduced the following elements:

- Proposal of service concepts for peak and off-peak hours to reconfigure the service and assessment in terms of the quality of the service, the ability to meet demand, the use of the trains and the impact on production.
- Study of systematic peak and off-peak schedules in order to provide a “pre-24h” analysis and assessment with the first rolling stock roster, and analysis of the possibilities of reducing the service.
- Examination of the 24-hour implementation of the preferred timetable and determination of the activity units to enable the SNCF to assess the impact in terms of the operating costs.



Regional Council for Occitanie: Audit of regional railway transport accounts The contract for the organisation of the TER in Languedoc-Roussillon expired at the end of 2016. Against the backdrop of the new contract, the Region of Languedoc-Roussillon, now Occitanie, wanted to assess and reconstruct the operating costs of the TER service on the basis of the Region's transport plan in order to make comparisons with the proposals of SNCF-TER. To this end, the Region instructed SMA to reconstruct the activity units of the TER Languedoc-Roussillon and Midi-Pyrénées and a partner to assess the operating costs on this basis. All the TER transport plan data for 2014 and 2015 which were chosen as reference years (timetables, service, rolling stock) was modelled using Viriato software. The movement of rolling stock was then planned using Viriato, which determined the activity units, the fleet of rolling stock, the days of service and the number of drivers and controllers. Furthermore, new indicators were integrated into this processing, such as the number of seats available per train*kilometre.



Transport Ministry, Government Authority for the Territorial Equilibrium Trains: Sizing the fleet to be managed for intercity links To ensure that future of the train services during the day remain under its responsibility, the authority of the territorial equilibrium trains decided to issue a call for tenders to acquire new multiple unit trainsets to serve the structural lines.

As part of a framework contract, SMA, together with several partners, estimated the necessary fleet size to be managed in the context of this call for tenders. The estimate was based on several increased service scenarios, whose provisional impacts on the railway operating accounts had been estimated.

These scenarios showed that an improvement in performance, enabled by modern stock and a suitable infrastructure, could deliver an increase in the service based on a fleet size equal to or even smaller than that which is necessary to maintain the service at its 2017 level. They also enabled the size of the fleet to be acquired in firm orders as well as in optional tranches to be quantified.

The study also highlighted the advantages of modern multiple unit rolling stock and the interest in optimising its use, particularly in view of the potential traffic of the various services provided by these lines (main radial flows and also traffic in stations such as Limoges, Brive or Clermont-Ferrand).

These various scenarios may be investigated further when the master plans are drawn up for each of the structural lines.



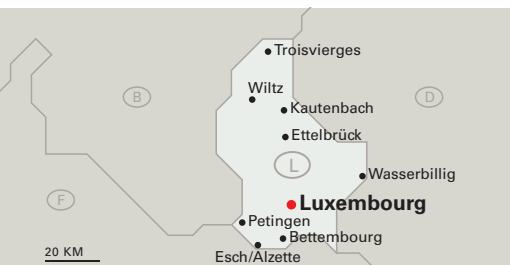
FTA and VR: Viriato 8 in Finland – More than just a migration project Viriato has been deployed in Finland for more than fifteen years, and is used by both the infrastructure manager FTA and the train operating company VR. In 2009, SMA developed the VLIKE capacity management module, linking the path ordering process with Viriato, in addition to smaller functional enhancements specifically for the Finnish market.

In 2016 FTA and VR decided to migrate their installations to the latest Viriato 8 version to take advantage of the new product design. The project started with a comparison between the existing Finnish version of Viriato and the standard version of Viriato 8 in order to document the additional functional requirements of the migrated version, including the VLIKE system. This phase involved both VR and FTA stakeholders allowing the elimination of customer specific functions that are no longer needed and more importantly to capture new requirements.

In order to develop appropriate solutions, SMA is dependent on regular customer feedback during the implementation phase. The distance between our offices and the customer's locations meant that it was not possible to meet regularly with the project stakeholders. To maintain the required integration for a project of this complexity SMA conducted regular web conferences demonstrating the latest developments, project management issues and allowing the future users to ask questions and provide the team with feedback.

