IRISSYS®
ERDMANN-Softwaregesellschaft mbH

THE LINEAR ASSET MANAGEMENT SOLUTION

CONTENT

INSIDE THE COMPANY

Foundation

ERDMANN Softwaregesellschaft mbH was founded by Ulrich Erdmann in 1994 with the vision of not only centralizing condition monitoring but also digitalizing the full maintenance process for an entire railway infrastructure. The company headquarter with the main business unit is located in Görlitz / Germany and with a branch office in Zwolle / Netherlands.

Development

During the founding years the company was focused on development and distribution of software solutions for railway infrastructure owners and maintainers. Based on the continuous growth in the international market our team built up to 50 employees and we developed additional business areas complementing our core product **IRIS**SYS®.

IRISSYS® International Railway and Inspection Services SYStem

IRISSYS® is a standard software platform for integrated maintenance management, launched on the market in 1998. The main reason for its success is the flexibility and adaptability to specific and complex customer requirements. The software is used to integrate and combine all available data sources in order to enable its users to evaluate the railway infrastructure condition in its entirety. The system supports the engineers with its comprehensive analysis capabilities, which allows to take a substantiated decision for the maintenance.

The ERDMANN-Softwaregesellschaft mbH offers **IRIS**SYS® as its main product with complimentary services such as product customization, hosting and operating, system administration, data import and consulting.

To ensure high quality and security standards for its products and services, the company is certified to DIN EN ISO 9001:2015 and DIN EN ISO 27001:2017.

WHY USE LAM

The Conflict

Typically, as a responsible entity for a railway infrastructure, owners / managers / contractors / maintainers face an increasing demand on safety, reliability and quality of their assets and services.
In contrast they are also under increasing pressure to reduce costs to meet economical goals for an efficient operating of the infrastructure.
These circumstances are building the main conflict in the day-to-day business of all participants in the maintenance process.
In order to balance the different boundary conditions, an efficient maintenance management is required.
An already proven solution is the introduction of a LAM (Linear Asset Management) system.

The Solution

LAM is a data management concept designed to link all information to a common infrastructure model with a unique location representation.
Connecting different independent data sources by using the same linear reference is the foundation. The main benefits of using LAM are:

- Detailed analysis capabilities of all information for a given location
- Comprehensive overview of the infrastructure condition by aggregated information and KPIs
- Data consistency especially with changing infrastructure
- Objective decision support for maintenance planning
- Basis for developing and introducing an optimised maintenance strategy

Linear Asset Management

IRISSYS®

Product Overview

IRISSYS® is acknowledged worldwide and has been embedded in the business processes of railway infrastructure owners and maintainers for more than 20 years. By addressing the day-to-day challenges of its customers and continuously evolving its capabilities, it has established the foundational pillars of the LAM philosophy.

IRISSYS® addresses the LAM requirements through its core features:

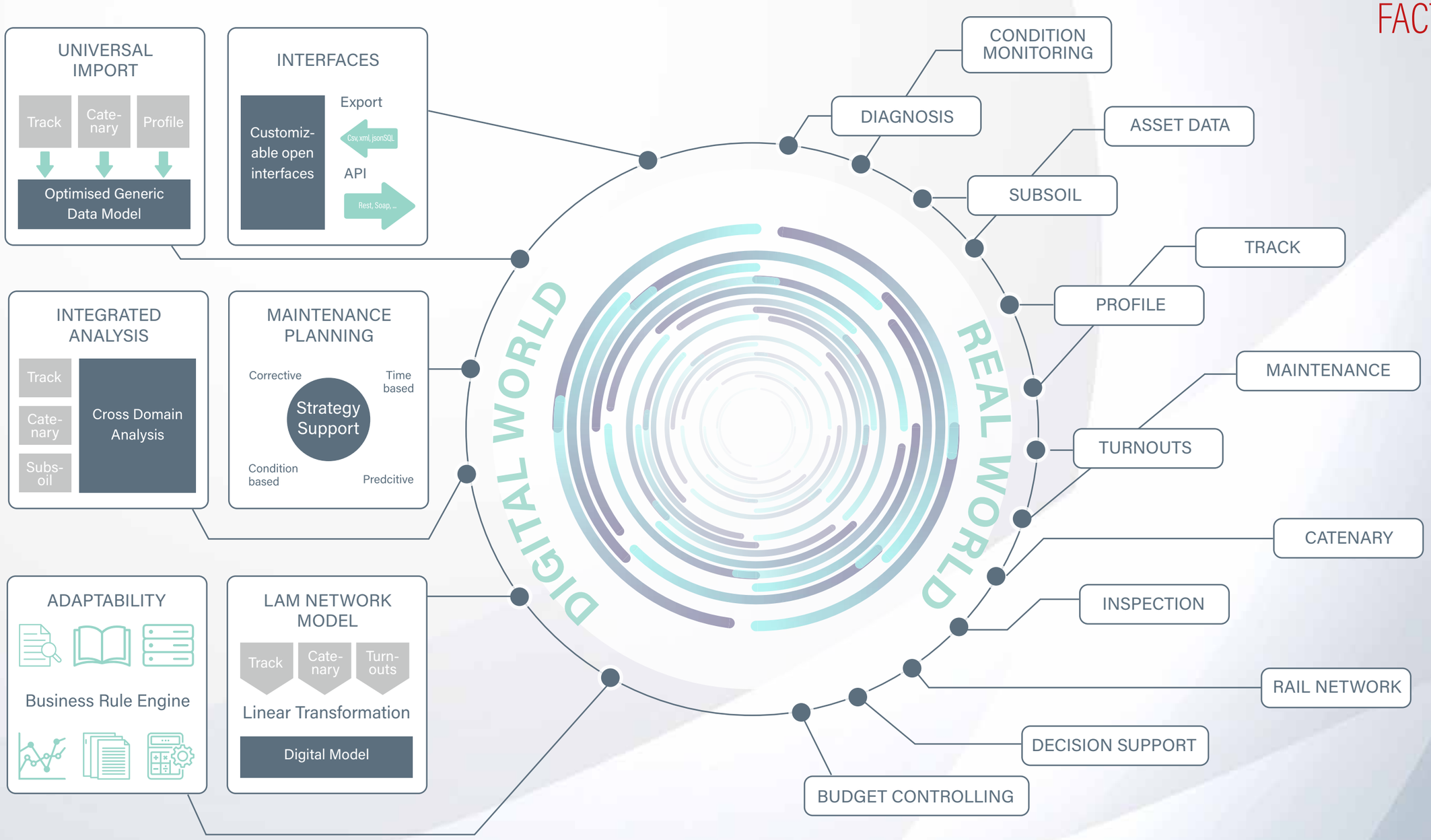
- Multi-layer linear representation of railway infrastructure including persistent data integrity on network changes
- Scalable analysis features from single value evaluation up to network wide data aggregation
- Comprehensive cross-domain data analysis capabilities with complete data history
- Sophisticated business rule engine to implement customer-specific maintenance approaches
- Adaptable data integration interfaces for various sources e.g files, databases, APIs
- Live data validation including automatic integrity and plausibility checks as well as correlation to historic data sets
- Data exchange engine for incorporating existing structures and definitions from connected 3rd party applications

IRISSYS® represents an enhancing data platform for and with continuous customer focused development.

