Geographic Information Systems for the railway industry

How data becomes solutions.
Railway transportation is a sector that is constantly in upheaval. As a significant mobility factor, the railway industry is in the never-ending process of having to prove its strength and competitiveness day in day out. Innovative and customer-oriented services for passenger and cargo transport are in demand as never before.

technet-rail helps the railway industry to develop innovative and future oriented services. We are among the market leaders in the area of geographic data-based products for railway companies.

Thanks to our more than 20 years of experience in surveying, we develop software programs that enable state of the art customer-specific software solutions. This also includes 3-D capture and 3-D data processing of infrastructure data, the development of navigation and simulation models as well as the conception of passenger information systems.

Every one of our solutions aims at giving our customers a head start in the field of their market. That advantage gives our customers the significant benefit for their work.

The technet-rail team looks forward to working with you.

Dr. Ivo Milev
Managing director
technet-rail 2010 GmbH
technet-rail was established in 2010 emerging from technet GmbH founded in 1989. Our scope of services encompasses customer consulting and software development for several applications in the railway industry. We offer our clients individual, innovative and complex software solutions in the area of transport and railway construction, surveying, integration of geographic data, 3-D laser scanning, inertial systems, satellite-aided navigation as well as multi-sensor systems in road and railway construction.

Bundled knowledge creates new solutions

technet-rail’s team of specialists has been bundling years of knowledge from the surveying and engineering sectors, from the fields of computer science, mathematics and cartography. As a UN consultant for global navigation satellite systems (GNSS), Managing Director Dr. Ivo Milev attends to upcoming trends and perspectives of geographical data-based information. Our state-of-the-art specialist knowledge enables us to constantly further develop software programs and to be able to adapt these to ever-changing requirements.

The industry trusts in us

Our current customer base consists of more than 200 engineering offices and major railway companies. We work with Deutsche Bahn AG, Leica Geosystems AG, Schweizerische Bundesbahnen (SBB), Österreichische Bundesbahnen (ÖBB), Luxembourg Railways (CFL), the Russian State Railways as well as key energy providers and chemical companies in Europe and the USA (e.g. BayerCorpScience).
technet-rail uses 3-D laser scanning technology to capture and process terrestrial data. The benefits of this method: extreme speed, precision and seamless recording of the environment with the aid of millions of 3-D object points as well as a broad range of usage of the acquired data.

Track and close topography seamlessly captured

3-D data is the basis of the most various types of analyses in rail traffic. technet-rail uses the captured track geometry to calculate driving dynamics or to test the target track geometry (Quality Control). Further applications are clearance measurements and the identification of clearance gauge. These applications are used to assess and secure transports with bulky or oversized loads. The topography in the vicinity of the track, such as buildings, masts and other facilities can be assessed within a radius of 200 meters and analyzed.

Innovative surveying method makes use of satellites

technet-rail is one of the very few data integrators that uses state-of-the-art kinematic surveying systems. This process involves the combination of 3-D laser scanners with real-time navigation and the use of satellite systems (GNSS), such as GALILEO, GLONASS and GPS. These innovative surveying systems have been applied numerous times by technet-rail in projects for customers from Germany, the Netherlands and Russia, in particular in the monitoring and control of rail and road conditions as well as volume calculations and deformation analyses.

technet-rail – Partners of system leaders

technet-rail cooperates with leading manufacturers of 3-D laser scanners, such as Riegl, Topcon, Leica, Zoller & Fröhlich and Faro, which is why we have direct conversion codes of all binary manufacturer formats. This allows an easy and quick import and further processing of nearly any kind of scanning data.
Many national railway networks already have railway databases. technet-rail has developed complex solutions with which we can visualize, analyze and process existing infrastructure data – in line with customer requirements.

Five integrated modules

Our five modules for the railway industry can be purchased as standalone solutions or as a package (SiRailData).

The SiRailScan module encompasses extensive software for the evaluation of laser scanning data. Various functional scopes such as the Basic, Architecture and Railway modules are available.

The SiRailViewer module is used to view scan data and to load geometric data. The module is suitable for clearance measurements (e.g. to calculate the platform edge with automatic distance measurement to the axis of track, collision test) and the export of measuring points.