In the last phase of the project SMA organised a training and testing workshop in which the Viriato users of FTA and VR learned the functionality of the new software, and then carried out acceptance testing against the project requirements. While testing workshops in Zurich are an established part of the project process for SMA, the combination of integrated test and training was new to all participants and has proved its worth. Users were able to work intensively with the new software and were therefore very well prepared for the launch of the productive version.

Since November 2016 Viriato 8 has been used productively in Finland by FTA and VR. Due to the increasing liberalisation of the railway industry in Finland, the group of users has been joined by HSL, the regional transport authority for the Helsinki area.



Luxembourg railways: Analysis and proposal for new short, medium and long-term concepts

The railway network in Luxembourg currently faces a large number of challenges including, for several years now, significant increases in the service and use without any noticeable increase in infrastructure capacity and without any reform of the timetable structure, resulting in an unsatisfactory situation in terms of quality of service. The network will undergo unprecedented development in the coming years from the point of view both of customer demand as well as of infrastructure with a large number of planned overhaul and refurbishment projects including, namely, the new Bettembourg–Luxembourg line that begins at Luxembourg station.

In this context, CFL Voyageurs instructed SMA to, as a first step, support it and draw up a short-term timetable to improve the quality and reliability of the service, taking into account the first planned infrastructure projects. This stage required an analysis and understanding of the existing failings and their effects in order to identify the home-grown causes and the realistic improvements to be made in the short-term. The second stage would require SMA to assist CFL in forming the network in the long-term to define a service able to meet demand, the timetables of the various lines and the necessary rolling stock fleet. The study process would also identify the additional functions that may be needed and that would be in keeping with the service objectives.

In order to achieve this, all the SMA tools are used to produce the various service, timetable and infrastructure proposals and present them to the study partners.



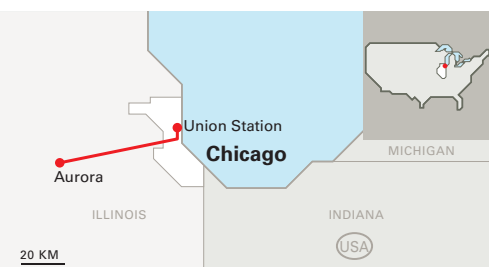
BNSF Railway and Caltrans: San Joaquin Corridor Strategic Operations Study

The State of California and the San Joaquin Joint Powers Authority (JPA) have expressed a near-term desire to increase the service frequency for the Amtrak San Joaquin passenger service from seven to eight daily roundtrips. As the host railroad of a large portion of the San Joaquin corridor, BNSF commissioned SMA to work with stakeholders to support the development of a new near-term corridor operation concept that defines the passenger schedules and identifies infrastructure investments needed to support the expanded service without negatively impacting freight operations.



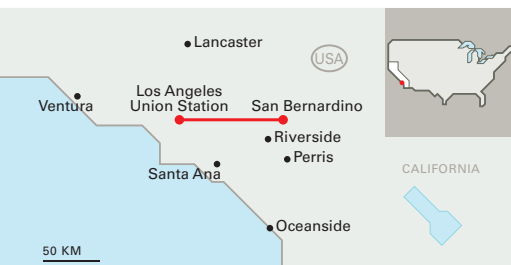
California High Speed Rail Authority: Peninsula Corridor Integrated Schedule Study (Phase 1&2)

The California High-Speed Rail Authority (CHSRA) contracted SMA through its Rail Development Partners (RDP) to conduct a planning study to develop an operating concept for blended Caltrain and High Speed Rail (HSR) service on the Peninsula corridor. SMA engaged in a collective planning effort with the CHSRA and the Peninsula Joint Powers Board (PCJPB) to design service and operation concepts under multiple infrastructure investment scenarios.



BNSF Railway: Metra Aurora-Chicago Line Operations Planning Support The project scope included an analysis of current operations on the Metra BNSF line running through the Chicago metro area, followed by schedule planning in anticipation of future service. Planning was split into two timeframes: short-term schedule adjustments and long-term schedule re-design.

