

# **Trimble GEDO Systems** Track Measurement Solutions





# Railway Measurement Solutions

Railways are essential components of the global economy and infrastructure. Throughout their life cycle, rail operators demand an efficient approach to planning, construction, operations, maintenance and expansion. These applications call for innovative solutions for measurement and information management.

Based on decades of experience in the rail industry, Trimble<sup>®</sup> GEDO systems combine positioning and measurement sensors with communications and software. Trimble systems provide fast, accurate and reliable solutions for railway spatial information needs.

## Planning

Trimble GEDO systems collect and manage detailed information needed by planners and designers.

#### Construction

Use Trimble GEDO systems for precise alignment of track and for post-construction inspections and approvals.

#### Maintenance

Trimble GEDO systems increase productivity in inspection and tamping operations.

#### Modernization and Expansion

High-resolution data from Trimble GEDO systems assist planners to update facilities and track for larger, faster rolling stock.

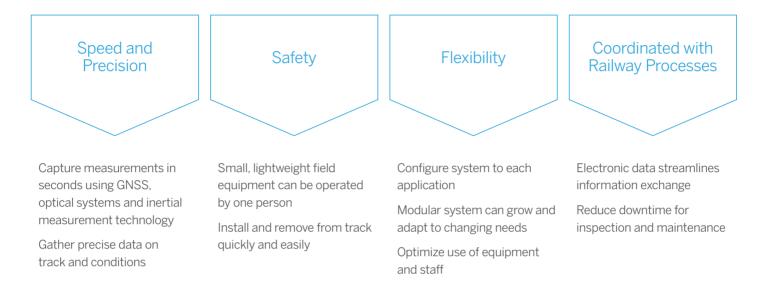
## Signalling (ETCS and PTC)

Use Trimble GEDO systems to collect and manage information on location of track, control structures and other safety activities.

- Speed and precision in measurement operations
- Accurate reliable information on track and facilities
- Increased efficiency in planning, design, and construction
- Reduced downtime for measurement and maintenance



## TRIMBLE GEDO SYSTEM





## TRIMBLE GEDO SYSTEM

Trimble GEDO systems utilize Trimble GNSS, Trimble Total Stations, inertial measurement and related sensor technologies to capture precise positioning data on railway track and surrounding features. Based on decades of experience in the railway industry, Trimble GEDO systems provide efficient tools and workflows throughout the rail measurement process. By integrating rugged field hardware with customized software and point of work guidance, Trimble GEDO systems reduce rework and increase productivity across the entire enterprise workflow.

Flexible Trimble GEDO systems provide maximum return on your investment. You can quickly configure your system to support track location, inspection, construction and maintenance as well as planning for improvements, updates and expansion. As your client's needs change, Trimble GEDO systems can adapt to new requirements for measurement and data management.







# Solutions for Track Documentation

Efficient management demands accurate information. To provide complete information, rail operators need productive rail measuring systems to provide accurate surveys of existing track.

The Trimble GEDO system is a fast, efficient tool to measure, record and document detailed information about existing track. By simply walking the track, you can capture detailed information for asset management, realignment, GIS, design, and quality control.

To use the Trimble GEDO system, a single operator pushes a simple trolley along the track. Onboard the trolley, components for measurement, recording and user guidance are integrated into a rugged, weatherproof system. The critical data is collected and stored in a single operation.

## TRIMBLE GEDO IN ACTION: TRACK DATA FOR PTC

California-based Cinquini & Passarino, Inc. uses Trimble GEDO Rec system to capture data for more than 80 km of track for Positive Train Control (PTC). Limited to working at night in four-hour windows, the Cinquini & Passarino teams covered 8 km – 13 km each night. Using standard PTC Data Model Definitions, they collected more than 120,000 points maintaining accuracy of 2.5 cm or better.

#### Measurement of As-built Track Conditions

In addition to capturing the absolute position of the rails, the system measures and stores cant and gauge. Measurements can be captured as the operator moves continuously along the rails, or by stopping at specified intervals.

#### **Determining Track Location**

With the Trimble GEDO system, you can quickly survey existing lines without the need for alignment data. Using GNSS or optical surveying techniques, the system provides survey-quality location of the Trimble GEDO Trolley. Results can be tied to national or company-specific coordinate systems.

#### Fast, Precise Measurement

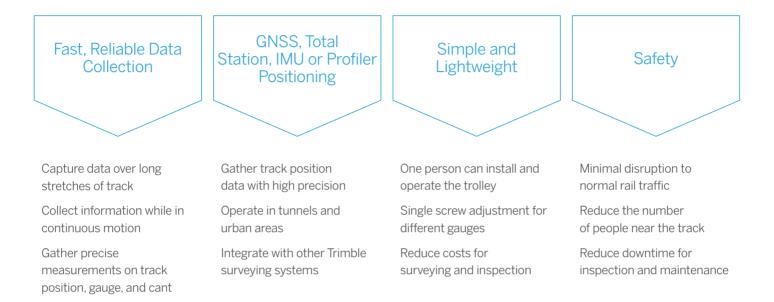
When configured with a Trimble S-Series Total Station, the Trimble GEDO Trolley can collect data with millimeter precision while covering up to 1,200 m of track in one hour. And, systems configured with Trimble GNSS can cover up to 3,000 m of track per hour with centimeter precision. The combination of inertial measurement technology with Trimble GNSS or laser distance measurement allows track survey with an inner accuracy of a few millimeter and a productivity of more than 2,500 m per hour. Pure relative survey can be done with up to 5,000 m per hour.

#### Measure Track in Any Location

Use the Trimble GEDO system to collect information on a wide variety of track. You can measure main lines, sidings, and spurs as well as urban trams and metro lines. The system can also measure track in industrial or commercial facilities. Because the Trimble GEDO system can use both GNSS and optical measurement, you are confident of accurate positioning in all locations.



## TRIMBLE GEDO FOR TRACK DOCUMENTATION



SVCF

GEDO CE

Trimble

## INTEGRATED TRIMBLE GEDO SYSTEMS FOR TRACK SURVEY AND CONTROL

The measurement of the track position can be done with different GEDO system configurations.

- GEDO Rec for geodetic track surveying with total station
   or GNSS
- GEDO Vorsys using an alignment methods
- GEDO IMS as a highly deductive system based on inertial measurement technology

The respective field software guides and informs the operator to ensure complete and accurate data acquisition. The Trimble GEDO CE 2.0 trolley can be quickly removed from the track in order to avoid interruption of operations. The GEDO Office software is used for data processing and analysis. Track position data can be transferred to GIS and planning systems.





# Solutions for Precise Slab Track Construction

Slab track construction calls for fast, precise measurements, and immediate feedback. The Trimble GEDO system let you measure for precise adjustments, inspections, and quality checks. In one operation, the Trimble GEDO system captures 3D coordinates of the track, together with gauge and cant. The information is compared to the design, and offsets and correction values are displayed in the field, where work crews make the necessary adjustments.



Before bringing the design to the job site, use Trimble GEDO office software to check the data and upload to the field computer. You can import data from popular design software or manually enter the information from paper.

# Tools for Slab Track Construction and Alignment

Trimble GEDO integrates measurements, field software and office systems to provide productivity and confidence in construction and quality control. Systems measure horizontal and vertical alignment, cant and gauge in a single operation. Working alongside track construction teams, the Trimble GEDO system provides immediate comparison of actual to design track positions. Construction teams can complete rough and precise adjustments as well as final checking quickly and with high confidence.

## Track Construction for High-Speed Railways

The Trimble GEDO measurement systems provide millimeter accuracy for construction, adjustment and inspection. Working in real time, the system displays measurements and information to ensure that rails precisely conform to design. Trimble GEDO systems support high-speed rail construction worldwide

## TRIMBLE GEDO IN ACTION: SUPERVISION SLAB TRACK INSTALLATION AT TUNNEL ZIERENBERG

A.I.T. GmbH was responsible for construction supervision of the ballastless track in the newly built Zierenberg Tunnel of Deutsche Bahn AG. In the project, the connection to the ballasted track was build with the Rheda 2000 system. The rest was build with the IVES system from Rhomberg-Sersa.

The Trimble GEDO CE 2.0 system was used for acceptance measurements prior to concreting and control measurements after completion.

## TRIMBLE GEDO IN ACTION: CONTROL OF SETTLING IN SLAB TRACK HANNOVER - BERLIN

As a service provider for Deutsche Bahn AG the engineering company GI-CONSULT GmbH used the GEDO CE 2.0 system for controlling the settling of the installed slab track (System Rheda) on the high speed connection Hannover – Berlin. The measurements were only taken in nightshifts. The collected data was used to calculate new gradients for the track for nearly 1,000 m and to control around 400 m of reconstructed areas of the slab track. The track is approved for a speed limit of 300 km/h.



## TRIMBLE GEDO FOR SLAB TRACK CONSTRUCTION





## TRIMBLE GEDO SYSTEMS FOR BALLASTLESS TRACK SYSTEMS ON HIGH-SPEED LINES AND METROS

In conjunction with the Trimble GEDO track measurement trolley, the Trimble GEDO Track software enables precise track adjustment during slab track construction and subsequent track position control. The flexible measurement configuration facilitates close cooperation with the construction team. If, due to the setup system used (e.g. portals), no track measuring carriage can be used, the electronic GEDO CE track measuring bar is used in combination with the Trimble GEDO Track software.

The system can also be equipped with rail inclination sensors for adjustment systems in which the inclination of the rail must also be set up or controlled.