ATrack stands for automatic track recognition. The module offers automatic track and gradient calculation. It enables error analyses to bridge measurement gaps and transformations of measured points to the calculated track geometry.

The module Verm.esn is used for track planning. This software has been further developed by technet-rail. It is used, for example, to create track plans, to optimize tracks and to calculate different transformations.

We use the SiRailManager database module to process, administer and update our customers’ databases. An important role in this respect is the enhancement and harmonization of data such as track networks and IvL plans. The latter does not only document the current track geometry but also the property ownership of the railway operator.
SiRailScan enables the direct import of proprietary (in-house) data formats from all significant laser scanner manufacturers. With this, the universal visualization and analysis of any 3D scan material is possible without any problems whatsoever.

Conversion to several graphics formats

SiRailScan works with a special graphics engine that was optimized to cater to the characteristics of 3D raster data. The program can generate all standard output formats such as DXF, DGN, JCE, Geomatics/GIS and provides high-resolution visualization in the image file formats BMP, TIFF and AVI.

SiRailScan determines the actual track geometry without any constraints and high precision manner. In this process, the inner sides of the toprail are modeled on the basis of point cloud data and the track’s actual position and height are calculated.

Potential collision points – clearly visible

The program can simulate train passages and conduct collision tests based on the determined track geometry. Potential collision points are colored in and displayed in a separate window for initial analysis. The program can also perform axle-based measurements. The clearance gauges that are determined by the collision test undergo vectorization and can then be exported in the desired file format.

Perfect for infrastructure modeling

In addition, the determination of the actual track geometry can also be used for comparisons with the planning status (actual-target comparison). SiRailScan is the perfect tool for modeling railway infrastructure, e.g. semi-automatic modeling of overhead line and their digitalization.

A point cloud is a list of Cartesian 3-D coordinates that is created by scanning objects or surfaces, e.g. with a laser.
SiRailScan (SRS) is a technet-rail-developed, cross-platform software for the evaluation and analysis of 3-D laser scan data. It can be used to simulate train passages to determine and localize clearance gauge and to conduct target-actual comparisons of track geometries.

Further applications are orthoviews, registration of static scans, point-cloud-based sections, creation of digital surface models and coloring a point cloud with a handheld picture.

Analyzing track data. Manufacture independent.

Because of a special component, the software SiRailViewer can analyze data in a geographic context. The benefit for the user is that georeferenced scans can be performed on their geographic surroundings.

SiRailScan can combine scans with orthophotos of the area. The program combines data of several origins and precisions such as airborne topographic data, orthophotos, LIDAR data, digitized raster data as well as LIMEZ data. This facilitates the handling of large volumes of data and simplifies the evaluation.

Quick view of track dimensions

SiRailViewer focuses on the important area of clearance gauge analysis (pursuant to the Obstacles gauges standard EN 15273-1). In this case, the software combines the track network data of the railway company with the data acquired by the survey train. This visualization in real-time shows for instance the track axis, radius, superelevation, gauge, track ID and chainage.

With the SiRailViewer, the user can determine a freely configurable part of the track. Within that part all platform points and their distances to the axis are mapped. The narrowest area is shown automatically. The edge points can be saved and exported with all information.

SiRailViewer also contains measurement functions, clearance frames, and a collision test pursuant to the Euronorm for Obstacles gauges. In addition to scan data, extensive map material can be fed into the system. This enables the visualization of plans in various degrees of detail, thus facilitating analysis. Of course, photos, videos and geometric data such as LIRA profiles (clearance gauge vectorised lines), sections and surfaces can be embedded.

SiRailViewer by technet-rail harmonizes all data and ensures clear access.
With SiRailViewer technet-rail has developed a module that is particularly suited for the visualization of static and kinematic scan data. It enables the execution and visualization of clearance analyses and collision tests.

The ATrack module automatically calculates the track geometry with regard to position (rail and tangent gradient). It is based on the positions and lengths of points as a result of continuous measurements. Automatic track recognition and calculation (including of track elements like circle, transition curve, tangent, etc.) and element parameters (radius, length, tangent direction) are known track segments (stationary, dynamic stations). ATrack enables the graphical visualization of tracks, curvatures and measurement points with descriptions and distances.