SMA developed a statistical analysis of current operations along the corridor, upon which "Quick-Fix" recommendations to the passenger schedule were made. Using Viriato, a comprehensive concept for a re-designed future schedule was developed in addition, taking into consideration updated planning parameters, planned overtakes, and the alleviation of bottlenecks. The resulting "Quick-Fix Schedule" was successfully implemented by BNSF on October 9th, 2016.



Metrolink: Southern California Regional Rail Authority, Network and Schedule Planning Support

With SMA's support Metrolink has introduced a new timetable on its line between Los Angeles and San Bernardino on April 4th, 2016. The line is Metrolink's busiest, serving approximately 11,000 passengers daily. Metrolink's objective was to develop a more robust timetable for this largely single-tracked corridor. SMA analyzed current operations data together with Metrolink and developed new planning parameters for the line, including an adjusted approach to allocate recovery times. After implementation, the on-time performance on the San Bernardino Line significantly improved. Subsequently, Metrolink requested SMA to support the development of new schedules for the Orange County Line, Inland-Empire Line, and 91 Line for a June 2016 schedule change, and for the Ventura County Line and Antelope Valley Line for an October 2016 schedule change.



Caltrans: California Passenger Rail Network Schematic Booklet Development

SMA, under contract with the California Department of Transportation (Caltrans), updated and expanded the California Passenger Rail Network Schematics book. The booklet, which previously only contained intercity routes, was expanded to include schematics for all subdivisions used by intercity and regional rail in California, redesigned to provide more detail and updated to include funded infrastructure improvements. The collaborative endeavor required input from 12 California rail owners, operators and agencies, including Amtrak, Metrolink, BNSF, Caltrain, and the San Joaquin JPA among others. The final product was distributed to participating agencies as an internal planning tool.



Caltrans: Southern California Coordinated Planning The BNSF, Caltrans, LACMTA, NCTD, OCTA, and RCTC contracted SMA to lead the development of a coordinated planning process for the Southern California rail network. The aim was to analyze the current operation, design a generalized operation plan that reflects today's operation, generate variability control strategies, and validate the ideas in collaboration with dispatchers. SMA developed an innovative approach to analyze past operation using data from the dispatch systems. Using visualizations, SMA described the variability in the current operation and developed a planning approach for a more robust operating plan before conducting an extensive iterative planning process. The resulting short-term (2015/2016) passenger timetable concept incorporated short-term variability control strategies and was implemented in June 2016.

Viriato Vehicle Rostering The planning of efficient vehicle rosters is a key activity affecting the economic performance of a railway, and in 2016 SMA has invested in developing a new Vehicle Rostering module for Viriato.

The new Viriato Vehicle rostering module has been developed from scratch, and is designed to be fully integrated with the timetabling functionality of Viriato, allowing the creation of vehicle rosters during the planning process.

Throughout the lifecycle of a timetable there are different requirements for vehicle rostering, and the new module provides the functionality for this entire process. During the initial long term strategic planning process the user can concentrate on determining the size of the required rolling stock fleet to deliver the service pattern. As more detail becomes available the vehicle rosters can be refined to include detailed rolling stock information, maintenance activities and empty runs.

Key features of the new Viriato Vehicle Rostering include: full integration with the timetable and date specific rostering, printed outputs and reports, display of the rosters on the graphic timetable, management of the sequence of vehicles and changes of direction during a timetabled run, plausibility checks, empty runs and maintenance activities to ensure that the rosters are operable, and automation tools to provide rostering solutions quickly.

An exciting feature of the new vehicle rostering module is the development of an interface for the model data, allowing the user to perform the planning within Viriato, and then undertake optimisation studies using external tools.

During the coming year SMA plan to continue developing the vehicle rostering module to add extra features.

Viriato: Passenger Demand Assignment The relationship between the timetable itself and the number of passengers travelling on trains is of vital importance to train operators for planning the efficient utilisation of their rolling stock. As the timetable changes during the planning process, this influences the routes taken by the passengers and therefore the ridership numbers on each train. Until now it has not been possible to directly determine this within timetabling tools.