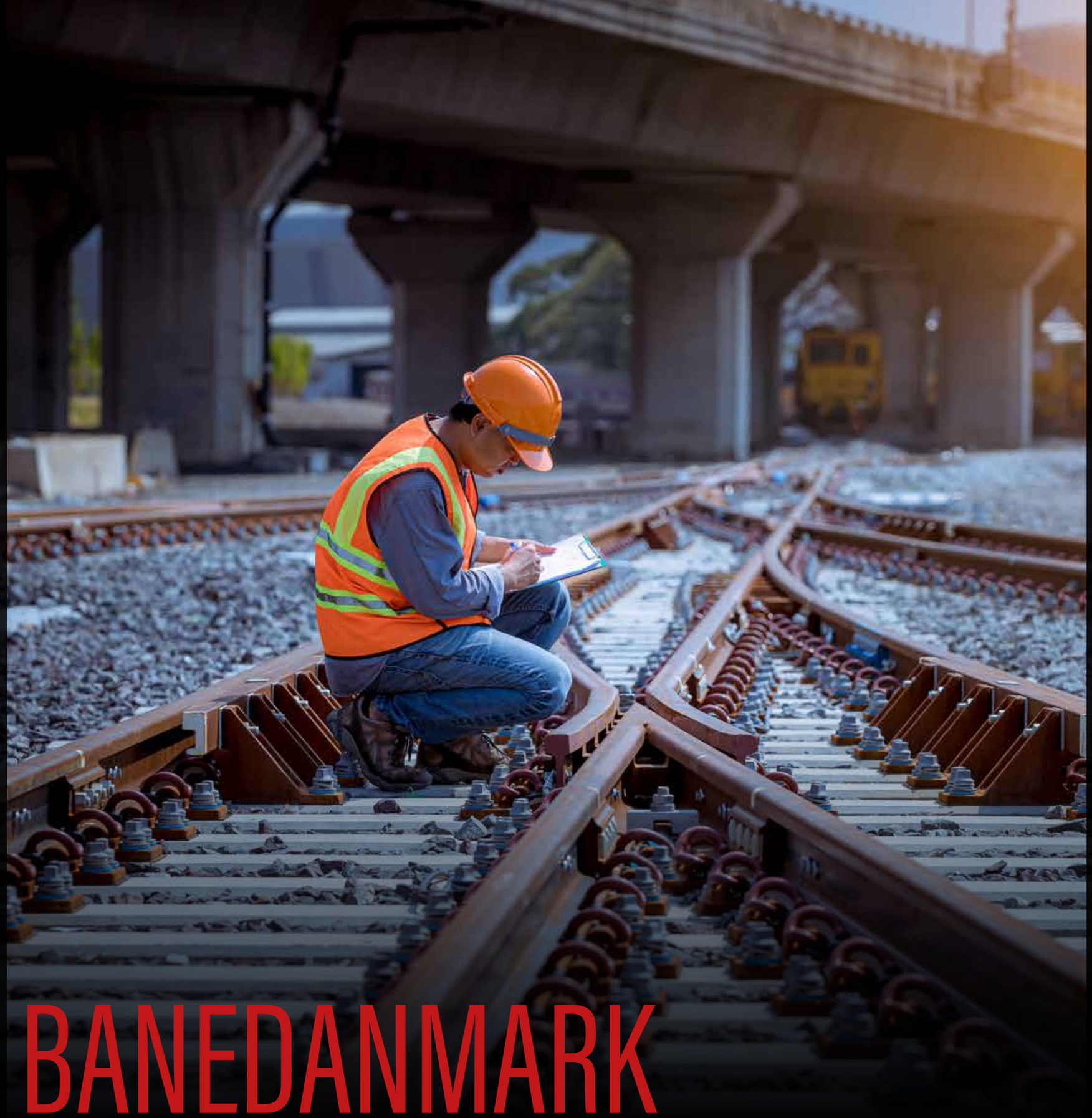
MAKE BETTER DECISIONS

IRISSYS®

FACTS



DENMARK



BANEDANMARK

banedanmark

Company Facts

- 3.102 km
- Infrastructure owner
- Since 2010

IRISSYS® Use Cases

- Central condition analysis and monitoring system
- Customized treatment process for safety related exceptions
- Automated decision support system for maintenance planning
- Data exchange with ERP systems

Datasets

- Track geometry
- Rail and non-destructive testing
- Overhead line
- Clearance profile

ULTRASONIC DEFECTS

In addition to data recorded by measurement vehicles, ultrasonic images, so-called „BScans", are used for the analysis of the rail condition. As part of the import process, the ultrasonic measurement data is categorized into potential defects (suspects) with a certain severity and labelled with an unique identifier. BaneDanmark has defined a specific business process in which the suspects are analyzed and treated based on a workflow with dedicated states.

Validation of Suspects

The maintenance engineer is performing an on-site review of a given suspect. Based on the validation, the maintenance engineer creates a defect report including images and remarks.
This defect report is uploaded to **IRIS**SYS® from a mobile device.
During the upload process, **IRIS**SYS® validates the entered information of the track engineer and confirms the submission.
In case of validation issues, the suspect is rejected with a detailed report (e.g. invalid location information).

Defect Management in IRISSYS

The defect management in **IRIS**SYS® is a custom built solution and consists of a detailed data model, dedicated business rules and a comprehensive history which allows to find and trace the relation to previous defects or suspects.

The data model identifies each defect unambiguously, contains process information and stores more than 70 properties for a given defect.

Connection ERP

In order to plan maintenance actions for treating defects, information is exchanged in both directions with Banedanmarks ERP system. **IRIS**SYS® can trigger the creation of a new work order. It will be enriched with the technical data inside **IRIS**SYS®.

Data Analysis

Ultrasonic defects and suspects can be visualized alongside the track graphically including the assessment of the condition and historical information. With the unified analysis system, additional data domains can be integrated on demand to support root cause evaluation. In addition to the representation, defect information can be edited. Updated information is exchanged automatically with the connected ERP system.

Interface to an External System

*The interface between **IRIS**SYS® and an external IT system (e.g. ERP) is a standard integration scenario when implementing **IRIS**SYS® at a customer.*

Depending on the technical requirements from the customer, a direct connection to an application or utilization of an available enterprise service bus is usually realized via a web service or REST API.

***IRIS**SYS® is able to provide custom-built and use-case oriented interfaces to adopt existing rules and definitions which simplifies the implementation process.*

SWITZERLAND

SBB AG

Company Facts

- 3.265 km
- Infrastructure owner
- Since 2016

IRISSYS® Use Case

- Central condition analysis and monitoring system
- Data exchange with ERP systems
- Customized treatment process for safety related exceptions
- Customized user interface for infrastructure maintenance and renewal treatment
- Integrated GIS viewer

Datasets

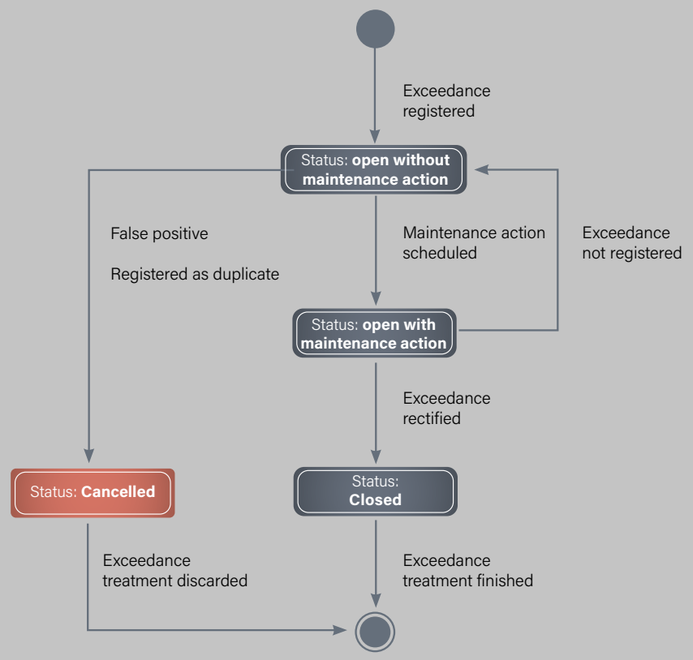
- Track geometry
- Rail and non-destructive testing
- Overhead line
- Clearance profile

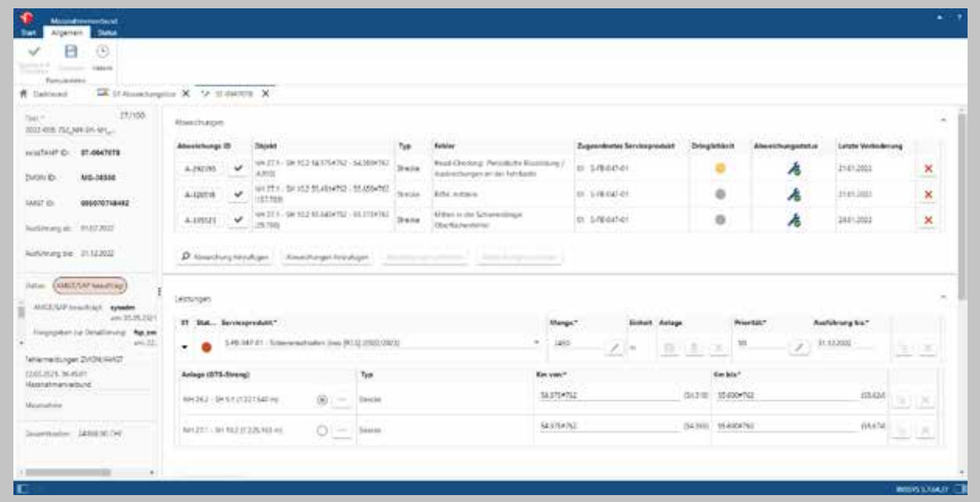
EXCEEDANCE MANAGEMENT IN SWISSTAMP

The Schweizerische Bundesbahnen AG uses **IRIS**SYS® as part of the swissTAMP project. Exceedances are a central element in the process of condition diagnosis at SBB AG. The attributes of severity and priority play an important role. Exceedances can occur based on manual or automatic inspections. An example of an exceedance resulting from a manual inspection is a loose rail fastening, while an exceedance from an automatic inspection is the squat detection. In swissTAMP, exceedances are registered automatically. During the registration process, recurrent exceedances are detected with complex algorithms. The content of these exceedances is updated and aggregated accordingly.