The GEDO Office software is used for data analysis, the generation of the plate correction lists and the preparation of the final quality reports.



0 2



# Solutions for Railway Tamping Measurements

Tamping is essential for railway maintenance to ensure track quality and stable ballast. Trimble GEDO provides an integrated solution for measurement and quality control to support tamping machines and operations.

Using the Trimble GEDO Trolley, a surveyor collects information about existing track positions. Data is quickly analyzed and prepared for output to the tamping machines. Deliveries of ballast can be planned and tied to specific locations along the track. When the tamping operation is finished, Trimble GEDO trolley re-measures the track to confirm that the work has been carried out correctly.

For safety and convenience, the lightweight Trimble GEDO Trolley can be quickly removed and relocated onto the track. The trolley and operator can stay clear of normal traffic, tamping, and construction machines.

# Reduce Surveying Costs for Tamping and Inspection

The Trimble GEDO system provides savings in time and labor costs for pre- and post-tamping surveys. In a single pass, the system collects information on track position, cant, and gauge. The Trimble GEDO Trolley can operate at speeds up to more than 2,500 metres per hour (6,500 feet per hour). The system records all data electronically, eliminating potential delays and errors in handwritten notes. The Trimble GEDO system compares measured data with design information to produce adjustment data needed by the tamping machine.

When compared to conventional surveying methods, labor costs are significantly reduced. Digital data management streamlines the capture and transfer of track information. Because the data is collected and checked in the field, the Trimble GEDO system reduces the possibility for costly revisits and rework.

## **KEY BENEFITS:**

- Reduce downtime for pre-tamping surveys
- Fast field operations reduce idle time for tamping machines
- Eliminate errors and delays in data transfers



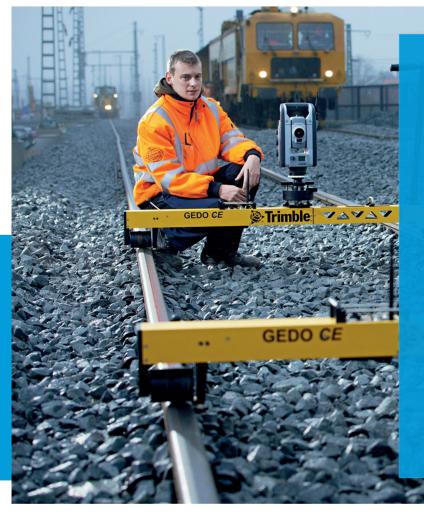
## TRIMBLE GEDO IN ACTION: SPITZKE SE

Spitzke SE received a contract for rail maintenance from Deutsche Bahn AG. Using the Trimble GEDO system for pre-tamping measurements, Spitzke SE reduced labor costs by more than 80 percent and increased the productivity of the tamping machine by 30 percent. The accurate measurements allowed construction managers to make quick decisions on tamping parameters and the quantity of ballast required.



## TRIMBLE GEDO FOR RAIL TAMPING





## TRIMBLE GEDO SYSTEMS FOR PRE-MEASUREMENT FOR TAMPING

The pre-measurement for tamping machines and related control measurements can be carried out with different GEDO system configurations:

- GEDO Track as a classical geodetic method with one or two total stations
- GEDO Vorsys as a universal and effective system using alignment methods
- GEDO IMS as a highly productive system based on inertial measurement technology for long distances

The respective field software guides the operator to ensure complete and exact data acquisition. During the measurement the tangent points are displayed and the user is already informed in the field about the deviation from the desired track position.

The GEDO Office software is used for data processing, analysis, data preparation for the tamping machine and the creation of quality reports.





# Solutions for upgrading lines and re-construction projects

Many infrastructure operators face major challenges when upgrading existing lines. Often tamping machines with insufficient precise absolute reference technology are used to measure the existing track. In contrast, a fully-fledged track layout can be created on the basis of a geodetic survey. This offers significantly enhanced driving dynamics and less wear.

However, the installation and measurement of fixed reference points along the track is complex and expensive. The Trimble GEDO IMS system in combination with the Trimble GNSS receiver and the Trimble GEDO Profiler can help.

## Track Survey and reference points

The combination of inertial measurement technology with GNSS enables track recording in an absolute coordinate system with GNSS accuracy. The internal accuracy of the track position is ensured by the inertial measuring system integrated in the GEDO IMS. Parallel to the recording, new points can be determined at any time adjacent to the track with the profiler. The coordinates of the track fixed points are available as a reference for later measurements.

#### Alignment

The Trimble GEDO NovaTrack software allows the calculation of a new track position from the measured track export. By means of regression algorithms an approximate track alignment is calculated which can be optimized by means of a graphical-interactive editor. A smooth alignment for axis, gradient and superelevation is created.

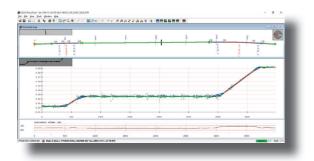
#### Construction

All subsequent reconstruction work will be carried out on the basis of the measured track markings and the new alignment. The Trimble GEDO Vorsys and Trimble GEDO IMS systems are used for survey during construction and premeasurement for tamping work.

The consistent data management during the exchange between field and office systems within the Trimble GEDO system components ensures that the rebuild projects can be carried out without delay and that the plant machinery can be used productively. Infrastructure operators benefit from the improved quality of the track position and shortened project duration.

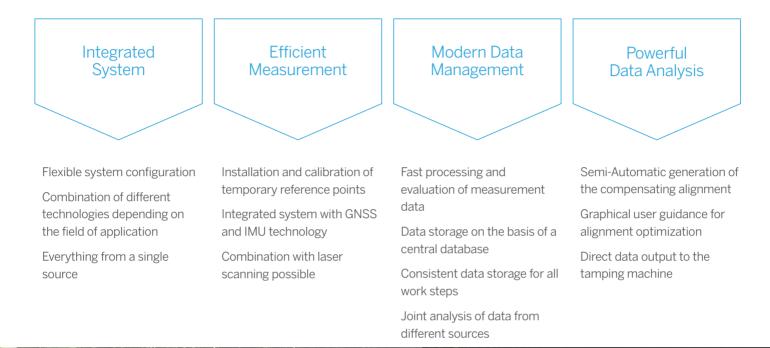
THE REAL PROPERTY OF

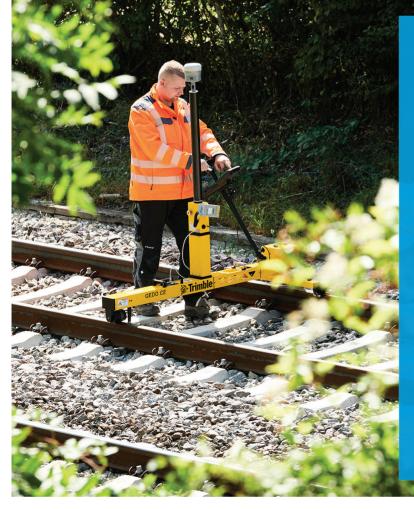
- No time-consuming traverse measurement necessary for permanent marking
- Productive and precise determination of track position
- Consistent data flow from the intake via the leveling line to the tamping machine





## TRIMBLE GEDO IMS SYSTEM





## TRIMBLE GEDO SYSTEMS FOR LINE UPGRADING AND RE-CONSTRUCTION PROJECTS

The Trimble GEDO IMS system is used in combination with Trimble GNSS and Profiler for the initial measurement of the existing track. The result is a trajectory of the actual track position and coordinates for the temporarily marked and with the profiler measured reference points. Based on this data, the Trimble GEDO NovaTrack software calculates a smooth alignment and optimizes and adjusts it according to the project specifications. The differences between the nominal and actual track position can be used immediately for tamping work. In large conversion projects with several tamping runs, the temporary marking is used for track laying and the subsequent pre-measuring work for the tamping machines. The Trimble GEDO IMS System with Profiler or the Trimble GEDO Vorsys System are used as a pre-measurement system.

The Trimble GEDO Office and Trimble GEDO NovaTrack software packages are used for data processing, analysis, route calculation, data preparation for the tamping machine and the creation of quality reports.





# Solutions for asset data collection and clearance analysis

As demand for rail transport increases, railways are introducing rolling stock that is faster and larger than existing rail cars. To ensure that tracks and facilities can support the new cars, railways need to collect detailed information about existing tracks and surrounding structures.

The Trimble GEDO Scan System combines precise positioning with 3D laser scanning to capture high-density information in tunnels and underpasses, stations, rail yards and other areas where clearance tolerances are critical. Trimble GEDO Scan replaces slow, labor-intensive measurements with high-speed measurement and automated data collection.

