DATA MANAGEMENT SYSTEM FOR TUNNELLING
A WORKING TOOL FOR DATA ACQUISITION, VISUALIZATION AND REPORTING
IRIS – INTEGRATED RISK AND INFORMATION SYSTEM

A single software solution for integrated data management of infrastructure projects. IRIS offers data access and processing to all project parties at-a-glance.

Tunnel construction using Tunnel Bore Machines (TBM) represents a highly complex process chain. Such processes generate large amount of data which can be used for monitoring, reporting and analysis. IRIS.tunnel is a process data management (PDM) system specifically developed for the data control and analysis of data generated by TBM tunnelling.

The engineering company ITC develops software systems which support civil engineering companies and their site teams in the data management as well as the data analysis. IRIS.tunnel has been developed as a web-based process data management system in order to manage tunnelling construction sites more efficiently.

IRIS offers the following advantages:

→ Full integration of general project information, ongoing process data, construction schedule, geological information and geotechnical/environmental measurements into a single data base system
→ Ongoing data evaluation during the construction process
→ Transparency by presenting complex data in standardized reports and charts.
→ User-defined reporting and analysis tools. The user can add their own analysis modules to IRIS in order to obtain tailored solutions.
→ Integrated alarm systems for all measurements which are acquired by the IRIS system.
→ World-wide access to data of ongoing or completed project, stored on a web-based database system.
→ Standardized reporting reduces the site team’s daily paperwork and provides a single report standard over the entire project.
A WORKING TOOL TO ORGANIZE, ANALYSE AND VISUALIZE DATA DURING CONSTRUCTION.

AN EFFICIENT ANALYSIS TOOL FOR THE PLANNING OF FUTURE PROJECTS.
SOFTWARE CONCEPT

The development of IRIS focuses on the following benchmarks:

- Mapping the process chain of the TBM tunnelling operation
- Independence from specific equipment supplier
- Independence from specific IT used on construction sites
- World-wide access to data of any project via Internet
- Flexible and expandable program structure

IRIS.tunnel is a web-based application. The project user only needs a browser and access to the internet. However, if required by the Client, IRIS.tunnel could alternatively be installed as a local system.

WHO NEEDS IRIS.tunnel?

- The construction industry can manage complex tunnelling projects more safely and cost efficiently.
- IRIS.tunnel provides project clients and project control engineers with an efficient cost and claim management tool.
- IRIS.tunnel supports the construction management in the decision making process by filtering the relevant information from the daily data flood.
- Insurance companies can efficiently control and assess the risk of ongoing and future projects.
FLEXIBILITY THROUGH USER DEFINED OUTPUT

DATA EXPORT / IMPORT

Data types              User-defined charts
→ PDF                   → line / point charts
→ JPG                   → bar charts
→ SVG                   → pie charts
→ PNG                   → diagram title
→ XLS                   → color, font size etc.
                           → individual comments
IRIS automatically generates summaries and reports. Reports are available for daily, weekly and monthly periods. IRIS offers a quick and detailed overview concerning advance rates, duration and causes of downtimes, etc.

**Standard report types**
- shift report
- daily / weekly / monthly shift reports
- performance report
- downtime evaluation

**Advanced modules for inventory lists of:**
- segment position
- segment damage management
- cutter tool management
- consumable management

### WORKSHIFT REPORT

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Quantity</th>
<th>Duration</th>
<th>Comments</th>
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</thead>
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<td>Test activity</td>
</tr>
<tr>
<td>01:30</td>
<td>Activity 2</td>
<td>50</td>
<td>02:15</td>
<td>Another activity</td>
</tr>
</tbody>
</table>

### WEEKLY PROGRESS SUMMARY

- **Advance Length:** 1000 m
- **Segment Setup:** 500 m
- **Operational Efficiency:** 90%

### PROJECT DATA

- **Total Tunnels:** 10
- **Total Length:** 5000 m
- **Average Daily Advance:** 20 m

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**Ring Build:** 80%

**System Out:** 10%

**Others:** 10%
IRIS is a working tool to analyse data during the construction process and can also be used to assess projects after their completion. IRIS allows the user the comparison and correlation of TBM process data, geological data, work shift data, data from the slurry plant etc.

User-defined charts showing
- TBM process data
- shift data
- geology

Advanced modules for analysis of
- slurry plant
- cutter tool wear
- target-performance analysis
- ground settlement

User defined diagram (e.g. cutting wheel torque, advance rate) plotted against chainage. The background colour represents the geology.

The optional analysis module „Cutter Tool Wear“ provides comprehensive evaluation tools for the analysis of cutter tool life and the prediction of tool exchanges.

Comprehensive tools for segmental lining management including statistic tools for segment damage evaluation.

Comprehensive target-performance analysis tools allow the user to update TBM advance predictions according to the encountered geology. Automatic chart generation allows performance assessment at a glance.
**VISUALIZATION**

IRIS provides comprehensive visualization tools for instant access to navigation, geotechnical and monitoring data.

- Map viewer (plan view)
- Surface settlement viewer
- Online TBM data viewer
- Interactive tunnel viewer (long section)
- Guidance system viewer

The Online TBM Data Viewer presents TBM process data at-a-glance.

The map viewer presents the TBM position in plan-view.

The Interactive Tunnel Viewer (ITV) presents the geological alignment of the project.