SMA has developed a new Demand Assignment add-on module for Viriato which allows the link between individual passengers and how they make their journey choices to be evaluated quickly and efficiently, without the use of third party tools.

Using this new module the number of passengers wishing to travel within the network, and the time distribution of these trips throughout the day are entered. These figures can be sourced from historic ridership figures, or predictions from socio-economic models. Each possible journey between stations is calculated for every train in the timetable using the Viriato Trip Time Analysis module, and an assignment algorithm combines them with the number of passengers wishing to travel in each time period. This algorithm uses the

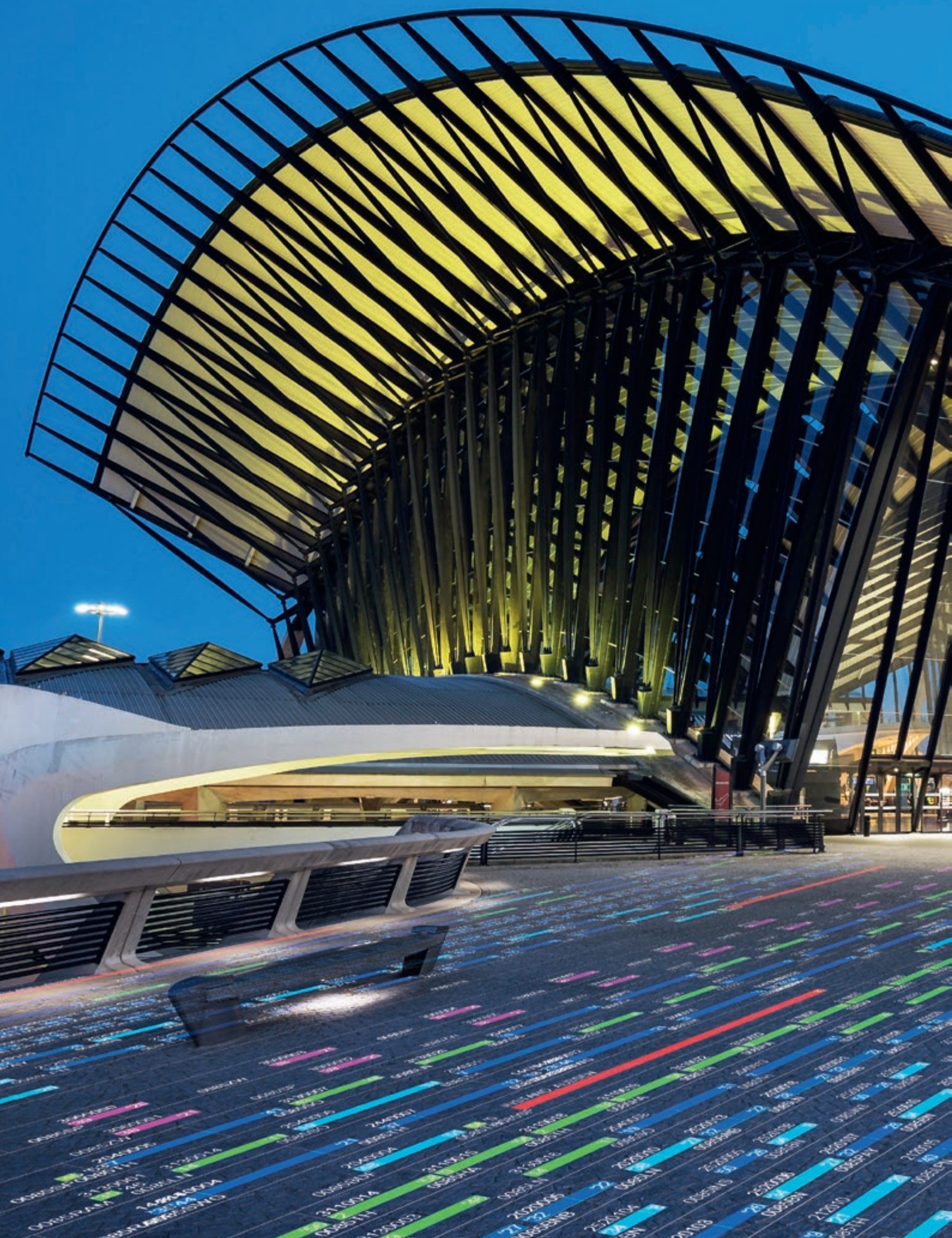
analogy of the flow of electrical current through a circuit to allocate passengers to the individual trains in the timetable based on the relative attractiveness of the trip compared to other possibilities. Finally, the numbers of passengers are summed to produce a train specific count of passengers on board throughout the trip.