# 3D SCANNING FOR RAILWAY APPLICATIONS

#### Railway Design

- Develop accurate, detailed models of existing conditions. All features can be tied directly to the track alignment
- Detect and analyze clearance encroachments. Compare clearance envelopes against existing features and provide information for track clearance databases
- Test new designs using Trimble visualization and animation tools

## Construction

- Final inspections
- As-built documentation / survey
- Quality control
- Clearance Analysis

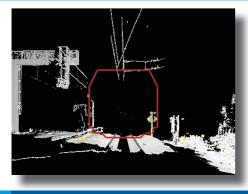
#### Asset Management

Collect information on railway facilities and structures

## TRIMBLE GEDO IN ACTION: CLEARANCE DATA FOR THE *LIRA* DATA-BASE OF DEUTSCHE BAHN AG

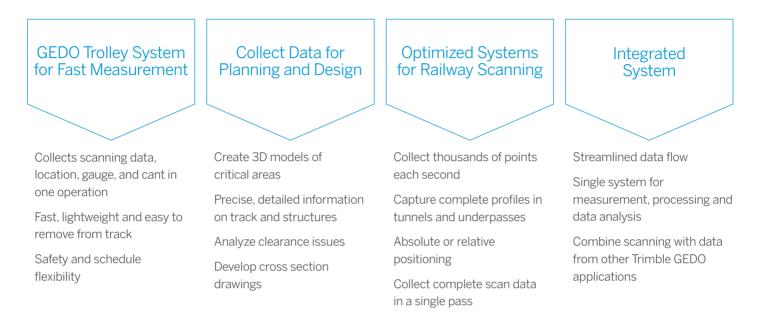
As a service provider for Deutsche Bahn AG and contractor for the construction companies, Ingenieurbüro Herzbruch GmbH has been using the GEDO Scan System for clearance measuring for many years. The clearance profiles are measured at critical points along the tracks and the information obtained is processed for Deutsche Bahn AG's *LIRA* database.

- Fast, accurate data collection and processing
- Reduce time on site and downtime for surveys
- 3D point clouds for design and analysis
- Quickly identify clearance issues
- Plan new construction and rolling stock with confidence





## TRIMBLE GEDO SCAN SYSTEM





A laser scanner is operated in helical mode on the Trimble GEDO CE 2.0 trolley to generate exact 3D data along railway tracks during movement. If the laser scanner is not required for measurements with the Trimble GEDO system, it can be used for static measurements in other projects.

The GEDO Scan System, consisting of the Trimble GEDO CE 2.0 trolley and laser scanner, is used for simple clearance checks. Trimble GEDO Scan System can be combined with other GEDO systems for asset data collection and advanced clearance analysis.

- GEDO Scan with GEDO Rec for classical geodetic recording
- GEDO Scan with GEDO Vorsys as a universal system using the alignment method
- GEDO Scan with GEDO IMS as a highly productive system based on inertial measurement technology optimized for long distances and subways

GEDO Scan Office software is used for data processing and analysis. The results are high-resolution 3D point clouds of the entire track system on the basis of which the object documentation and clearance analysis is carried out.







# The Versatile Solution for Rail Measurements

The Trimble GEDO Trolley provides the ultimate in productivity and flexibility. Developed based on years of experience, Trimble GEDO Trolley is a key component of Trimble GEDO field measurement systems. Easily adjusted to fit different track gauges, the lightweight trolley is designed for operation by one person. Powered by removable Trimble S-Series batteries, the system can operate for up to sixteen hours before replacing the battery.

## Benefits

- Lightweight, easy to use by one person (depending on configuration)
- Configurable to work with onboard Trimble GNSS, Scanner, or Total Stations
- Built-in sensors for rail gauge and cant
- Onboard cable-free Bluetooth<sup>®</sup> communications
- Removable rechargeable batteries for reliable power
- Single- and dual-trolley configurations to optimize speed and accuracy
- Non-profiled rollers for long life and low maintenance
- Specially raised trolley available for ballastless track projects with Iron Horse equipment systems

#### **Product Specifications**

- Description: Track-mounted trolley
- Gauge: 1000 mm, 1067 mm, 1100 mm, 1435 mm, 1520 mm, 1600 mm, 1668 mm, 1676 mm, other gauges on request
- ► Gauge Measurement Range: -20 mm to +60 mm
- ► Gauge Measurement Accuracy: ±0.3 mm
- ► Cant Measurement Range: ±9° or ±235 mm
- Cant Measurement Accuracy: ±0.5 mm (static)
- Weight: 16.0 kg
- Power: Self-contained, in-field replaceable
- Battery Type: Trimble S-Series Li-Ion, rechargeable
- ► Battery Life: 6–8 hours
- Certified by: Network Rail (United Kingdom), SNCF (France) and other rail companies around the world

## The Trimble GEDO CE 2.0 is approved by Network Rail (United

TRIMBLE GEDO CERTIFICATION

Kingdom), SNCF (France) and other railway operators worldwide as track measurement equipment. Within the scope of the approvals, the compatibility with the network, the suitability of the test method, the functionality as well as the operational safety and ergonomics were verified. The Trimble GEDO CE 2.0 track measuring trolley meets the requirements of DIN EN 13977 "Safety requirements for portable machines and trolleys for construction and maintenance" and is therefore also approved for use at DB AG and on other European networks.



## **TRIMBLE GEDO HARDWARE**

- 1 Trimble S-Series Total Station
- 2 Laser Scanner
- 3 Precise prism
- 4 Active MultiTrack Target
- 5 Trimble GEDO Profiler
- 6 Trimble GEDO IMU
- 7 Trimble GNSS Receiver
- 8 Trimble Controll Units
- A Brake
- B Pushing rod
- C Universal mount
- D Roller
- E Gauge adapter
- F Inclination sensor
- G Battery holder
- H Electronic box with bluetooth
- I Gauge sensor
- J Spring loaded contact



Non-profiled rollers for long life and low maintenance; Bearings 14 mm below rails

Elevated trolley for slab track construction using iron horses

Adapter available for different track gauges

Battery holder with in-field replaceable S-Series Li-Ion batteries

LED strip for illumination



Integrated electronic box with Bluetooth communication





# Integrated Software for Efficiency and Accuracy

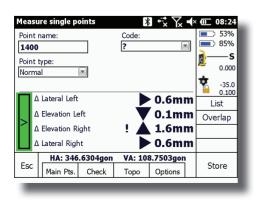
## Seamless Flow of Data and Information for Measurement and Analysis

The Trimble GEDO System ensures easy, secure data management throughout data collection and analysis. In the office, GEDO software provides data management and analysis in a modern, cohesive software environment. Importing data from external sources - both digital and paper plans - is fast and efficient. You can quickly complete your work and provide deliverables to clients and colleagues.



## **KEY BENEFITS:**

- Simple operation and clear user interface with focus on the essentials
- Integrated software eliminates data reformatting and transfers
- Consistent look and feel streamlines workflows and reduces training needs



## Software für den Einsatz im Feld

Trimble GEDO Field software provides powerful functionality and excellent user interface addressing various applications.

GEDO Doc: Used for entry level track control in combination with the track measuring trolley GEDO CE 2.0 for collecting gauge, cant and twist parameters.

GEDO Rec: Used in combination with the track measuring trolley GEDO CE 2.0 and a Trimble total station or a Trimble GNSS receiver. Based on the measurements the left rail, center line and right rail together with the cant and gauge are calculated and visualized live in the field. The software supports also the use of the Trimble Profiler to measure side offsets and height differences.

GEDO Track: For geodetic alignment based measurement. Based on the measurement, the differences between actual and target are displayed live in the field according to the track design together with the current station and the next tangent points. The calculation can be carried out either horizontally or in an elevated system.

Variant *GEDO Track Survey* is a software for several survey tasks at railway lines.

*GEDO Track Trolley* is used in combination with the track measuring trolley GEDO CE 2.0 and a Trimble total station or a Trimble GNSS receiver. Based on the measurements from the geodetic sensor and the cant and gauge values from the trolley the differences between design and as-built are calculated and visualized online in the field. These are calculated horizontal and in the elevated track system for the complete track (left and right rail).

If, due to the construction method or the low construction output, no track measuring carriage can be used, the *GEDO Track Bar* variant with the Trimble GEDO track measuring bar is used. GEDO Scan: Supports the kinematic data collection of laser scan data in combination with a Trimble GEDO CE 2.0 trolley and a Trimble or Faro laser scanner. Data can be collected stand alone, in combination with GEDO Rec, GEDO Track or GEDO Vorsys as well as fully integrated with GEDO IMS.

**GEDO IMS:** Software for flexible and productive usage for several track survey applications. It's used in combination with the Trimble GEDO CE 2.0 trolley and the Trimble GEDO IMU. If used for track survey on lines with reference points along the track the Trimble GEDO Profiler is added to the setup. For re-construction projects without reference points additionally a Trimble GNSS receives is used. Combined with a laser scanner the software controls the full three dimensional data collection. GEDO Vorsys: Software for high productive premeasurement for tramping or track survey utilizing two trolleys in combination with a Trimble S-Series total station. The alignment based measurement method guarantees high inner accuracy and very high productivity. Measurements can be taken based on classic paper plans or based on digital alignment data. All differences between design and as-built are shown in field. An optimized user interface enables the usage by non survey staff.

Chainag^	Slue	<<<		
12301 <b>5.35</b>	1 🕨	Stop		
Lift left	Lift right			
▲ 51	<b>▲ 52</b>	Store		
Tang. point	Point type			
2349	Auto store 🔳			
Gauge 1435 Tw	0 dCant1	GEDO		

GEDO Of	GEDO S	oftware		
GEDO Of	fice Rase			
	nice base		Data Preparation	
Rec GEDO Track	GEDO Vorsys	GEDO IMS	GEDO Scan	In-field measurment
_				
GEDO Office Modul Rec	GEDO Office Modul Vorsys	GEDO Office Modul IMS	GEDO Scan Office PreProcessing	Data Processing
GEDO Office	Modul Tamp		GEDO Scan Office	Data Analysis
GEDO Office	Modul Quality			-
GEDO Office Mo	odul Monitoring		GEDO Scan Analysis	
GEDO N	ovaTrack		Planning	
	GEDO Office Modul Rec GEDO Office GEDO Office GEDO Office M	GEDO Office GEDO Office	GEDO Office Modul Rec       GEDO Office Modul Vorsys       GEDO Office Modul IMS         GEDO Office Modul Tamp       GEDO Office Modul Quality         GEDO Office Modul Monitoring       GEDO Office Modul Monitoring	GEDO Office Modul RecGEDO Office Modul VorsysGEDO Office Modul IMSGEDO Scan Office PreProcessingGEDO Office Modul Tamp GEDO Office Modul QualityGEDO Scan Office Point CloudGEDO Scan Office Point CloudGEDO Office Modul MonitoringGEDO Scan Office AnalysisGEDO Scan Office Point Cloud





# Software for Data Processing and Analysis in the Office

GEDO Office Base: Module for alignment data input and import of design data. Standard design data formats are supported (e.g. Verm.ESN, LandXML). Alignment data can be checked to verify the use of the data in the field.