The visualization of geomonitoring systems enables to assess the interaction between TBM control (e.g. face pressure) and surface settlement.

The Guidance System (GS) Viewer presents the TBM-navigation data at-a-glance.
INTEGRATED SOLUTIONS
FOR COMPLEX PROJECTS
Tunnelling induced ground settlement and its influence on existing buildings is one of the major concerns of any urban tunnelling project. The combination of IRIS.tunnel with IRIS.geomonitoring integrates settlement measurements (precise levelling, total station, water settlement cell system etc.) and TBM data into a single data platform. This allows instant cross-evaluation of the surface and building settlement with particular focus on:

→ Volume loss evaluation in near real-time
→ Comparison with limiting values
→ Comparison with expected values
→ Alarm function
→ Correlation between TBM process data and settlement

State-of-the art visualization tools allow the user to access the data in forms of diagrams, map views and long sections. The data can also be overlaid with CAD-images.

ITC engineering offers a wide range of engineering services on settlement prediction:

→ Settlement contours, even for complex underground structures (stations, cross-overs, open excavations etc.)
→ Building damage risk assessment based on critical strain model
→ Numerical analysis of structure-soil interaction problems (2D & 3D)

These results can be used for the IRIS target-performance analysis and also provide IRIS with project specific trigger levels for the automated alarm function.
ITC SERVICES

ITC engineering offers a wide range of services from IRIS system installation to the full engineering design of segmental tunnel lining.

**IRIS services:**

→ IRIS Training on site
→ System installation on site
→ Site-specific program updates
→ Data interpretation and summary reports

**Tunnel engineering services:**

→ Soil-structure interaction numerical analysis
→ Tunnel segment design
→ TMB launch/reception structures

**Geotechnical engineering services:**

→ Settlement prediction & building damage risk assessment
→ Risk evaluation
→ Geotechnical interpretative reporting

Data Interpretation

ITC offers additional consulting services to get the most out of your data. The Process Analysis Service Module comprises regular interpretation of the TBM data through one of our experienced engineers. This service will provide a weekly update on issues like:

→ Correlation between geology and TBM advance
→ Deviations from original design/assumptions
→ Update of tunnelling advance prognosis
→ Update of tunnelling risk evaluation
→ Prediction of maintenance requirements

A final report containing comprehensive data and charts will also be submitted after project completion.
DATA PROTECTION

A key requirement for any centralized data storage is data protection and security. IRIS.tunnel uses modern security features to protect all data and to avoid unauthorized access.

- Secure connections
- Secure authentication
- Hard- and software firewalls
- Data encryption
- Separate servers
- Server mirroring
- Automated backup

These systems provide the highest level of data security and reliable data access.

A modular user and access rights management within the application provides authorized users with access to selected software modules.

This user account control can be flexibly adapted according to the requirements of each project. This simplifies the organization of user access within construction joint ventures.
IRIS integrates different aspects of process data management such as data acquisition, data organization, data evaluation and visualization into a single platform. IRIS is a web application. The prerequisite for using IRIS is a construction site with an Internet connection. The system can also be operated on the construction site Intranet.

User access is provided via a standard browser. The software is independent of the operating system. Being a flexible web system, IRIS can also be used with mobile devices (e.g. smartphones).

In order to use IRIS.tunnel just enter your personalized URL into your preferred web browser. That's it – no further installation is necessary.
REFERENCES

→ RandstadRail Rotterdam, Netherlands
→ Tunnelkette Perschling Vienna, Austria
→ H8 Jenbach, Austria
→ Citytunnel Leipzig, Germany
→ Finnetunnel, Germany
→ Metro Line 7 New York, USA
→ St.Petersburg, Russia
→ U4 Hamburg, Germany
→ Niagara Ontario, Canada
→ Metro Budapest, Hungary
→ Metro Line C Rome, Italy
→ Ems-Dollart-Tunnel, Germany
→ Proyecto Hidroelectrico Palomino, Dominican Republic
→ Neuer Kaiser Wilhelm Tunnel, Germany
→ Metro Noord Zuidlijn Amsterdam, Netherlands
→ Queens bored tunnel New York, USA
→ Stadtbahntunnel Karlsruhe, Germany
→ Tunnel Quejigares, Spain
→ Prag Metro, Czech Republic
→ Lee Tunnel, England

OTHER PROGRAMS OF THE IRIS FAMILY

IRIS.tunnel is part of the IRIS program family. The IRIS product range provides software solutions for different civil engineering project types of infrastructure construction. Similar programs as IRIS.tunnel are available for the following project types:

→ **IRIS.geomonitoring** provides a data platform for geotechnical and building monitoring often associated with urban underground construction.

→ **IRIS.foundation** is a software solution for the data management of cut and cover excavation. Monitoring data such as diaphragm wall inclinometers or settlement points can be easily accessed via the user-friendly graphical interface.

→ **IRIS.microtunnel** adds specific analysis modules to the IRIS.tunnel program (such as bentonite injections and jack forces)

→ In the near future it is planned to expand this product range by **IRIS.geoenvironmental** for geoenvironmental monitoring.
ITC Engineering offers web-based process management software systems for civil engineering and infrastructure projects. Our programs offer tailored solutions for contractors, consulting engineers, project developers and insurance companies. The focus of our software is on TBM-tunnelling, geo- and geo-environmental monitoring.