The results of this analysis are shown directly within the trains in Viriato, allowing the timetable planner to quickly make decisions about the rolling stock to use, and to concentrate on the service pattern in areas of high demand.

This module is undergoing testing, and possible future additions to the module include automatically validating passenger loadings against rolling stock assignment and integration with the Vehicle Rostering Module.

New Viriato Licenses

- BLS AG, Passenger division, Switzerland
- Helsinki Regional Transport (HSL), Finland
- LISEA, Bordeaux, France



2007	2008	2009	2010	2011	
SMA opens a branch office in Lausanne. In Zurich, the offices also undergo a further expansion.	More than 350 participants attend IT08.rail at the ETH, the first of this series of events. The SMA website also keeps up with the times, and undergoes a thorough overhaul.	SMA formulates a new organisational structure; the company exceeds the 50 employees for the first time. By redesigning Viriato, SMA starts the task of completely re-implementing the software. The project required a total of five years.	For the first time, the turnover exceeds CHF 10 million. In workshops, a group of senior staff defines a company vision and a future strategy for the company.	A new board of directors takes charge of the company.	SMA INTERNAL
In the project “Structuration” commissioned by RFF SMA develops a train path catalogue based on a clockface timetable. The LIIKE project involves the development of a train path ordering portal in Viriato for the Finnish infrastructure operator RHK.	The Belgian operator SNCB switches to Viriato for their service planning. SMA develops a strategic timetable for 2020 on behalf of RFF.	The planning activity of SMA related to the commissioning of the high-speed line LGV Rhin-Rhône influences the path catalogue of the RFF project “Structuration”.	The conciliator Heiner Geissler designates SMA as a neutral expert in the public conciliation phase of the Stuttgart 21 project. For the Zurich S-Bahn, we develop with ZVV and SBB a future vision under the title “S-Bahn Second Generation”. An analysis of the RER line A of RATP identifies improvements for reliability and punctuality.	As part of the Stuttgart 21 project conciliation, SMA is commissioned to undertake a stress test as a neutral expert on behalf of the stakeholders. Following a European tender, SMA is awarded a contract for a new timetable system at DB Long-distance Traffic. Based on the core of Viriato Enterprise, the project encompasses comprehensive, customer-specific extensions. It also is represents the largest project at SMA to date.	SMA PROJECTS
ETCS Level 2 is commercially introduced in Switzerland with the commissioning of the Lötschberg base tunnel and on the new line Mattstetten–Rothrist. In France, the first stage of high-speed line LGV Est is taken into operation as part of the Paris–Strasbourg connection.	In Lausanne, the M2 is the first metro line in Switzerland.		The Glattalbahn is finished with the commissioning of the 3rd stage.	The start of operation on the high-speed line LGV Rhin-Rhône occurs in parallel with a new interval timetable for the whole of France.	MILESTONES

Events, publications and presentations

InnoTrans 2016 The eleventh InnoTrans turned Berlin from the 20th to the 23rd September into the international hub of the railway world. As was the case in 2014, the number of exhibitors and visitors again reached a new record this year, and the exhibition grounds in Berlin were fully booked. This was the seventh SMA presence in Berlin, this time on the main Swissrail stand. Numerous visitors called in at the redesigned SMA stand, and many interesting discussions were held.