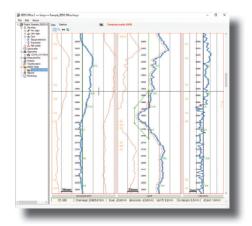
GEDO Office Module Rec: Module for processing GEDO Rec field data. Station setups can be re-calculated. Different matching algorithms are used to connect the overlapping areas. Coordinate export for the left rail, center line and right rail together with the cant and gauge values. Based on alignment data the differences between design and as-built are calculated.

GEDO Office Module Vorsys: Module for processing GEDO Vorsys field data. Measured data can be re-processed based on another design or new reference point coordinates. Processing of measurements taken without alignment data for track survey purposes.

And	Liste et al.2 Liste et al.2 Liste Strength Liste Strength	Elevention Single Ina Context	42004 1910 420543 1917 420552 1924 420555 1924 420555 1924 420555 1940 420555 1940 420555 1940 420555 1940 420555 1940 420555 1940 420555 1950 420555 1950 420555 420555 1950 420555 1950 420555 1950 420555 1950	BACT 647     BACT 647     BACT 647     BACT 647     BACT 647     BACT 647     BACT 740	Dewsten [gov] 101.224840 102.757842 102.757842 102.757842 102.757842 102.757842 102.757842 102.757842 102.7547500 102.7547500 102.7547500 102.7547500 102.7547500 102.7547500 102.75475	Langh (n) 1 (564/22 21 (00000) 23 190842 21 00000 23 190842 21 00000 23 19262 25 00000 25 5727 25 00000 10 521572 25 00000 10 521572 25 00000 10 521572 25 00000 10 521572 21 00000 10 521572 11 50000 10 521572 11 50000 11 50000 10 500000 10 500000 10 500000 10 500000 10 50000000 10 500000000000000000000000000000000000	Sart table [.	210 0000 210 0000 0 00000 100 0000 100 0000 0 00000 176 00000 176 00000 178 00000 178 00000 178 00000 178 00000 178 00000 178 00000 178 00000 178 00000	Parsmeer ( 81 240304 81 240264 81 54750 95 744758 95 544758 95 54758 95 54759 95 54759 95 55 54758 95 55 55 95 55 55 55 95 55 55 95 55 55 95 55 55 55 95 55 55 55 95 55 55 95 55 55 55 95 55 55 95 55 55 95 55 55 55 95 55 55 55 95 55 55 55 55 95 55 55 55 55 55 55 95 55 55 55 55 55 55 55 55 55 55 55 55 5		
The discussion is a second sec	Liste et al.2 Liste et al.2 Liste Strength Liste Strength	Saught ke     Control	42008 1142 42504 1151 42504 1151 42505 1172 42505 1172 42505 1172 42505 1172 42505 1172 42505 1172 42505 1174 42505 11745 42505 11745 42505 11745 42505 11745 42505 11745 42505	BACT 647     BACT 647     BACT 647     BACT 647     BACT 647     BACT 647     BACT 740	121 628481 221 628481 221 757842 221 7578442 221 757842 221 757842 221 757842 221 757842 221 757842	81.084-22 21.00000 23.510000 25.35724 25.00000 25.35724 25.00000 25.35724 25.00000 25.35724 25.00000 25.564742 25.00000 25.364785 26.00000 25.758785 26.00000 25.758785 26.00000 21.00007 21.000777 21.00077 21.000777 21.0	E 000000 335 000000 335 000000 335 000000 325 000000 225 000000 225 000000 225 000000 325 000000 325 000000 325 000000 325 000000 325 000000 225 000000 225 000000	210 0000 210 0000 0 00000 100 0000 100 0000 0 00000 176 00000 176 00000 178 00000 178 00000 178 00000 178 00000 178 00000 178 00000 178 00000 178 00000	81,24004 81,24004 81,247502 81,547502 91,510002 91,510002 91,510002 81,04004 80,04004 81,04004		^
✓ grantski V str. 1. deprese 2. deprese strate ender eno	1235 SINCE 1244 SINCE 1245 SINCE 1249 SINCE	Control Deuter and Control Serget trie Control Deuter Deuter Control Deuter Deuter Control Deuter Deuter Control Deuter Deuter Control Deuter Deuter Control Deuter Deuter Control Deuter and Deuter a	42004 1910 420543 1917 420552 1924 420555 1924 420555 1924 420555 1940 420555 1940 420555 1940 420555 1940 420555 1940 420555 1940 420555 1950 420555 1950 420555 420555 1950 420555 1950 420555 1950 420555 1950	56429-7865 56429-787 56429-785 56429-785 56410-576 56400-576	121 82886 122 73468 122 74468 122 74476 123 74476 123 74477 123 74477 124 74477 125 74477 126 724775 126 74477 126 724775 128 74577 128 745777 128 74577 128 745777 128 745777 128 745777 128 7457777 128 745777 128 745777 128 74577777 128 74577777777777777777777777777777777777	21.00000 33.53485 20.00000 53.5729 25.00000 55.6729 25.00000 55.6729 25.00000 55.6729 25.00000 108.524742 25.00000 108.524742 20.00000 108.524740 25.00000 118.52474 25.00000 118.54452 25.000000 118.54452 25.0000000000000000000000000000000000	235 00000 235 000000 245 000000 245 000000 245 000000 245 000000 0 000000 145 000000 141 000000 141 000000 141 000000 141 000000 140 000000	315.0000 5.00000 195.00000 195.00000 295.00000 -175.00000 175.00000 175.00000 175.00000 295.00000 275.00000 275.00000	81.240204 81.547532 86.746758 91.543002 76.210206 81.049954 87.268720		
A but days	1245 51 02 1275 1 020 1252 1 020 1252 1 020 1252 1 020 1252 1 020 1252 1 020 1252 1 040 1252 1 040 1253 1 040 1253 1 040 1255 1 040 1255 1 050 1255 1	Coult as Casted Casted Casted Coult as Coult as	429483 4173 429623 25864 429657 2612 429678 5182 429678 5182 429678 5182 429678 5182 429678 5182 429678 5187 429682 8187 429682 8187 420682 8187 42068	554109 7021 564207 7020 554105 2001 554105 2001 554105 2001 554105 2001 554105 2001 554005 2005 554005 2005 55400	92.97842 92.079762 92.07976 92.07976 93.0755775 94.42024 94.62075 95.620750	23 13685 26 00000 73 122603 75 122603 75 122603 75 122603 75 00000 75 122603 75 00000 75 124635 76 00000 76 52475 78 00000 78 524759 78 00000 71 151427 72 00000 71 151427 60 00000 73 77860 50 77860	235 00000 235 000000 245 000000 245 000000 245 000000 245 000000 0 000000 145 000000 141 000000 141 000000 141 000000 141 000000 140 000000	315.0000 5.00000 195.00000 195.00000 295.00000 -175.00000 175.00000 175.00000 175.00000 295.00000 275.00000 275.00000	81.240204 81.547532 86.746758 91.543002 76.210206 81.049954 87.268720		
A Contraction of a Contraction of Co	1279 6 508 1295 9 5752 1295 7 8779 1295 7 8779 1295 7 8779 1295 7 8779 1295 2 8462 1275 2 8462 1275 2 8462 1295 13927 1295 13927 1295 13927 1295 83878 1394 57579 1394 57579 1394 57579 1394 57579 1394 57579 1394 52759 1394 52757 1394 52757 1395 52757	Cashad Saraji ke Cashad Cashad Cashad Cashar ac Cashad Cas	42068225864 4206842875 42006756786 420075757848 42007057878 42007057878 42007057878 42008557878 42008557878 42008557878 42008557878 42008557878 42008557878 42008557878 42008528715 4200858715 42008528715 42008528715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 4200858715 42008575715 42008575715 42008575715 42008575715 42008575715 42008575715 42008575715 42008575715 42008575715 420085757575757575757575757575757575757575	96(227) #85. 95(1)(25)(3) 95(1)(25)(3) 95(1)(25)(3) 95(1)(3)(25) 95	122 54586 132 574196 132 574196 133 57735 164 425735 166 425735 168 528755 168 528755 168 528755 168 528755 167 557350 167 57350 167 57350 268 79585 177 55250 268 79585 263 187728 263 187728 263 187728 263 187728 263 187728 263 187728 263 187728 263 187728	21 00000 15.15(72) 25 00000 75 12560 56.47422 25 00000 116.44625 41.00000 25 74750 35.00000 26 74750 36.00000 15.826555 271.05045 15.817457 36.00000 15.826555 271.05045 36.00000 15.817457 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477 36.00000 15.817477860 15.8174777860 15.81747777860 15.8174777860 15.81747777860 15	215 00000 195 00000 215 00000 215 00000 195 000000 195 000000 195 00000 195 00000 195 00000 195 00000 195 00000 195 000000 195 000000000000000000000000000000000000	20000 12:0000 12:0000 21:0000 0:0000 11:00000 11:00000 11:00000 11:00000 21:00000 21:00000 21:00000	81.547532 86.746758 91.5475032 76.210226 83.645554 87.268728		
<ul> <li>Buge streams</li> <li>Buge streams</li> <li>And parts</li> <li>And</li></ul>	1206 5/02 1255 14759 1257 14759 1257 1475 1257 1475 1275 3462 1275 3462 1275 3463 1275 3463 1205 1507 1306 1507 1306 1507 1306 1507 1306 1507 1306 2577 1305 2576 1305 2576 1005 2576	Snight ke     Control	420055 (2013) 420055 (2013) 420075 (2013) 420075 (2013) 420075 (2013) 420075 (2013) 420075 (2013) 420075 (2013) 420085 (2013) 40	55421777803. 554714277915. 554714277915. 554714277915. 554714277915. 55471479272. 55427147922. 5542714792. 55427147935. 55427147935. 5542714794. 5542714794	102 CT+196 103 CT+196 103 S17750 196 421254 101 64257 108 228750 103 52750 103 52750 103 52750 103 52750 103 52750 103 52750 103 52750 103 52750 103 52750 203 107128 203 107128 203 107128 203 107128 203 107128	153.5729 26.00000 25.647420 25.647420 25.647420 25.647420 25.74740 26.74740 25.747400 25.747400 25.74740000000000000000000000000000000000	E 000000 245 000000 245 000000 475 000000 475 000000 475 000000 91 000000 91 000000 91 000000 91 000000 91 000000 91 000000 91 000000	195,0000 195,0000 295,0000 -175,0000 -175,0000 -175,0000 175,0000 -175,0000 -275,0000 -275,0000 -275,0000	81.547532 86.746758 91.5475032 76.210226 83.645554 87.268728		
S No permo mentan N TEXUTRATUR N TEXUTRATUR N	2852 14759 12852 14779 12852 14779 12855 24422 12752 34422 12856 15857 12856 15857 13956 15957 13956 15957 13956 15957 13956 15957 13956 15957 13956 15957 13956 15957 139577 13957 139577 13957 139577 139577 139577 1395777 139577 139577 1395777 1395777	Ontried     Order ac     Order ac     Order ac     Order ac     Order ac     Order     Order ac     Order     Order ac     Order     Order ac     Order ac     Order ac     Order ac     Order ac	425025 6 782 425070 5 784 425070 5 826 425070 5 826 425070 5 827 425070 5 827 425028 783 425028 783 425028 783 425028 587 425055 587 425055 587 425055 587 425055 587 425052 281 425055 587 425052 281 425052 281	5541125 2715 5541125 2715 554204 303 554204 303 554204 303 554204 303 554204 303 554204 303 554207 303 55420 305 55420 305 5540 305 55420 305 55420 55420 55420 55420 55420 55420 55420 55420 55420 55420 55420	132 CT4196 137 537759 164 421254 181 648775 186 228755 187 547360 137 364277 131 87567 133 877547 133 877547 133 877547 133 877547 133 877547 133 877547 133 877547 134 87967 263 187728 263 187728 263 187728 263 187728 263 187728	25.00000 75.12560 55.67420 75.00000 105.54425 30.00000 25.764750 30.00000 25.764750 30.00000 25.764750 30.00000 25.764750 21.00077 25.00000 21.151427 25.00000 21.151427 25.00000 21.151427	195.00000 215.00000 215.00000 -176.00000 -176.00000 176.00000 181.00000 181.00000 181.00000 181.00000 181.00000 181.00000	195.00000 295.00000 0.00000 175.00000 0.00000 175.00000 175.00000 175.00000 0.00000 0.00000 0.000000 0.000000	06 746758 51 51 3032 76 240236 85 645554 67 268728		
