ENABLING INTEROPERABILITY IN ROTARY DRILLING

Anu Niittynen, Sandvik Mining, USA, details the role of the iLink Data Interface in modern mining systems.

As the mining industry undergoes a profound transformation driven by automation, digitalisation, and sustainability imperatives, the ability to integrate equipment into a unified digital ecosystem has become a cornerstone of operational excellence. In surface mining, rotary drilling operations are among the most data-intensive and operationally critical processes. They serve as the starting point for the entire value chain – from ore extraction to processing and logistics. Consequently, the interoperability of drill rigs with mine planning, monitoring, and reporting systems is essential for achieving real-time visibility, process optimisation, and data-driven decision-making.

To address this need, Sandvik has developed the iLink Data Interface, a standards-based, vendor-neutral communication layer that enables secure and efficient interaction between Sandvik iSeries surface drill rigs and third-party mining systems. Built on REST web services and HTTP protocols, iLink Data Interface provides a robust and scalable foundation for integrating drilling operations into broader mine automation strategies.

The digital transformation of surface drilling

Historically, rotary drill rigs operated as standalone mechanical systems, with limited connectivity and minimal integration with mine-wide IT infrastructure. Operators manually uploaded drill plans, recorded performance data on paper or local storage, and relied on radio communication for coordination. This siloed approach limited the ability to optimise drilling performance, respond to changing geological conditions, or ensure alignment with dynamic mine plans.

Today, rotary drill rigs are increasingly equipped with advanced onboard control systems, GNSS-based positioning, real-time telemetry, and onboard/remote automation features (such as auto-drill and auto-levelling). These capabilities generate vast volumes of operational data, including penetration rates, torque, and measurement while drilling (MWD) parameters. At the same time, rigs require continuous input from centralised systems – such as updated drill plans, configuration files, and safety protocols.

The challenge lies in enabling seamless, secure, and standardised communication between these systems. This is where the iLink Data Interface plays a pivotal role.

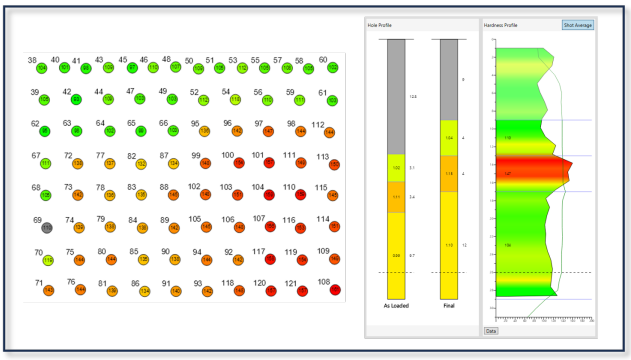


Figure 1. Blasting solution integration.

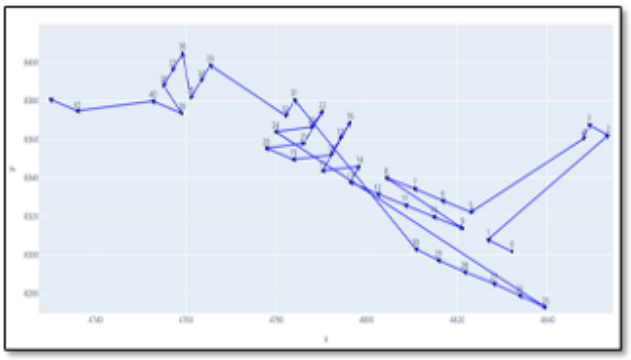


Figure 2. Operating efficiency integration.

Technical architecture: RESTful design for industrial integration

The iLink data is architected using Representational State Transfer (REST) principles, which are widely adopted in industrial automation and enterprise IT due to their simplicity, statelessness, and compatibility with web technologies. RESTful APIs use standard HTTP methods to perform operations on resources, making them easy to implement and integrate across diverse platforms.

In the iLink implementation, external systems interact with the drill rig via HTTP requests, accessing structured data in JSON format. This eliminates the need for proprietary protocols or middleware, reducing integration complexity and enabling faster deployment. The interface is designed to be platform-agnostic, allowing integration with a wide range of systems, including:

- Mine planning software (e.g. Deswik, Hexagon, MinePlan).
- Fleet management systems (e.g. Wenco, Modular).
- Data analytics platforms (e.g. Power BI, Tableau).
- Cloud-based IoT platforms (e.g. Azure IoT, AWS Greengrass).

Depending on the deployment scenario, communication can occur over local networks, VPNs, or cloud gateways. In remote or offline environments, physical connections may be required, but the communication model remains consistent.

Functional capabilities: A modular and extensible interface

The iLink Web Interface exposes a comprehensive set of endpoints grouped into logical modules that reflect the functional architecture of the drill rig. These include:

System metadata and configuration

- Access to rig identification, software versions, and hardware capabilities.
- Read/write access to system-level settings, such as time synchronisation and operational modes.