The treatment of exceedances is represented by a custom process in swissTAMP. Multiple interfaces to other IT systems have been implemented in order to accomplish a full integration into the existing business processes of the customer:

- Mobile app for manual track inspection
- Viewer for videos / images from automatic track inspections
- Resource management SAP-PM





Exceedance List

All exceedances of the permanent way are gathered from the different available sources and are assigned to the operating asset manager who is responsible for the related area.

The operating asset manager can view and manage the exceedances of his or her area of responsibility inside a SBB-specific user interface which is called „Exceedance List“.

Maintenance Activity Group

In order to treat and rectify an open exceedance, a maintenance activity can be defined in a different SBB-specific user interface which is called „Maintenance Activity Group“. This maintenance activity is then assigned to the related exceedance by the user. In doing so, the status of the exceedance is updated automatically by the system. As soon as the maintenance activity has been performed, the operating asset manager is notified. The last step is closing the exceedance officially inside the „Maintenance Activity Group“ user interface.

ISRAEL

ISRAEL RAILWAYS

רכבת ישראל

Company Facts

- 1.138 km
- Infrastructure owner
- Since 2014

IRISSYS® Use Case

- Central condition analysis and monitoring system
- Turnout inspection
- Data exchange with ERP systems
- Exception management
- Maintenance planning
- Bridge life cycle monitoring

Data Domains

- Track geometry
- Rail
- Turnout
- Clearance profile
- Bridge condition

CONDITION REPORTING

Overnight Calculation

At Israel Railways, infrastructure condition data is imported into **IRIS**SYS® through a manual validation process with customer specific business rules. This data is aggregated and evaluated automatically every night. The system automatically distributes the resulting network condition report to the responsible track engineers via email. The report contains all potential exceedances including the classification of the severity and due date for rectification.

Verification and WorkOrder

Based on the received information in the email, graphical analyses are used to verify the reported exceedances. If an exceedance is verified, then a work order can be created and exchanged with the connected ERP system. If an exceedance was identified as a false-positive, it would be black-listed for future condition reports.
This automated work flow to monitor the condition and generating the report including follow up actions is also available for the turnout domain.

THE NETHERLANDS

PRORAIL

ProRail

Company Facts

- 7.970 km
- Infrastructure owner
- Since 2003

IRISSYS® Use Case

- Central condition analysis and monitoring system
- Distribution platform for maintenance information
- Automatic data import and validation functionality
- Automatic track and switch model update
- Integrated GIS viewer

Data Domains

- Track geometry
- Overhead line
- Rail profile
- Rail and non-destructive testing
- Switches

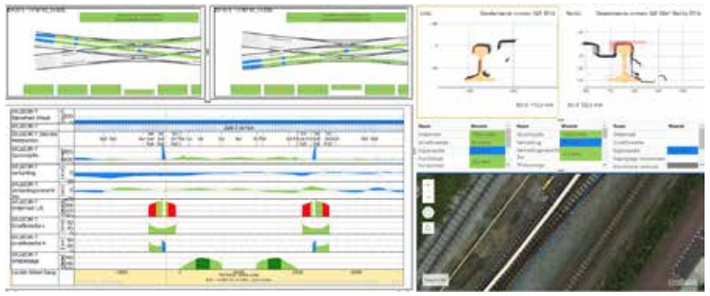
SWITCH INSPECTIONS
IN A BRANCH WIDE SYSTEM

Branch Wide Monitoring System (BBMS)

ProRail is responsible for the Dutch railway network and has been using **IRIS**SYS® since 2003. In 2012, ProRail launched a new project in order to centralize the diagnosis and the monitoring of the condition of all infrastructure elements. This project has achieved to implement an open platform for the maintenance process. The maintenance of the infrastructure is tendered on the market based on a regional division of the country. This platform is called Branch Wide Monitoring System (BBMS) and **IRIS**SYS® is the core.

Standardized National-Wide Network Model

With the introduction of BBMS, a complete detailed national network model was made, which serves as a basis for all parties of the maintenance process like measurement providers and maintenance companies. This linear track model provides geographic and supporting administrative data. Every six months, a new version of this model is processed incorporating updates based on the current external situation. The import process of a new track model version is a complex custom workflow which is fully automated. As a result, not only is the new version of the track model accessible to system users, but previous versions of the track model are also still available as snapshots in the system.



Central Data Access for All Maintenance Participants

In addition to the linear track model, ProRail also provides and maintains a detailed switch model. Due to the quality of both models, the data import process for all data sets such as track geometry, catenary, rail defects and switch inspections could be implemented with a very high degree of automation. With the pre-configured analyzes, a correct assessment of the data regarding safety and maintenance need can be made. Unique about BBMS is that all connected contractors can log in to use the information in order to coordinate their maintenance activities within their own regional areas.

Switch Inspections

One of the challenging data sets is switch geometry. The switches are measured loaded with dedicated measuring vehicles. The geometry and rail profile data are supplied to BBMS in a standardized open format. The import of switch measurement as well as the validation of the supplied data is done automatically. Before releasing the data to end-users of BBMS, specific cases are checked manually by specialists. After the data has been released a switch can be analyzed in detail in graphical views and reports with several assessment levels and geographical localization in GIS. The condition is evaluated based on specific measurement points, which are maintained as part of the switch model and with continuous measured values with assessment against dedicated areas in a switch.

FRANCE

SNCF RESEAU

SNCF RÉSEAU

Company Facts

- 49.500 km
- Infrastructure owner
- Since 2019

IRISSYS® Use Case

- Central condition analysis and monitoring system
- Navigation to connected customer systems
- Automatic data import
- Monitoring of inspection intervals
- Maintenance impact analysis

Data Domains

- Track geometry
- Rail
- Overhead line
- Signalisation
- Clearance profile

AUTOMATIC DATA IMPORT IN CLOUD ENVIRONMENT

IRISSYS® participates in the TOTEM (Traitement Opérationnel des Tournées des Engins de Mesures) programme at SNCF RESEAU, which manages the processing and analysis of condition data from France's entire railway infrastructure.

The SNCF RESEAU IT-strategy requires the deployment of **IRIS**SYS® in a public cloud environment instead of an on-premise setup.
Additional services to operate the system are provided e.g. monitoring, user and database administration.

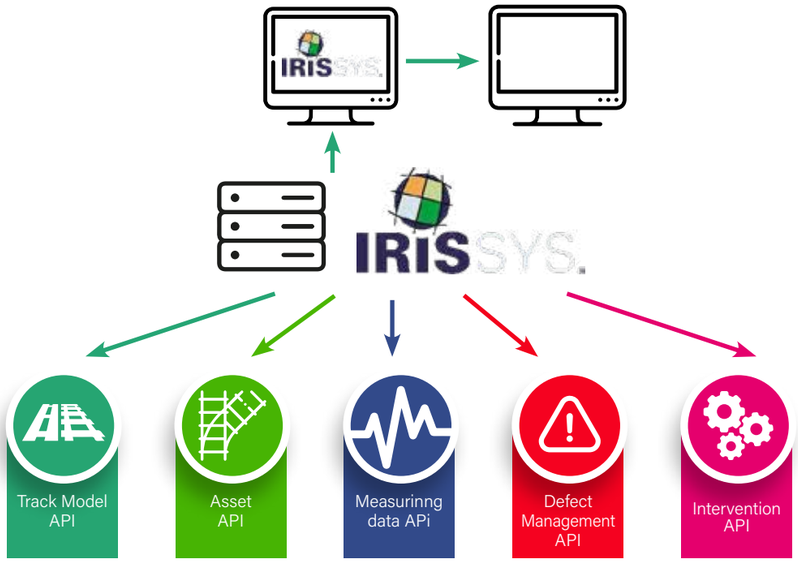
User Access

The end-users have access to the application in the cloud via the **IRIS**SYS® Web-Edition. Users can navigate between other related SNCF RESEAU systems and **IRIS**SYS® to determine the infrastructure condition in a comprehensive way. With this approach a root cause analysis of different information sources can be performed.