And She	2267 4579 1996 25740 1772 2442 1772 2442 1775 2442 1796 1987 1796 1987 1796 1987 1796 1987 1796 1987 1796 1987 1796 1987 1797 1996 1796 2076 1796 2076 1796 2076 1796 2076 1796 2076 1796 2076 1796 2076 1796 2076 1796 2076 1797 2564 1707 2564	Contain and Contain and Contain Straight live Contain and Contain	425075.7464 425075.2624 425075.3621 425075.3621 425075.578 425065.578 425065.578 425065.578 425065.578 425065.578 425065.578 425065.578 425065.578 425065.578 425065.578 425062.2005 5127 5127 51	554125 7915 554200 405 554200 405 554201 202 554204 402 554207 102 554207 102 554207 780 554207 780 554207 208 554207 208 554207 208 554207 208 554207 208 554207 208 55420 208 55420 55420 55420 55420 55420 55420 55420 55420 55420 55420 55	137 517729 164 471254 101 (648)77 168 228759 168 228759 167 547580 167 547580 167 547580 167 547580 167 547580 167 547580 168 786898 167 528000 268 1017128 263 1017128 263 1017128 263 1017128 263 1017128 263 1017128	73 129603 56.047420 25.00000 116.046051 46.000000 28.524155 33.000000 28.754755 36.000000 28.754755 36.000000 28.754755 27.000000 28.85655 27.1.000077 28.000000 28.85655 27.1.000077 28.000000 28.85655 27.1.000077 28.000000 29.754755 20.00000 21.817562 21.217578	195.00000 215.00000 215.00000 -176.00000 -176.00000 176.00000 181.00000 181.00000 181.00000 181.00000 181.00000	195.00000 295.00000 0.00000 175.00000 0.00000 175.00000 175.00000 175.00000 0.00000 0.00000 0.000000 0.000000	06 746758 51 51 3032 76 240236 85 645554 67 268728		
Annual	10002 23240 1272 3442 1272 3442 1295 3442 1296 15027 1296 15027 1306 15527 1306 15527 1306 15527 1306 15527 1346 2576 1346 257	Coulor and Control Straight line Control Control Straight line Control Control Straight line Control Straight line Control Control Straight line Control Straight line Control Control Control Straight line Control Control Straight line Control Control Straight line Control Control Control Control Straight line Control Con Control	4250783 2834 4250793 3814 4250793 3814 4250293 3814 4250293 3814 4250295 3817 425085 2817 425085 3817 425085 3817 425085 3817 425085 3817 425082 2817 425082 2817	554300 H05 554294 403 554294 403 554294 403 554277 NS 554277 NS 554278 NS 554278 NS 554278 NS 554278 NS 554278 NS 554278 NS 554287	164.421234 101.64875 108.228759 108.228759 107.34277 103.817967 103.817967 103.817967 103.817967 103.817967 103.817967 203.107128 203.107128 203.107128 203.107128 203.107128 203.107128 203.107128	56.047420 25.00000 110.044051 44.00000 25.34755 33.00000 25.34755 30.00000 108.00005 231.03077 25.00000 118.01427 23.00000 118.01427 23.00000 118.0147 23.00000 118.0147 23.00000 118.0147 23.00000 118.000000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.00000 118.000000 118.000000 118.000000 118.000000 118.000000 118.000000 118.000000000 118.000000 118.0000000000	215.00000 215.00000 -176.00000 -176.00000 -176.00000 178.00000 181.00000 -181.00000 -181.00000 -181.00000	215.0000 C 0000 -176.0000 -176.0000 C 00000 176.0000 176.0000 275.00000 -275.00000 -275.00000 -275.00000 -275.00000	91.513032 74.210236 85.649964 47.268728		
	127223402 127223402 120013007 1202453007 130251502 130251502 130252007 131252707 131252707 131457207 13457207 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 13457200 134572000000000000000000000000000000000000	Cohod Stelly take Cohod Cohod Cohod Stelly take Cohod Stelly take Stelly take Stelly take Stelly take Stelly take Stelly take Cohod Cohod Cohod Stelly take Cohod	425070 4021 425070 5184 425005 5170 425005 5170 425085 5170 425085 2011 425085 2011 425085 5177 425085 5177 425085 5177 425085 5177 425085 5177 425085 5175 425085 5175 5175 517555 51755 517555 517555 5175555 5175555555 51755555555	5542010 2222 554205 3053 554205 3055 554205 3055 554205	101 G4075 106 220750 107 52750 107 54780 107 54780 107 54780 101 817967 101 817967 101 817967 101 817967 101 817967 101 817967 201 10706 201 10710 201 10710 201 10710 201 10710 201 10710 201 10710 201 10710	25.00000 116.848051 46.00000 128.524155 33.00000 28.754750 36.00000 128.808658 201.03007 25.00000 11.830647 103.152427 46.000000 11.8375420 46.000000	215 00000 0 00000 -176 00000 -176 00000 0 00000 176 00000 181 000000 0 0 00000 0 0 0 00000 0 0 0 0	C 00000 -176,00000 -176,00000 C 000000 178,00000 178,00000 0,00000 -176,00000 -176,00000 -176,00000 -176,00000	91.513032 74.210236 85.649964 47.268728		
	1 1757 3442 1 2001 3007 1 2001 3007 1 2001 3007 1 3005 1952 1 3006 1952 1 3006 3027 1 3120 5007 1 3120 5007 1 3145 3027 1 3445 3027 1 3445 3027 1 3457 2022 1 3177 3566 1 3167 2022 1 3167 2022 1 3177 3566 1 3167 2022 1 3167 2025 1 3167 2025 1 3167 2025 1 3167 2025 1 3167 2025 1 3177 3566 1 3167 2025 1 3167 2025 1 3177 3566 1 3177 2056 1 3177 2056 1 3177 2056 1 3177 2056 1 3177 2056 1 3177 2057 1 3177 2056 1 3177 2057 1 317	Straght Ive Cothod Desize arc Cothod Straght Ive Cothod Cother arc Cother arc Cother arc Desize arc Desize arc Desize arc Cother arc	4220791.3194 4220025.57073 4220025.1703 4220025.490 4250025.5117 4250055.5127 4250055.5127 4250055.5127 4250055.5127 4250052.5115 4250052.5115 4250052.5115 4250052.5115 4250052.5115 4250052.5115	5542964 3633 5542195 3058 5542192 3758 5542192 3758 5542112 3758 5542112 3758 5542112 3758 5542112 3758 5542102 3045 5542102 3251 5542103 3251 5542103 3251 5542103 3251 55422103 3251 55422103 3251	105.226755 107.52750 107.52750 107.52750 107.82780 101.82780 101.82780 102.82780 203.82780 203.82780 203.82780 203.82780 203.82780 203.82728 203.82778 203.82728 203.827778 203.82778 203.827778 203.827778 203.827778 203.827778 203.827778 203.827778 203.827778 203.827778 203.8277778 203.827778 203.827778 203.827778 203.8277778 203.82777777777777777777777777777777777777	110,846051 40,00000 105,824155 33,00600 25,754750 34,000000 105,808058 271,000077 25,000000 11,8321427 103,152427 40,000000 11,8321427 40,000000 11,8321427 40,000000 11,8321427	6.00000 -176.00000 -176.00000 176.00000 176.00000 171.00000 -176.00000 -176.00000 -176.00000 -176.00000	-176,0000 -176,0000 0,0000 178,0000 178,0000 178,0000 0,0000 276,0000 276,0000	91.513032 74.210236 85.649964 47.268728		
	1 1300 3507 1 2294 5107 1 3026 1167 1 3026 1167 1 3026 2167 1 3125 5077 1 3125 5077 1 3145 7575 1 3445 7575 1 3445 7575 1 3445 7575 1 3457 2022 1 3277 2022 1 32777 2022 1 3277 2022 1 32777 2022 1 327777 2022 1 327777 2022 1 327777 2022 1 327777 1 32777 1 327777 1 327777 1 327777 1 327777 1 327777777 1 32777777777777777777777777777777777777	Control Control Streight live Control Streight live Control Control Streight live Control Streight live Streight live Control	420085 7078 420085 7078 420084 640 420085 5127 420085 5127 420085 5127 420085 5127 420082 5175 420082 5175 5100 5100 5100 5100 5100 5100 5100	5542178 1028 5542144 2177 5542714 2177 5542714 2177 5542715 2048 5542717 2048 5542717 2048 5542717 2048 5542717 2048 5542704 2025 5542704 2025 5542704 2025 5542704 2025 5542204 2025 5542204 2025 5542204 2025 5542204 2025	105.228755 1177.547800 103.7484277 103.817967 103.817967 103.829808 203.107120 203.107120 203.107120 203.107120 203.107120 203.107120 203.107120 203.107120 203.107120	48,00000 105,524155 33,00000 25,754750 36,00000 105,800555 201,00007 11,520427 56,00000 11,520427 56,00000 11,520427 56,00000 11,520427 56,000000 11,520427 56,000000 11,520427 56,0000000 11,520427 56,000000000000 11,520425 56,00000000000000000000000000000000000	-176 00000 -176 00000 176 00000 176 00000 181 00000 181 00000 010 00000 -185 00000	-176 00000 0 00000 176 00000 176 00000 0 00000 0 00000 0 00000 0 00000 0 00000 0 00000 0 00000 0 00000	76.210226 80.043554 67.268128		
	2214 1002 13051 1502 13051 1502 13054 1502 13054 3502 13054 3502 13054 3502 13054 3502 13054 3002 13054 3002 13055 3002 130555 13055 13055 13055 13055 130555 130555 130555 1305555 130555 130555 1305555 130555	Contrain and Control Sneight line Control Contraint Contraint Contraint Sneight line Contraint C	42002011181 425084-640 42508522811 4250855552 4250855552 4250855557 4250825817 4250825818 4250825818 4250825818 4250825818 4250825818 4250825818 4250825818 4250825818 4250825818 4250825818 4250825818 4250825818 425085818 4250858 425085818 425085818 42508588 42508588 42508588 4250858 425	5542129 7781 5542714 6717 5542714 6717 5542715 6842 5542715 6842 5542715 6842 5542715 6845 554280 6854 554280 6854 554280 6854 554280 6855 554281 5451 554281 5451 554281 5451	177 54780 107 744277 101 87787 102 29468 177 52900 263 74728 263 16728 263 16728 263 16728 263 16728 263 16728 263 16728 263 16728 263 1675 263 1675	125 524155 33 00000 25 754755 36 00000 108 808055 231 03677 21 000000 11 530147 103 152423 40 000000 11 537560 41 000000 11 57560	-176 00000 -176 00000 176 00000 176 00000 181 00000 181 00000 010 00000 -185 00000	-176 00000 0 00000 176 00000 176 00000 0 00000 0 00000 0 00000 0 00000 0 00000 0 00000 0 00000 0 00000	76.210226 80.043554 67.268128		