Operator interface and equipment live monitoring

- Read/write access to operator interface data, enabling remote visualisation of user interactions.
- Real-time access to equipment signals, including hydraulic pressures, rotary speeds, feed force, and bit position.
- Alarm and event logs for fault diagnosis and operational analysis.

Drill plan and geospatial data

- Access to TIM3D drill plan files, including hole coordinates, depths, and collar positions.
- Integration with mine design models for spatial alignment and compliance verification.

File transfer and document exchange

- Bi-directional file transfer for: drills plans, configuration files, MWD reports, and quality assurance documents.
- Supports automated workflows for plan deployment and report retrieval.

This modular design allows mining companies to implement only the functionalities they require, while maintaining the flexibility to expand integration as operational needs evolve.

Operational use cases: From planning to predictive maintenance

The iLink interface supports a wide range of use cases across the mining value chain, enabling both tactical improvements and strategic transformation.

Automated drill plan deployment

Mine planning systems can push updated drill plans directly to the rig, eliminating manual data entry and reducing the risk of errors. This is particularly valuable in dynamic pit environments – where geological conditions or production targets change frequently.

Real-time equipment monitoring

Maintenance and operations teams can monitor rig performance in real time, accessing live telemetry and alarm data. This enables proactive maintenance, reduces unplanned downtime, and improves asset utilisation.

Quality assurance and compliance

MWD data can be automatically retrieved and analysed for quality control, ore body modelling, and regulatory compliance. This supports faster decision-making and enhances transparency.

Integration with blasting and load/haul systems

By sharing drill hole data with blasting systems (e.g. Dyno Nobel), mining operations can optimise fragmentation and reduce overbreak. Similarly, integration with load and haul systems ensures alignment between drilling, blasting, and material movement.

Foundation for automation and AI

With programmatic access to machine data, iLink enables the development of advanced automation applications, including:

- Predictive maintenance using machine learning.
- Autonomous drill scheduling.
- Integration with autonomous haulage systems.
- AI-driven optimisation of drilling parameters.

Security, governance, and compliance

Given the critical nature of operational data, iLink incorporates robust security features, including:

- Authentication and authorisation: Role-based access control ensures that only authorised systems and users can access sensitive data.
- Encryption: All data in transit is encrypted using industry-standard protocols (e.g. TLS).
- Audit logging: All interactions with the API are logged for traceability and compliance.

These features support compliance with industry standards, such as ISO 27001, and ensure that data integrity and confidentiality are maintained across the mining enterprise.

Scalability and future-proofing

The iLink interface is designed to scale with the evolving needs of mining operations. As new sensors, automation features, or analytics tools are introduced, the API can be extended to support additional data types and workflows. This extensibility ensures that mining companies can future-proof their digital infrastructure and adapt to emerging technologies without costly system overhauls.

Strategic implications for the mining industry

The adoption of interoperable interfaces like iLink reflects a broader shift in the mining industry towards open architectures, vendor-neutral ecosystems, and data-driven operations. By enabling seamless integration between equipment and enterprise systems, mining companies can:

- Break down data silos and improve cross-functional collaboration.
- Accelerate the deployment of automation and AI.
- Enhance operational agility and responsiveness.
- Improve safety, sustainability, and regulatory compliance.

In this context, iLink is not merely a technical solution – it is a strategic enabler of the digital mine.

The Sandvik iLink Data Interface represents a significant advancement in the integration of surface drilling operations into modern mining systems. By providing a standardised, secure, and extensible communication layer, iLink enables real-time data exchange, automation, and analytics across the mining value chain.

As the industry continues to evolve toward intelligent, autonomous, and sustainable operations, solutions like iLink will play a central role in shaping the future of mining – where every drill hole, data point, and decision is connected. GMR

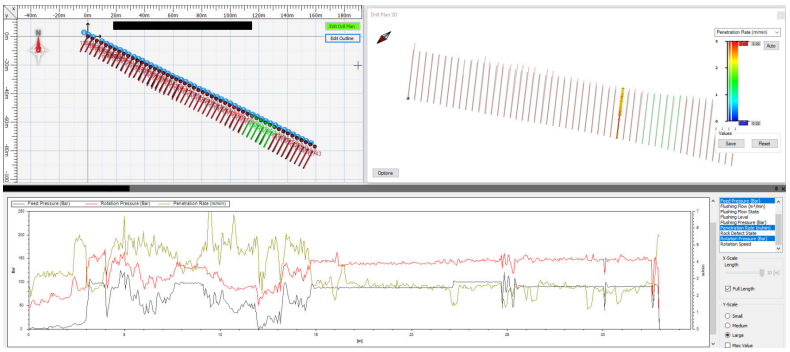


Figure 3. Measure while drilling data visualisation.