The end-users are distributed over the entire country with different authorisation levels.
The system is configured to allow access only to the corresponding part of the network and the functional scope of the competencies.

Data Integration

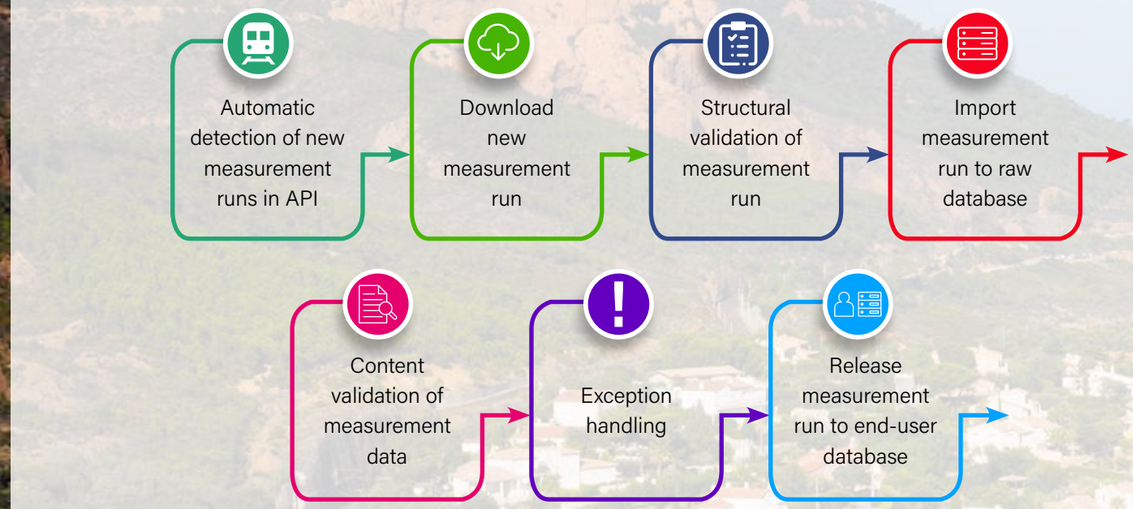
IRISSYS® utilizes multiple data sources for retrieving and processing information. Most of the sources are addressed by SNCF RESEAU-specific APIs.
The data integration processes are designed to run in a fully automated way. The operational sequence is logged in order to guarantee the traceability of all actions and support administrative tasks.



Automatic Import

Measurement data is imported automatically with a complex management of different states.
The first step is to evaluate if a new delivery was published. A download task then downloads the measurement run or triggers dedicated processes if the download fails.

In the next step the data is imported into a dedicated raw database. After this stage SNCF RESEAU specific treatments are performed and applied.
At the last stage the data is finally released to a dedicated database accessed by end-users.



THE NETHERLANDS

STRUKTON RAIL

Strukton Rail

Company Facts

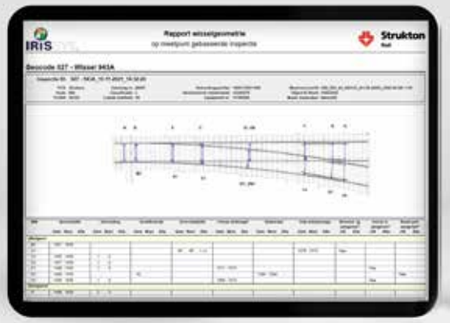
- 2.673 km
- Infrastructure owner
- Infrastructure maintenance specialist
- Since 2002

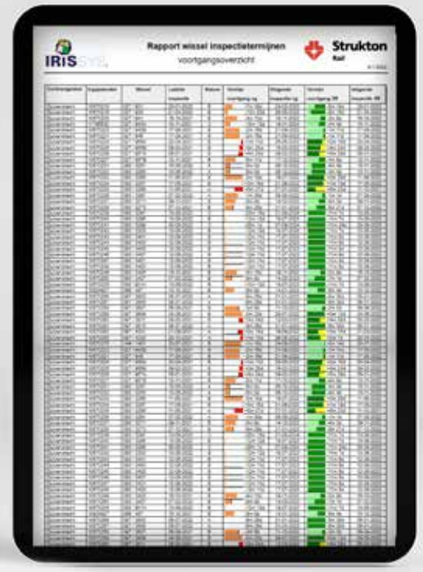
IRISSYS® Use Case

- Central condition analysis and monitoring system
- Decision support system for maintenance planning
- Manual switch inspection in the field
- Interface to ERP system

Data Domains

- Track geometry
- Overhead line
- Rail profile
- Switch inspection





SWITCH INSPECTION IN THE FIELD

The First Customer

Strukton Rail is one of Europe's largest railway infrastructure maintenance companies. They were one of the first companies which believed in digitalization of the maintenance process as one of the key success factors to establish an efficient way of working. Strukton Rail was the first customer of **IRIS**SYS® which supported the development and provided detailed insights in practical use cases which needed to be covered. The system is fully hosted and operated by ERDMANN-Softwaregesellschaft mbH.

Manual Switch Inspection

Strukton Rail has been using **IRIS**SYS® for manual switch inspections for more than 10 years now. For this purpose, a mobile device with an offline configuration of **IRIS**SYS® is used. With this configuration, the inspector collects condition data directly at the switch in the field. The data collection is supported by a customer-specific user interface which has been developed to simplify the measurement data input due to the special requirements of a switch inspection process.

Custom-Specific User Interface

This user interface of **IRIS**SYS® shows a graphical overview of the switch layout including the points to be inspected per measured parameter. During the data input, quality checks are applied to the entered value immediately and the inspection result is assessed according to the locally applicable regulations. This allows the inspector to determine on-site if immediate actions must be taken.

In-Office Workflow

After completion of the inspection, the condition data is transmitted to the main **IRIS**SYS® server of Strukton Rail. Every morning, a report is automatically generated by the system and sent to the various maintenance teams. Information is exchanged with an ERP system, where work orders for the related maintenance actions are created. As part of the reporting to Strukton's clients, a summary can be created stating details about the progress of the switch inspections and the overall quality.

NORWAY

BANE NOR

BANE NOR

Company Facts

- 4.200 km
- Infrastructure owner
- Since 2012

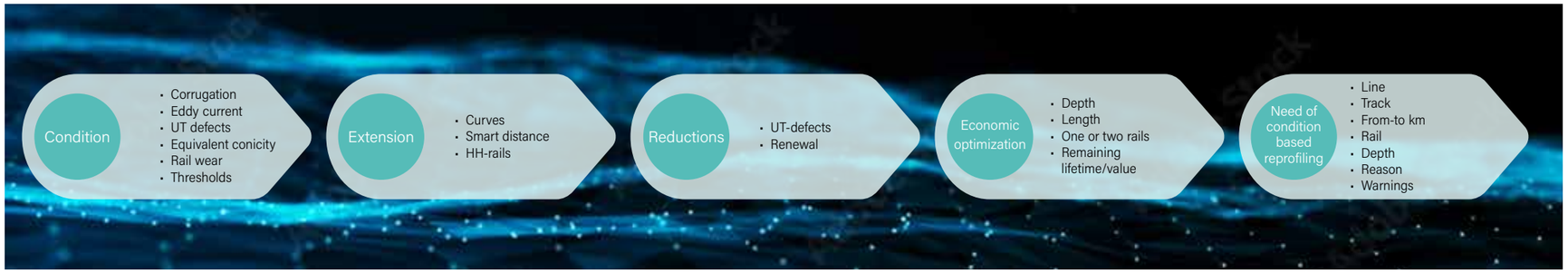
IRISSYS® Use Case

- Central condition analysis and monitoring system
- Automated decision support system for maintenance planning

Data Domains

- Track geometry
- Overhead line
- Rail profile
- Rail and non-destructive testing

PREVENTIVE AND CONDITION BASED REPROFILING



Life Time of Rails

Bane NOR is the owner of the railway network in Norway. **IRIS**SYS® is used to store and analyse the condition data as well as to provide decision support for track engineers. The system is deployed in an on-premise scenario. Operational and strategic maintenance actions such as rail profiling are planned and evaluated in the solution.

The lifetime of the railway infrastructure, especially the rails, plays a key role in ensuring that transport remains a sustainable solution. The degradation of rails depends on various factors like type of defect, location of defect, curve radius, axle load, line speed and rail steel hardness.

The life cycle of the rails can be optimised using a data driven rail reprofiling management system as implemented with **IRIS**SYS® at Bane NOR.