	1 1325 1952 13265 1952 13265 2575 13255 2577 13255 2577 13255 2577 13467 2575 13467 2575 13467 2575 13467 2575 13467 2575 13467 2575 13467 2575 13467 2575 13467 2575 1347 2575 13475 13475 13475 13475 13475 13475 13475 13475 13475 13475 13475 1347	Cetted Stellight live Octored Couler set Couler set Couler set Stellight live Couler set Couler set Couler set Couler set Couler set Couler set	4250822811 4250822811 4250825817 4250855817 425085817 4250828110 4250828110 4250828110 4250828100 425082818 42508588182 425085818 425085818 425085818 42508518 4250	9542144 (277) 9542127 9680 9542117 9680 9542117 9580 9542112 0780 9542142 0780 9542140 0581 9542140 0581 9542140 4025 9542140 4025 9542240 4025 9542240 4025	107.396277 101.817967 103.817967 103.896466 177.529000 263.397428 263.317128 263.317128 263.317128 264.118055 255.545209 226.317176	23.00000 25.754783 36.00000 105.808555 231.03677 25.000000 11.83047 103.75242 103.75242 103.75242 113.75242 113.75242 113.75242 113.75242	1/16.00000 5.00000 1/16.00000 1/16.00000 1/16.00000 0/16.00000 1/16.00000 1/16.00000	00000 178,0000 181,0000 00000 075,0000 181,0000 075,0000 180,0000	80.043394 87.288728		
	13068 1/902 13064 2027 13120 20870 13200 20870 13461 20870 13461 20870 13461 20870 13461 20941 13461 44228 13475 22022 13761 44228 13475 2022 13777 20560 13302 20566	Steght ke Octool Octool Octool Steght ke Steght ke Octool Steght ke Octool Octool Octool Octool Octool Octool Octool Octool	42508223811 42508253527 42508253187 42508253187 4250825110 4250825110 4250825110 4250825310 42508553810 4250855810 4250855810 4250855810 4250855810 4250855810 425085510 425085100 425085100 425085100 42508510000000000000000000000000000000000	5542727 9682 5542715 5042 5542715 5048 5542112 0198 5542112 0198 554210 0261 5542104 0205 5542104 0205 5542108 4305 5542210 3481 5542210 3491 5542210 3495	101.817967 101.817967 108.296665 107.529000 288.307529 263.107128 263.107128 263.107128 263.107128 263.107128 263.107128 263.107128	25 754750 96 00000 105 808055 201 03677 25 000000 11 520427 103 152427 103 15247 103 10000000000000000000000000000000000	E 000000 178 000000 181 000000 181 000000 6 000000 275 000000 185 000000	178,00000 178,00000 181,00000 0,90000 275,00000 275,00000 185,00000	80.043394 87.288728		
	13064 30378 13125 30378 13125 30378 13406 79878 13406 79878 13406 79878 13406 20094 13406 20094 13406 20094 13406 20094 13406 20094 13406 20094 13407 12122 13479 12122 13479 12122 13479 12122 13479 12122 13479 12122 13479 12122 13479 12122	Otherd Crovier are Orovier are Otherd Sheight live Sheight live Coulor are Orovier are	4250585 3327 4250585 3387 4250582 3387 4250582 83187 4250582 8318 4250582 8318 4250582 3413 4250582 3413 4250582 3413 4250582 3413 4250582 5815 4250582 8388 4250782 8425	5542715.0042. 5542627.3048. 55426172.0788. 55426122.0788. 5542762.0554. 5542754.0255. 5542754.0255. 5542753.4025. 5542213.9427. 5542213.9427. 55427192.8798.	101 817967 108 20005 177 529000 288 700503 263 107120 263 107120 263 107120 263 107120 263 107120 265 110515 261 108155 261 545200 226 317175	36.00000 109.8008058 201.036077 25.000000 11.6301427 103.152423 40.00000 17.877560 53.875760	178.00000 181.000000 181.000000 270.000000 -270.000000 -250.000000	178 50000 1(1 00000 0 90000 376 50000 376 50000 -185 50000	0.3923		
	11125 80878 113250 70879 113461.79879 113461.79879 113461.29994 113461 44238 113479 20294 113479 2022 113473 2029 11377 70640 11377 70640 11377 70640	Onuiar an Onuiar an Outred Sheight Ine Sheight Ine Outred Outred Onuiar an Onuiar an Outred	4250876 9187 4250872 9187 425082 8110 425082 8110 425082 2000 425082 2010 425085 9802 425085 9802 425085 9802 425085 8982 425075 8085	1942007 3045 55421420 7554 55421420 2054 5542150 3261 5542150 3261 5542150 3201 5542250 3201 5542250 3205 5542250 3205 5542250 3205 5542750 3295	138,286886 177,529000 288,790563 263,187729 263,187729 263,187729 263,187729 263,187729 263,187729 263,187529 226,317775	128.808808 231.038077 28.000000 11.830147 103.152420 40.000000 17.877980 63.07076	178.00000 181.000000 181.000000 270.000000 -270.000000 -250.000000	178 50000 1(1 00000 0 90000 376 50000 376 50000 -185 50000	0.3923		
	1 13250 71879 1 13461 79879 1 13486 79879 1 13486 79879 1 13486 79879 1 13480 29994 1 13461 44298 1 13679 52022 1 13679 52022 1 13679 52022 1 13777 78660 1 13022 78660 1 13022 78660	Crokent Development Snephine Snephine Development Crokent Crokent Crokent Crokent	42510x3 3005 4290902 8110 4290902 8110 4290902 3415 4290902 3415 4290905 3415 4290905 9002 4290905 9002 4290905 8098 4290702 9015	5543112 0138. 5543405 0554. 5542300 0261 5542304 0225. 5542304 0225. 5542201 5405. 5542201 5405. 5542201 5405. 5542201 5408.	177 529070 288,790593 263,117128 263,117128 263,117128 264,1138/5 265,540200 226,317175	231.036077 28.000000 11.830147 103.152423 40.000000 17.877960 53.875760	181 000000 181 000000 6-000000 275 000000 -185 000000	101 00000 C 00000 275 00000 275 00000 -105 00000			
	1 13461.79878 13406.79878 13406.79878 13406.20994 13406.44298 13661.44298 13671.42298 13673.7029 13177.70560 13802.70560	Othed Stephine Stephine Onderer Onderer Onderer Onderer	4250902.8110 4250902.0000 4250952.3413 4250858.9802 4250878.9902 4250878.9902 4250878.9902 4250752.8098 4250752.8098	1542405.0854. M42190.1001 1542184.1025 M42108.205 1542191.805 1542191.947 M42290.1028 1542191.876	258,790900 263,167120 263,167120 263,167120 256,113075 251,54000 226,317175	21.000000 11.53(14.7 103.152423 60.000000 17.877560 53.575756	181 000000 0-000000 -710 000000 -185 000000	0.00000 270.00000 270.00000 -180.00000			
	13406 29676 13406 29994 13105 44236 13861 44236 13861 44236 13861 44236 13862 44236 13862 1426 13802 29560	Streight Ine Streight Ine Cosheid Cosular an Cosular an Cosular an Cosular an	4290942 0000 4290952 3415 4290855 9802 4290876 9802 4290876 9807 4290803 7273 4290755 8080 4290752 9035	5542390 3261 5542354 5225 5542358 5225 5542258 5305 5542258 5305 5542258 5305 5542258 5305 5542158 6766	263 187128 263 187128 263 187128 256 113575 251 545300 228 317175	11 830147 103 152423 60 000000 17 877860 83 879796	8-000008 -270-000008 -180-000008	276-00000 276-00000 -186-00000			
	1 13430 20194 1 13651 44236 1 13661 44236 1 13675 12022 1 13763 12024 1 13777 70560 1 13802 70560	Sheght ine Coshed Cosher as Cosher as Cosher as Coshed	4250552 3415 4250845 9602 4250816 9807 4250803 7273 4250765 8088 4250752 8085	5542354 8225 6542328 2431 5542258 8305 5542259 8305 5542259 8208 5542259 8208	283 187128 283 187128 296 113575 251 545200 226 317175	103 152423 60.000000 17.677960 63.019796	-270 000000	-270.00000	127.279021		
	1 1967 AU290 1 1967 AU290 1 1967 AU290 1 1967 12022 1 1977 20560 1 1902 20560	Celebral Coulor an Coulor an Coulor an Cathed	4250885 9802 4250816 9807 4250803 7273 4250765 8598 4250752 8035	5542128 2451 5542293 8305 5542211 5481 5542210 8309 554210 8308	263 187128 256 113575 251 545300 226 317175	60.000000 17.677960 53.979796	-270 000000	-270.00000	107 279021		
	1 13661.642280 1 13679.72022 1 13783.53004 1 13777.78560 1 13802.78560	Crouter and Crouter and Crouter and Costherd	4250818 9907 4250803 7273 4250795 8098 4250792 8085	5542250 8305 - 5542201 5401 - 5542250 8208 - 5542150 8208 -	254.113575 251.545200 226.317175	17,677560	-270 000000	-270.00000			
	13763 53001 13777 79564 13802 78564	Coule an Ophed	4250765 8098. 4250752 8085	5542210-2026 - 5542738-5766 -	226.317175	63.919796 34.685627	185 000000	-180.00000			
N 22 2	13777 79560	Calved	4250752 8035	5542198-8766		34,695827					
22	1380279564							225 00000			
2 22							-335 000000	6.00000	74 161805		
22					215.052545	126.436954					
2 3		Canad	6250715 5626	55420513021	215.952945	32,000000	6.000000	185.50000	75.699425		
3	12961 22290	Crowler and	4250705 5400	55400111162	221,754330	153,225058	198,500000	198 50000			
2			4250609 2305		265 \$36000	35,375127	218 000000	218 0 0000			
	H 153 82578	Ocular ac	4250572 7441	5541250.3776	201.434036	104.030054	182 000000	152 00000			
				5541092.7797	217.622921	84,254815	254.000008	254.00000			
			4250096 1740	5541521 0003	264 119206	55.445421	234 000000	234.00000			
X		Cohod	4250055 5941	5541975-4531	361.010797	32.000000	234 000000	0.00000	54.6640H2		
5	14430.55107	Straight line	4250008.8996	5542302 A763	365.558004	75.402040					
2	P.0001394	Cohod		5542070-8078.	265 558061	31,000000	6-000008	-372 00000	107.367150		
3		Grouler arc	4250281.5946		362.905439	41.751172	-372 000000	-372.00000			
3			4250251 5196		254.309653	36,000000	-372 000000	0.00000	118.054512		
3	140179425	Straight line	4250225 6065	5542164 5402	251 138120	77.051345	0.000000	352 0 0000	16.00776		
					261 136126	25.000000	352 000000	-362 00000	en (107%)		
		Creater are	4250154 0850	5542237 5681	348.903065	68,774613 77,799472	312 000000	302 00000			
		Creular arc	4250055 3707	5543275-352N 5542310 7784	208 99057 9	37,647972	244 000000	330 00000			
2		CHEVR ME	4349991 6862	5542310 7784	203 172522	37,647672	244 000000	0,00000	68.362568		
		Trainte Ine	ADAMON PEN	204231720028	304 999062	30414673	044 000000	00000	00,74200		
			4349903 2534	MACTURE AND 1	304 999367	38,000000	0.000000	214 00000	90 177933		
					200 347135	\$1400045	214 000000	214 00000			
2		Conciler and		5542117 1482	281,060816	125.661793	220 000000	230,00000			
			6368727 2167		204 717751	80.514730	-281 000000	281 00000			
2				15421716112	204 182612	<1.000000	281 000000	0.00000	112 443003		
		Baldi be	4301688 3123		215 095123	123 296829					
		Crowler and		5542021 5616	215 095123	63.957118	-00000	-8300 00000			
1	1 10020 10121	Distant Ine	4242402.6018	5541340 8355	218.063580	253 205529					
	reason and the	Autor .	state vo with	Edward a line	but delight			16+ 04000	#8.5654×4		