In terms of gradients, ATrack calculates the length of a certain track at the press of a button. This also applies to the gradient variation and the determination of start and end points of the gradient. The respective tangent length or main gradient points is automatically calculated.

A further benefit that ATrack has to offer: Preceding filtering of measurement data allows the detection of major errors and closing measurement gaps.

The geographic information system of the Deutsche Bahn AG encompasses all railway geodata and topology, topography, buildings, technical facilities and railway crossings. They are geometrically and geographically precision captured and visualized in the railway-specific DB-REF-System.
Calculating tracks.
Efficient and user friendly.

**ATrack** is an efficient module for the automatic measurement-point-based determination of tracks and gradients. The program is also suited to process large volumes of data. Track elements and inclination ratios can be calculated in a few seconds. The GUI is very user-friendly.

### Calculating tracks.

**Efficient and user friendly.**

The basic functions of **Verm.esn** on track planning. This includes the position and length of the track as well as geodetic calculations. The program permits the evaluation of driving dynamics, and shift-based determination of track geometry pursuant to the guidelines of Deutsche Bahn AG.

Track plans, railway switch layouts and railway switch height plans can be created. The potential correction values can be transferred to the track laying machinery of the track system.

### Exceptional function range – simplified analysis

**Verm.esn** offers a user-friendly and clear functional range and user interface. It offers plan track elements including all corresponding parameters, color-coded element groups, the visualisation of track elements. Action results with combinations and control points. In addition, it integrates points with displacement lines in position and height can be shown.

### Compatibility in a wide range

A further program add-on – **AXTRAN** – is used for track optimisation in terms of position and height. It offers an automatic analysis of existing track parameters with constraints such as track or object points, radius and length. Track geometries can be optimised in AXTRAN within a few seconds.

The add-on **GVPlan** enables the automatic drawing of track plans pursuant to the requirements of Deutsche Bahn AG. It is easy to integrate buildings and symbols.

### Useful extension:

**TechCAD**

The graphics program **TechCAD** is a user-friendly extension of **Verm.esn** to visualize railway data. The track and geographic data can be further processed with a broad range of drawing, text and object options. It also imports and exports data in the standard formats *.DXF and *.DGN.

**TechCAD** also has an extensive library containing symbols used by Deutsche Bahn AG. It is possible to edit layers and their properties.
Verm.esn is used to manage track data of Deutsche Bahn AG in an optimal and multifunctional manner. Among other possibilities Verm.esn can process the results of the modul ATrack for further analysis. Verm.esn is completely compatible with the rail track database and geographic information system of Deutsche Bahn AG (DB-GIS). This means: All calculations and graphic outputs are based on DB AG guidelines.

Planning and optimizing tracks.
For the rail track database of DB AG.

Verm.esn allows various information from the database to be extracted and combined with chainage lines and IvL plans. Based on the integrated data set, such as tracks, chainages and IvL plans, several functions and evaluations are provided.

Creating measuring points, tracks and layers
The user can create e.g. schematic plans or measuring points on a virtual track. Measuring points can be saved, organized and edited in several layers. Additionally, information (coordinates, back, chainage, distance to track, radius, etc.) can also be exported to PDF files.

Unlimitedly expandable
In addition, SiRailManager offers unlimited expansion options. It offers the possibility of integrating bridges, railway switches, tunnels or railway crossings. Further useful functions are the visualization and combination of airborne data, IvL plans and data from web-based map services (such as Google or Bing).

Besides the physically installed versions, SiRailManager is also available as a web application. In that way, stored information can be called with mobile end devices such as smartphones or tablet PCs from anywhere.

In addition to the status and location of the track facilities, IvL plans also show the property boundaries of the respective railway operator. They contain information on shafts, signals, slopes and railway crossings.

Airborne topographic data are acquired by flying over the terrain on predefined routes to capture a seamless collection of aerial images.
Flexible and mobile management of rail track databases.

**SiRailManager** is a program by *technet-rail* used to display and manage complete national rail track databases. The program is a server based solution.