Data Driven Rail Reprofiling

The main inputs are condition data of relevant sources managed by **IRIS**SYS® as well as safety and maintenance regulations. Bane NOR has introduced a sophisticated rule system to determine the locations with need of rail reprofiling.
At the beginning of the process, the rail sections that potentially require maintenance are identified using only condition data. The next step is an optimisation based on technical criteria, which leads to an extension or reduction of a potential location. At the end, an economic optimisation is applied to consider the costs and the remaining life time. The final output is an automatically generated overview of sections with need of reprofiling and maintenance related information.

THE NETHERLANDS

INFRASPEED

INFRASPEED

Company Facts

- 180 km
- Infrastructure PPP contractor
- Since 2006

IRISSYS® Use Case

- Central condition analysis and monitoring system
- Decision support system for maintenance planning
- Custom apps with system integration

Data Domains

- Track geometry
- Overhead line
- Rail profile
- Rail and non-destructive testing

MOBILE APP INTEGRATION

One System for all Condition Information

Infraspeed Maintenance bv manages the full maintenance of the Netherlands' sole high-speed railway line. The project is structured as a 30-year public-private partnership (PPP) contract. Since the start of the contract, **IRIS**SYS® has been used as primary infrastructure management system to store all condition-related information. The track inspections are done based on a fixed frequency. The inspection results are imported directly into the system and are processed and analyzed afterwards in order to get a detailed overview about the degradation at the earliest possible stage. The **IRIS**SYS® environments of Infraspeed Maintenance bv are hosted at the Erdmann data center.

Mobile Apps as Extension of IRISSYS®

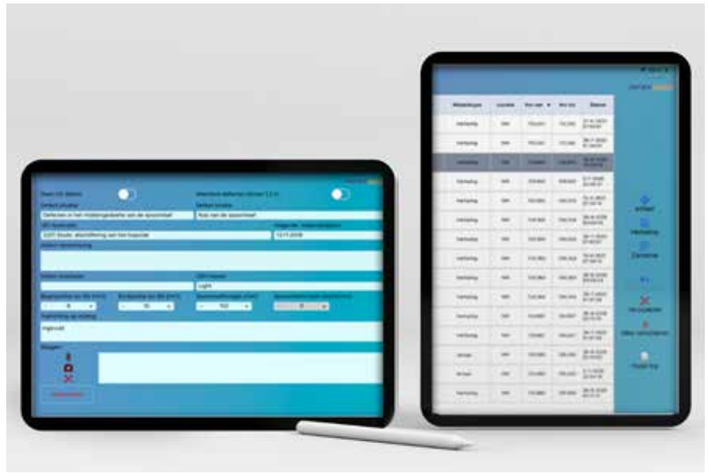
In order to simplify and optimize their maintenance processes, Infraspeed Maintenance bv introduced three mobile apps assisting the track engineers in their daily work. All three apps have been developed by ERDMANN-Softwaregesellschaft mbH and have a deep integration into **IRIS**SYS®. There is an app for manual ultrasonic inspection, for visual rail inspection and a locator app supporting the operator in the field with the localization of his or her current position on the track based on infrastructure properties without relying on GPS coordinates. All apps can be used offline and are connected to **IRIS**SYS® via a custom API. They are developed to run on Apple devices which was the platform of choice by Infraspeed Maintenance bv.

Manual Ultrasonic Inspection with App Support

Before an inspector goes into the field to perform a manual ultrasonic inspection, the ultrasonic suspect locations to be inspected are prepared in **IRIS**SYS®. As a second step, the measurement points are downloaded to the ultrasonic inspection app. During the inspection on site, the inspector can add investigation results such as measurement data, images and written remarks to the related ultrasonic defect. If the ultrasonic app has an online connection, the gathered information is transmitted back to the **IRIS**SYS® server as soon as it has been released by the inspector. If the app is offline, the transfer can also be triggered manually at a later point in time. Once the information is transmitted, a maintenance engineer can immediately analyze the incoming ultrasonic reports in the office and take follow-up actions as needed.

Benefits of App Integration

The use of mobile apps for manual inspections in the field together with the close integration into **IRIS**SYS® has brought major benefits for the overall maintenance process of Infraspeed Maintenance bv. In addition to the lowered administrative effort due to a streamlined inspection work flow and optimal use of previous inspection results, the data quality could be raised significantly because of validations and checks which are applied to entered values directly at the time of input. The time from entering inspection results until the start of further analysis in the office has also been decreased substantially. On top of that, the pre-defined inspection workflow and the user-friendly interface of the apps enabled Infraspeed Maintenance bv to contract external measurement parties in addition to use own personnel.



AUSTRALIA

QUEENSLAND RAIL

QueenslandRail

Company Facts

- 6.600 km
- Queensland Government
- Since 2018

IRISSYS® Use Case

- Central linear asset analysis system
- TQI prediction
- Integrated GIS viewer
- Integrated video viewer

Data Domains

- Track geometry
- Rail profile
- Overhead line
- Maintenance data

SEAMLESS INTEGRATION OF VIDEO STREAMING INTO ANALYSIS

Queensland Rail uses **IRIS**SYS® for condition monitoring in the state of Queensland in Australia. The system is deployed as an on-premise solution and is operated by the company itself.

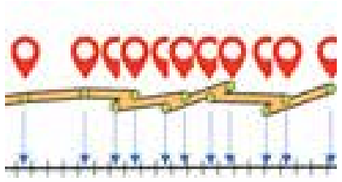
Common Reference Model

The permanent way, as the main „operational infrastructure“ with many thousand miles of track, is subject to usage-related or unforseen changes that can lead to damage or disruptions. Rail assets must be maintained, inventoried and monitored systematically using the latest available inspection technologies to meet safety requirements and economical boundaries.
Any retrieved measurement data must be referenced by a common linear asset model to recognize the changing conditions from the same location. Additional information supports the decision maker to understand the root cause and select the appropriate maintenance action.

Real World Connection

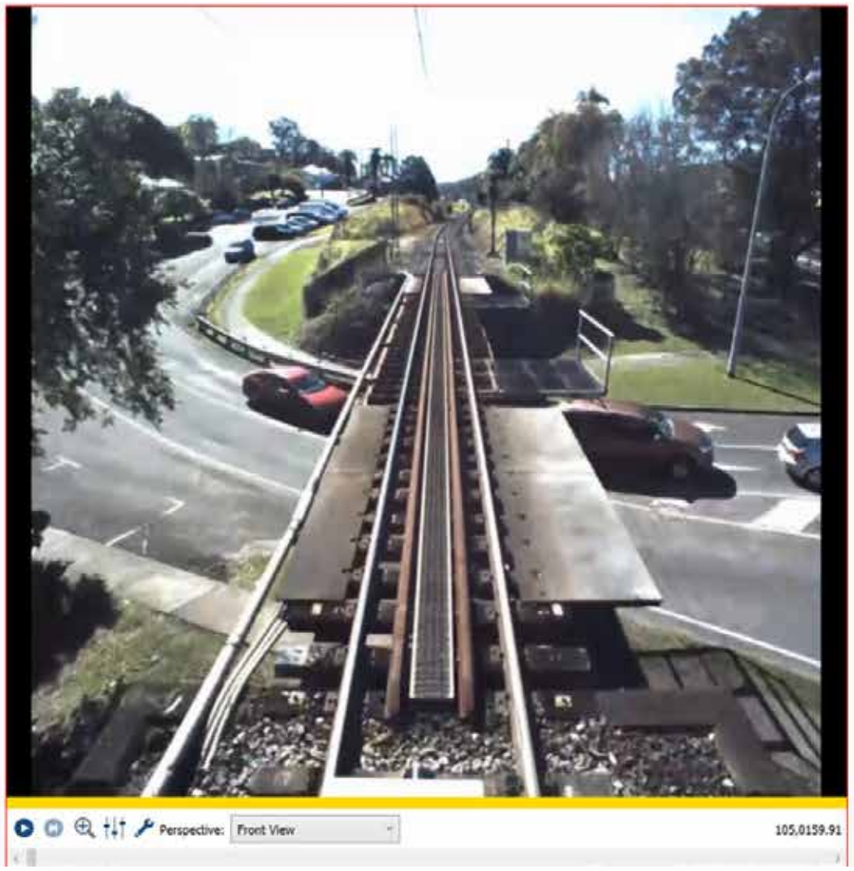
High-resolution cameras are increasingly deployed to provide track engineers in the office with a comprehensive view, enabling them to correlate technical condition data with real on-site occurrences. The main challenge is based upon the correct projection of the GPS-referenced video onto the common reference model.