GEDO Office Module IMS: Module for processing GEDO IMS field data. Measured data segments can be analyzed and re-processed based on new reference point coordinates as well as merged to a line. The differences between design and as-built are calculated.

GEDO Office Module Tamp: Module for data preparation for tamping machines. Measured and processed data from GEDO Rec, GEDO Track, GEDO Vorsys and GEDO IMS measurements can be used. A graphical interface allows an easy ramp definition by ocusing on minimum lift values, maximum lift and shift values and other constraints. Data for all common tamping machines can be output.



- Simple and clear user interface and operation
- Flexible data adjustment and recalculation taking into account any data or framework modifications
- Individual definition of parameters for calculation and output
- Concise quality reports

GEDO Office Module Quality: Generates reports on the quality of the track. In addition to flexible travel chord evaluations, special calculations can be carried out and special formats such as MKS (manual replacement measurement DB AG), Speed Raiser (Network Rail) or TUCRail (Belgium) can be created. For slab track projects, the necessary corrections are optimized and correction lists are created.

GEDO Office Module Monitoring: Module for comparison of measurements from different epochs for monitoring tasks and control of tamping work.

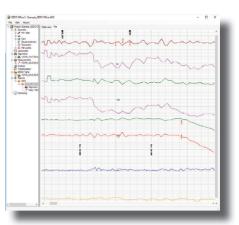
GEDO Scan Office: The *GEDO Scan Pre-Processing* Module pre-processes GEDO Scan measurements. Purely relative measurements are then available immediately. Absolute measurements as geo referenced 3D point cloud for analysis after synchronization with the track geometry.

The *GEDO Scan Office Point Cloud* module enables trackspecific analysis of the point cloud. The distances of objects relative to the track position or between objects can be measured. The clearance can be checked with a static frame or on the basis of a wagon model. The position of the adjacent track can be detected from the scan. Overhead lines are detected and the distances to the track position are calculated. Points can be taken directly from the point cloud and line objects can be registered automatically. Cross profiles generated along the route are further processed and vectorized with *Trimble GEDO Scan Analysis*. After automatic dimensioning, the DXF export takes place.