Events, publications and presentations

Aula Aberta Instituto Superior Técnico, Lisbon and
Aula Aberta Universidade de Coimbra
April 2016

**RAIL 2000 – More trains for Switzerland:
A sustainable and comprehensive project to boost
public transportation**
Hansruedi Akermann

California Passenger Rail Summit
Los Angeles, CA, April 2016

Shared Corridor Operation
Ulrich Leister

Seminar on railways and railways operation at the
TU Berlin
Berlin, July 2016

Guest lecture «Fernverkehrsplanung in der Schweiz»
Raphael Karrer

Association of Public Transport Engineers
Zurich, September 2016

Angebotsplanung S-Bahn München
Georges Rey

«VDEI talk.ING»
Frankfurt am Main, October 2016

**Impulsreferat und Podiumsdiskussion:
Eisenbahn in Deutschland – Szenarien der Zukunft**
Trutz von Olnhausen (SMA) and Simon Hofmann

Netzwerk Intelligente Mobilität (NiMo)
at the Working Group «Self-Driving Cars»
Berlin, November 2016

**Zukunft der Eisenbahn
im Kontext des autonomen Fahrens**
Trutz von Olnhausen

SPUR Oakland
Oakland, CA, November 2016

**Swiss Time at SPUR – Design of an
Integrated Network**
Ulrich Leister

Metro Report International
December 2016

Using simulation to predict the impact of upgrades
Eric Cosandey and Pascal Joris

Key figures

The SMA Group turnover rose again in 2016 compared to the previous year. This positive trend is driven by the development of our activities in the USA and the intensification of the consulting business in Switzerland. The IT department also shows healthy and steady growth both in services and in the area of maintenance.

SMA continued its internationalisation strategy in 2016. Our locations in Switzerland, Germany, France and the USA allow us to develop the desired diversification of our customer portfolio and services, and thus ensure local support for our clients.

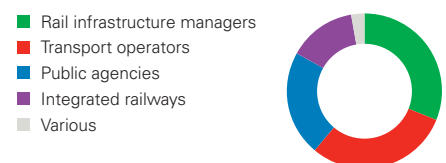
Key figures* in millions of Swiss francs	2016	2015
Gross turnover	12,4	12,01
Full-time employees	67	64
Turnover/employee	0,19	0,19

*incl. subsidiaries

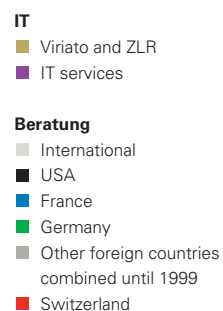
Turnover by country



Turnover by client category



Development of turnover 1988 – 2016 (millions CHF)





2012	2013	2014	2015	2016	
On the occasion of its 25th anniversary, SMA issues new company and product brochures, and adopts the company slogan “optimising railways”.	The company ownership is transferred to a group of long-term employees by means of a management buyout commencing on the 1st January 2013. The SMA website undergoes a complete redesign.	SMA founds the subsidiary SMA Rail Consulting + IT, Corp. in Santa Ana, California to serve the US market. The Viriato migration to a new technical platform is completed with the introduction of Viriato 8.	With the opening of the two subsidiaries SMA (Germany) GmbH in Frankfurt and SMA (France) SAS in Paris, we move even closer to our most important customers.		SMA INTERNAL
SMA penetrates the North American market with a study for a train path catalogue for Caltrans and BNSF on the San Joaquin corridor in California.	SMA wins an international tender for a study on the operations and capacity optimisation of the Santiago de Chile metro. SMA supported BAV and SBB in the STEP AS 2030 project planning the next stages of railway infrastructure development in Switzerland. As part of neXt project, we advised DB Netz on the process for industrialised timetable production.	SMA expands its customer base to Asia with a simulation study for MTR Hong Kong and the sale of Viriato to VNR in Vietnam. Infrabel selects the ZLR running time calculation service from SMA as part of their new dispatching system.	The timetabling system Viriato.FF is successfully commissioned at DB Long-distance Traffic.		SMA PROJECTS
		The opening of the new through-line Altstetten–Zurich HB–Oerlikon marks the provisional conclusion of the extension of the Zurich railway hub.		The commissioning of the Gotthard base tunnel closes a circle after three decades, as the company was concerned at its very beginning with the 10 arguments in favour of the Gotthard Tunnel.	MILESTONES

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