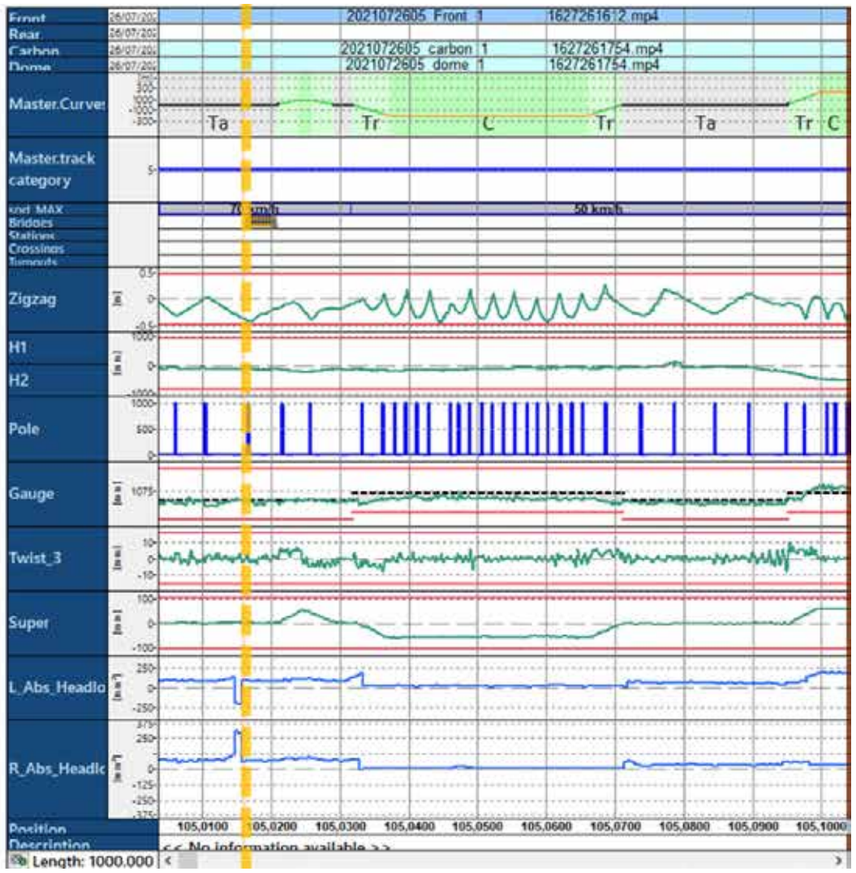
The video recording is captured with a fixed frame rate while the train is moving with non-constant speed.



This circumstance needs to be considered during the processing and playback of the video if other information (e.g. track geometry) has to be synchronized.

Whilst streaming the video, **IRIS**SYS® is compensating the changing drift between the non-linear distribution of the frames in terms of location and the linear position of the analysis.





THE NETHERLANDS

VOLKERRAIL

VolkerRail

Company Facts

- 1.790 km
- Infrastructure contractor
- Since 2004

IRISSYS® Use Case

- Central condition analysis and monitoring system
- Decision support system for maintenance planning
- Automatic exchange with ERP system

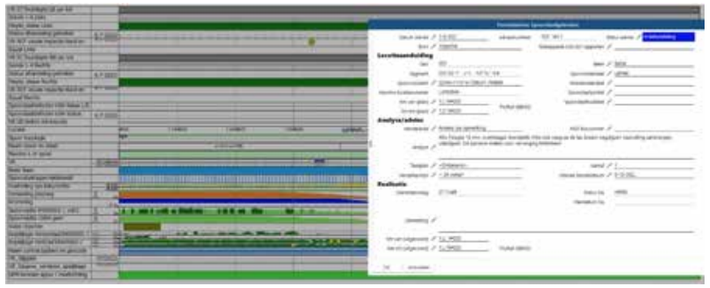
Data Domains

- Track geometry
- Overhead line
- Rail profile
- Rail and non-destructive testing

MAINTENANCE PLANNING WORKFLOWS

Shared Data Basis

VolkerRail is a major maintenance contractor in the Netherlands and the **IRIS**SYS® system is fully hosted and operated by ERDMANN-Softwaregesellschaft mbH. VolkerRail's customer provides the pre-validated measurement data and the underlying network model in an open digital format. These circumstances allow the automated import of infrastructure items and their condition into VolkerRail's system.



Maintenance Planning

VolkerRail enriches the imported data in their own **IRIS**SYS® environment. It consists of custom-designed analyses and special workflows for maintenance planning, including user-defined application interfaces to enter maintenance actions such as tamping, milling, and rail renewal. All entered maintenance actions are transmitted automatically to an ERP system. There is a link between the maintenance actions defined in **IRIS**SYS® and the stored items in the ERP system. This way, status information about the execution of the maintenance actions can be transferred back from ERP system into **IRIS**SYS®. One of the main benefits of this two-way connection between both systems is, that the track engineer has an up-to-date overview about the condition of the infrastructure including the historical development and the status of the proposed maintenance actions at the same time.

Ultrasonic Defect Management

A particularly complex maintenance work flow is related to ultrasonic defect management. Ultrasonic measurements are performed and provided by VolkerRails's customer. The information can be accessed via a dedicated contractor API. This API has been connected to VolkerRail's **IRIS**SYS® instance which downloads the defect reports for further processing automatically. The defect reports are transmitted in a custom XML format which contains information about location, defect type, severity and further details provided by the original measurement source. In addition to this data source, VolkerRail's **IRIS**SYS® instance is also supplied with maintenance actions from an external field inspection application. All information from these two data sources is combined and validated in **IRIS**SYS® to obtain a full picture of the occurrence, root cause, and maintenance status of an ultrasonic defect. After the maintenance engineer has controlled and closed an ultrasonic defect, he or she can authorize to release the upload of all information back to VolkerRail's customer via the API.

SWITZERLAND

RHOMBERG SERSA RAIL GROUP

RHOMBERG SERSA RAIL GROUP

Company Facts

- 2.000 km
- Full railway engineering service provider
- Since 2014

IRISSYS® Use Case

- Central condition analysis system
- Verification of maintenance quality
- Approval for new constructed tracks
- Fractal analysis
- Integrated GIS Viewer

Data Domains

- Track Geometry
- Catenary
- Rail

FROM TRACK GEOMETRY DOWN TO SUBSOIL

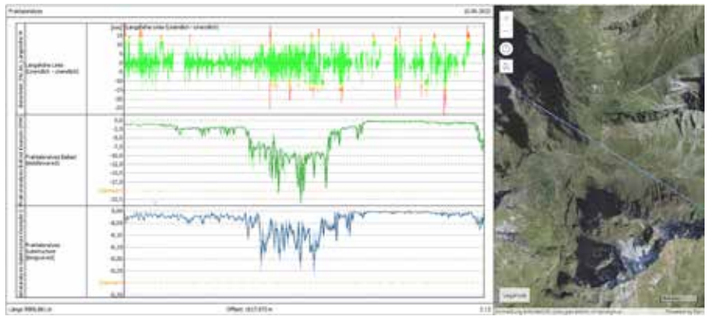
Rhomberg Sersa Rail Group

The Rhomberg Sersa Rail Group provides **IRIS**SYS® as a service solution for narrow gauge railways.

In addition to standard features, the Rhomberg Sersa Rail Group also applies analyses which are based on the mathematical model of the fractural analysis and are configured in **IRIS**SYS®. The customer thereby utilizes an additional integrated system component for asset analysis and assessment. ERDMANN-Softwaregesellschaft mbH hosts and operates the system in the in-house data center as part of the service contract.