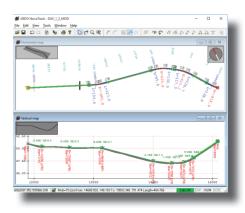
In addition to the data kinematically recorded with the Trimble GEDO Scan System, static laser scan data and point clouds can also be processed by the Mobile Mapping System.

Additional modules (e.g. *WinLUE, Clearroute, Banedanmark*) allow the export of analysis results according to the requirements of the infrastructure operators for the respective clearance databases.

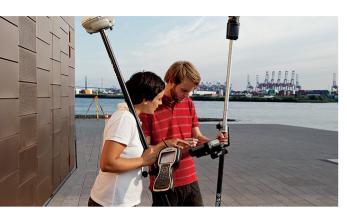
GEDO Nova Track: For semi-automatic calculation of new alignments or new proposed track based on GEDO measurements. Trimble GEDO NovaTrack takes into consideration various specifications and limiting factors for smoothing design. Interactive graphical views with editing commands allow the end user to quickly generate a workable solution. There is a direct data exchange with GEDO Office to use GEDO measurements and return the alignment (axis, gradient, superelevation). This can be used immediately for as-build comparison and preparation of tamping data.











# The Components of Accuracy

By integrating Trimble technologies for measurement and information management, Trimble GEDO systems are tailored to the environment and applications of the railway industry. Trimble instruments and systems are designed to meet exacting standards of performance under the most challenging conditions. The flexible, modular design lets you adapt Trimble GEDO system to meet changing and expanding needs.



The Trimble GEDO measuring trolley can be equipped with GNSS as well as with optical instruments and inertial measuring technology for position determination.

## ADVANCED TECHNOLOGY FOR EFFICIENT MEASUREMENT

Trimble instruments provide world-class performance in precision and reliability. For track documentation in open areas, you can use Trimble GNSS with standard RTK or Trimble VRS™ corrections. To measure in tunnels, stations and congested or urban zones, If the application calls for the highest precision, use Trimble Total Stations for fast, reliable measurements.

## ADVANCED TECHNOLOGY FOR EFFICIENT MEASUREMENT

#### **Control Units**

The powerful Trimble control units offer integrated communication modules and cameras in a robust and portable format. Thanks to the large display with touchscreen operation, all information can be viewed on site on the Trimble control units. A full Microsoft<sup>®</sup> Windows<sup>®</sup> 10 Professional 64-bit operating system means high data security and support for many other Trimble software products.

#### Trimble TSC7

The Trimble S7 and S9 Total Stations provide automated tracking and measurement with millimeter precision. Trimble Total Stations let you meet demanding tolerances for precise track positioning. Robotic measurement & free stationing gives the greatest flexibility & efficient operation.

#### Trimble T10

The robust Trimble T10 Tablet offers this functionality in a robust tablet format. The easily pluggable keyboard with track pad also allows it to be used as a full-fledged computer for evaluation,

- All system components from a single source
- Universally applicable instruments
- Modular combination for flexible expansion and adoption to the respective measuring task

#### Trimble S-Series Total Station

The Trimble Total Stations provide automated tracking and measurement with millimeter precision. Trimble Total Stations let you meet demanding tolerances for precise track positioning. Robotic measurement & free stationing gives the greatest flexibility & efficient operation.

#### **Trimble GNSS**

Trimble GEDO Systems let you choose from a range of Trimble RTK GNSS receivers. Trimble's modern GNSS receiver combines advanced GNSS tracking and computation technology to ensure reliable results in challenging conditions.

## Trimble GEDO IMU

Highly accurate and fully integrated sensor based on inertial measurement technology for track survey applications in combination with the Trimble GEDO CE 2.trolley. The measurements can be carried out precisely, quickly and almost independently of weather influences.

#### Trimble Scanner TX6/TX8

Trimble TX6/TX8 laser scanners are highly versatile scanning solutions for a broad variety of scanning applications. The compact and lightweight design, improved range, and simple, intuitive operation allow fast and accurate measurements of complex environments. In combination with GEDO Scan Systems they are used in helical mode. This achieves very high accuracy in the distance measurement between objects and the track.

#### **Trimble GEDO Profiler**

Used for fast and accurate measurement of objects close to the track. Enables the geo referencing of measurements carried out with the inertial GEDO IMS system.

#### Trimble GEDO Rail Inclination Sensor

These sensors are connected to the Trimble GEDO CE 2.0 track measuring trolley and are used to measure the inclination of the individual rails.



The Trimble GEDO system helps you get the most from your Trimble positioning systems. When your Trimble instruments are not at work with the Trimble GEDO Trolley, you can use them on other projects. Your Trimble Total Stations, GNSS, Scanners and Field Controllers provide world-class performance in applications for surveying, construction, planning and industrial measurement.



0



# **Customized Solutions**

Around the world, different construction methods require different approaches to track measurement. In many areas, new approaches to increase quality and reduce costs are being developed and tested. In addition to Trimble GEDO trolleys and software, Trimble can develop measurement solutions that are tailored to your construction needs. The Trimble GEDO staff of in-house development experts provide fast, flexible implementation for your needs.

## BÖGL SPS IN ACTION: MAX BÖGL NEW RAILWAY PROJECT EBENSFELD - ERFURT

The German based MAX BÖGL uses the custom specific SPS and SSPS systems to adjust more than 10,000 standard, special, compensation, and turn-out slabs. Some of the major challenges for the 32,3 km project that had to overcome were the difficult site access and time constraints.

## TRIMBLE GEDO SPS SYSTEMS FOR PLATE ADJUSTMENT GEDO SPS

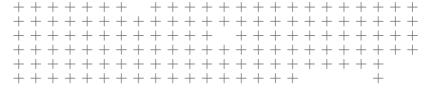
Trimble GEDO SPS is a single-source system developed from years of on-site experience. During plate adjustment, the GEDO SPS measuring bar communicates with a Trimble TSC3 Controller running GEDO SPS software. Results are displayed immediately in the field and the workers can make adjustments according to the measured information.

## GEDO J-Slab

Developed to support Japanese slab track techniques, Trimble GEDO J-Slab is optimized to support larger ranges for side and height adjustment. You can use GEDO J-Slab for mounting Japanese slabs, and then use GEDO Track for fine adjustment of the rails.

## GEDO Systems for Slab Track Bögl

Developed in cooperation with Max Bögl, the Bögl SPS and Bögl SSPS systems enable precise adjustment of the Bögl system of preassembled rail plates. The Trimble solution provides high inner coherence and fast construction. These specialized applications support construction of high-speed switch slabs.



## Trimble GEDO Track Measuring Bar

The Trimble GEDO Track Measuring bar is an ideal solution for slab track measurements when the Trimble GEDO Trolley is not suitable or when you need to measure only a few locations on the track. It's easy to carry and place the bar where needed.

- Built-in gauge and cant sensors
- Bluetooth communications to Trimble field controllers.
- Optical target for positioning with Total Station
- Fast and lightweight

#### **Trimble Track Measuring Tools**

Railway survey work requires specialized equipment and tools. Some work can only be done if you have the right tools tailored to the job at hand. For other jobs having specialized tools will increase the productivity and accuracy of your results. Trimble offers a wide range of solutions to meet country specific as well as worldwide needs for railway survey work.





## **TRIMBLE GEDO SPS SYSTEM**

The Trimble GEDO SPS system is a flexible measurement solution to adjust pre-fabricated slabs. The adjustment is done based on digital alignment data and precise reference

The system can be adapted to various slab types, workflows and construction methods where no rail is installed during

combination with additional sensors and special bars which are positioned on the slabs.

The Trimble GEDO SPS system provides precise correction values for height and side adjustment at all necessary construction workers to operate the system.



## About Trimble

Founded in 1978, Trimble is a publicly traded company headquartered in Sunnyvale, California. Trimble serves its customers with employees and distribution partners in more than 100 countries. The company's more than 1,800 patents provide the basis for the broadest portfolio of positioning solutions in the industry. Trimble's integrated solutions allow customers to collect, manage and analyze complex information faster and easier, making them more productive, efficient and profitable.

Trimble Railway solutions combine measurement with data management, communications and customized software to deliver accurate information with speed and reliability. Trimble solutions enable advanced process and workflow integration for a more streamlined operation. From feasibility studies through construction and operation, Trimble Railway solutions help keep your operation running smoothly and safely.

For more information visit www.trimble-railway.com, or contact us info@trimble-railway.com.



#### NORTH AMERICA

Trimble Navigation Limited 10368 Westmoor Drive Wesminster CO 80021 USA

#### EUROPE

Trimble Railway GmbH Korbacher Straße 15 97353 Wiesentheid Germany +49-9383-9732-0 Phone +49-9383-9732-10 Fax

#### ASIA-PACIFIC

Trimble Navigation Singapore Pty Limited 80 Marine Parade Road #22-06, Parkway Parade Singapore 449269 Singapore +65-6348-2212 Phone +65-6348-2232 Fax

© 2018. Trimble Navigation Limited. All rights reserved. Trimble and the Globe & Triangle logo are trademarks of Trimble Navigation Limited, registered in the United States and in other countries. AllTrak and VRS are trademarks of Trimble Navigation Limited. All other trademarks are the property of their respective owners. PN 022516-011 (08/16)