About Fractural Analysis

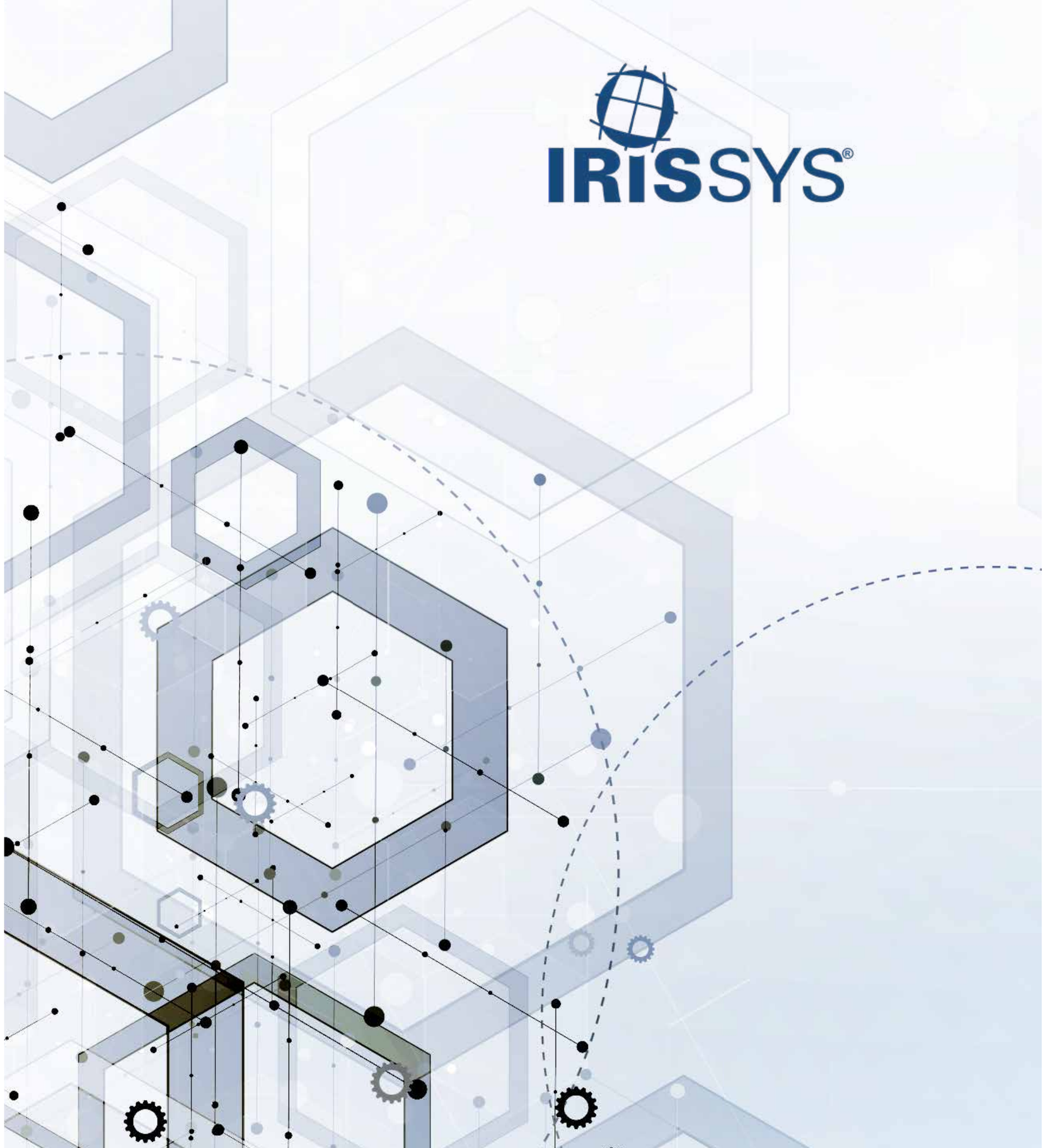
A polygonal line with segments of equal length is calculated from the measurement parameter vertical alignment. As the segment lengths are incrementally reduced, the shape of the polygonal line approaches the original measurement signal. The graphical presentation of different segment lengths in relation to the overall length of the polygonal line allows a conclusion of potential issues in the permanent way's substructure.
Empirical tests have proven, that a high slope of a regression line from the curves points to different layers in the substructure. The evaluation of the slopes in the mid and longwave section is an indicator for the root cause based in the ballast or in the subsoil.



RSRG Diagnostic

RSRG Diagnostic offers measurement services of track geometry, catenary and rail profile for multiple independent Swiss narrow gauge railways. The planning of maintenance and renewal is also part of the services. **IRIS**SYS® is used as measurement database, evaluation platform and visualization component.

TECHNICAL OVERVIEW



SYSTEM LANDSCAPE

IRISSYS® offers multiple application types tailored to different use cases. End users primarily access the system via a web application that requires only a modern web browser.

For data import management, administrative tasks, and advanced analyses, the solution also provides dedicated desktop applications.

IRISSYS® DesktopEdition

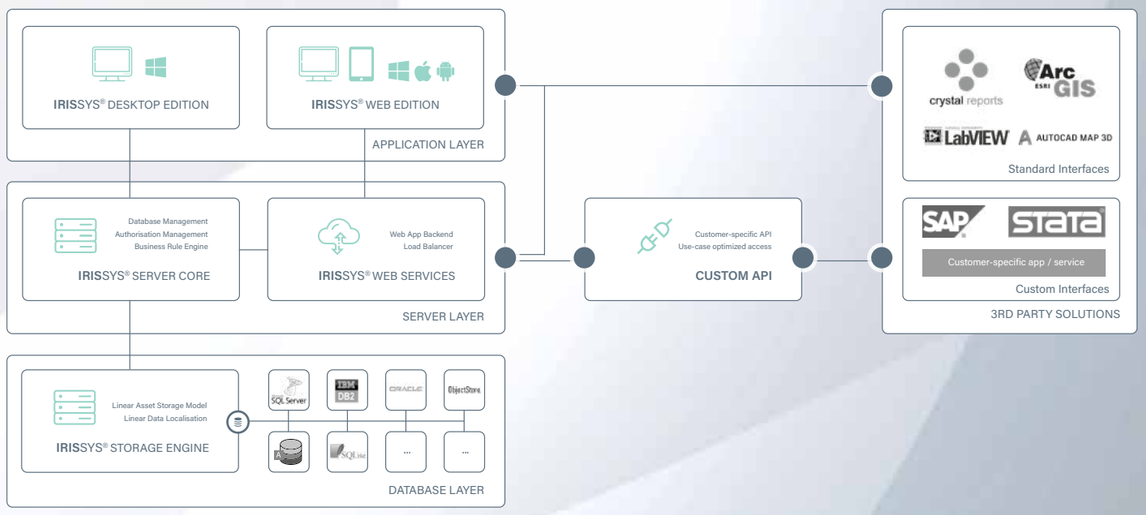
- Microsoft Windows
- Accessibility:
  - Local installation
  - Remote access (Microsoft RemoteDesktop & RemoteWeb, Citrix)
- Use Cases
  - Data import
  - Administration & maintenance
  - Extended analysis

IRISSYS® WebEdition

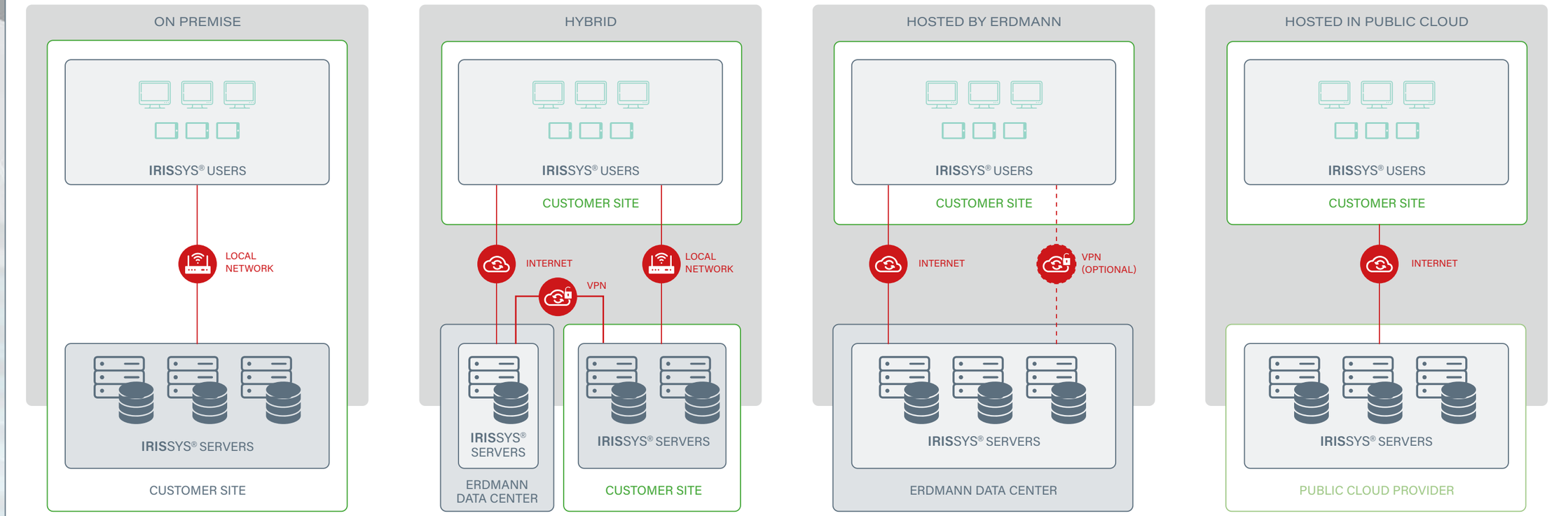
- Web application (platform independent)
- Accessibility:
  - Modern browser
  - No plugins required
- Use Cases
  - Data analysis
  - Quick reporting
  - Touch support
  - Manual on-site data input including recording of pictures
  - GPS tracking

IRISSYS® is based on a scalable client-server architecture. The server core and the web services are located in the server layer which all clients applications are communicating to. The **IRIS**SYS® storage engine allows the easy adaption of arbitrary database management systems. The internal **IRIS**SYS® server components are not tied to specific database logic or implementation and can utilize any database management systems through the storage engine which is required by the integration scenario.

For general tasks, **IRIS**SYS® provides integrated interfaces to widely-adopted 3rd party solutions. They are connected to the application or the server layer. Customer specific 3rd Party applications, which need to be connected are following a different approach. Due to the wide variety of functional capabilities, **IRIS**SYS® does not provide an open standard API. To allow a flexible interaction and a simplified integration approach, custom APIs are implemented to cover dedicated requirements with the introduction of **IRIS**SYS®.



DEPLOYMENT SCENARIO



Responsibility	Party
Hardware/platform provisioning	Customer
System administration	Customer
IRISSYS® administration	Customer
IRISSYS® support and maintenance	ERDMANN

Responsibility	Party
Hardware/platform provisioning	Mixed
System administration	Mixed
IRISSYS® administration	Mixed
IRISSYS® support and maintenance	ERDMANN

Responsibility	Party
Hardware/platform provisioning	ERDMANN
System administration	ERDMANN
IRISSYS® administration	ERDMANN
IRISSYS® support and maintenance	ERDMANN

Responsibility	Party
Hardware/platform provisioning	Customer (cloud)
System administration	Customer (cloud)
IRISSYS® administration	ERDMANN
IRISSYS® support and maintenance	ERDMANN

IRISSYS® can be operated in compliance with the customer's IT policies and regulations. The range of the deployment scenarios is spread from a self-hosted on-premise set-up to the operation on a cloud instance.

ERDMANN-Softwaregesellschaft mbH operates a certified data centre in Germany, dedicated only to the operation of **IRIS**SYS® customer installations. About half of our customers are currently hosted and operated with the offered services.

BUSINESS RULE ENGINE

One of the key factors behind the continuous growth of the **IRIS**SYS® customer base is its high level of adaptability to diverse real-world requirements. The adaptability is established by an integrated business rule engine.

The engine can be utilized in every integral part of the system:

- Data interface
- Data validation
- Import workflow modelling
- Data transformation

- Graphical display
- Data aggregation
- KPI calculation
- Regression analysis
- Prediction modelling
- Reporting

- Data exchange with 3rd party systems
- Data export to files
- API pre-processing

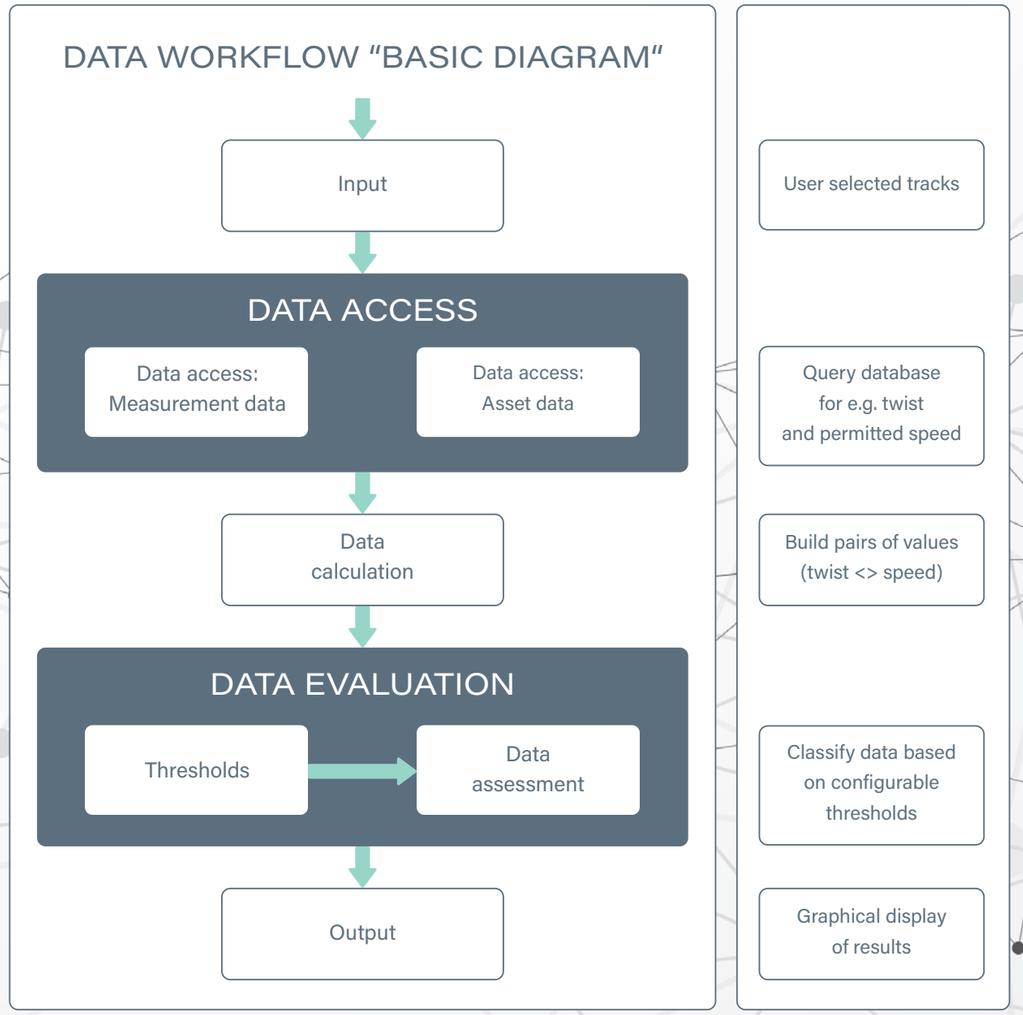
- Notifications

- Business process modelling

- Automation procedures

The business rule engine is a no-code configuration environment. It enables a graphical implementation of tailored functions suitable for a dedicated use case and can be used by every trained user. The principal philosophy of the internal modular architecture is follows the IPO model.

The **IRIS**SYS® business rule engine offers several key benefits: it allows new functions to be created without modifying the platform's source code, streamlines deployment by eliminating complex software distribution, and accelerates development cycles by leveraging existing user experience functionality.



CUSTOMERS

Country, Customer	From	To	IRISSYS®	Hosting	Administration
GERMANY					
DB Systemtechnik – TZF	2007	2011	✓		
EBA: The Federal Railway Authority	2013	-	✓	✓	✓
NETHERLANDS					
ProRail bv	2003	-	✓		✓
Strukton Rail	2002	-	✓	✓	✓
BAM Rail bv	2003	2012			
Eurailscout Inspection & Analysis bv	2003	2022	✓		
Volker Rail	2004	-	✓	✓	✓
Infraspeed Maintenance bv	2006	-	✓	✓	✓
GVB Amsterdam	2010	-	✓	✓	✓
RET Rotterdam	2022	-	✓	✓	✓
GREAT BRITAIN					
Network Rail (High Speed) Ltd.	2005	-	✓		✓
SLOVENIA					
Slovenske zeleznice d.d.	2003	2005	✓		
DENMARK					
Banedanmark	2010	-	✓	✓	✓
NORWAY					
Bane NOR	2012	-	✓		
MOROCCO					
Office National des Chemins de Fer (ONCF)	2010	2017	✓		
ISRAEL					
Israel Railways Ltd.	2014	-	✓		
SWITZERLAND					
SBB AG	2016	-	✓	✓	✓
Rhomberg Sersa Rail Group	2014	-	✓	✓	✓
FRANCE					
TREALIS	2015	-	✓		✓
EIFFAGE Rail Express LGV BPL	2017	-	✓		✓
SNCF RESEAU	2019	-	✓		✓
AUSTRALIA					
Queensland Rail	2018	-	✓		
LITHUANIA					
LTG INFRA	2022	-	✓	✓	✓

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P. 58, 59: NWM | stock.adobe.com
P. 60, 61: royyimzy | stock.adobe.com
P. 63: ON-Photography | stock.adobe.com
P. 64: Max Pixel | maxpixel.com

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