

Journey to the Digital Mine

July, 23rd, Germany - Santiago de Chile

Pictures of the Future – Mining

4 Sub-Scenarios shaping the future of the Mining Industry in 2030

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EXTREME
MINING

ADAPTIVE
MINING

DIGITAL MINE

VALUE MINING
NETWORKS



Digitalization is the major key for increasing cost-efficiency and automation of operations and processes in the mining industry, especially in hazardous and hard to reach environments.

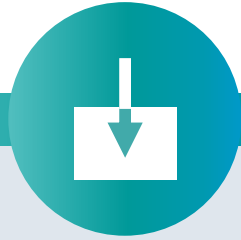
Five fundamental drivers in the Mining Industry

Handling lower ore grades will be the major challenge in mining industry in the future



Lower Grade

- Continuously decreasing of average ore grade
- Less large high quality deposits



Go deeper

- From open pit to underground mine
- New underground operation



HSSE

- Health, Safety and Security in harsh environment
- Awareness of environmental care
- Lack of skilled talents



Costs

- CAPEX efficiency
- OPEX reduction
- Organizations and processes optimization
- Standardization



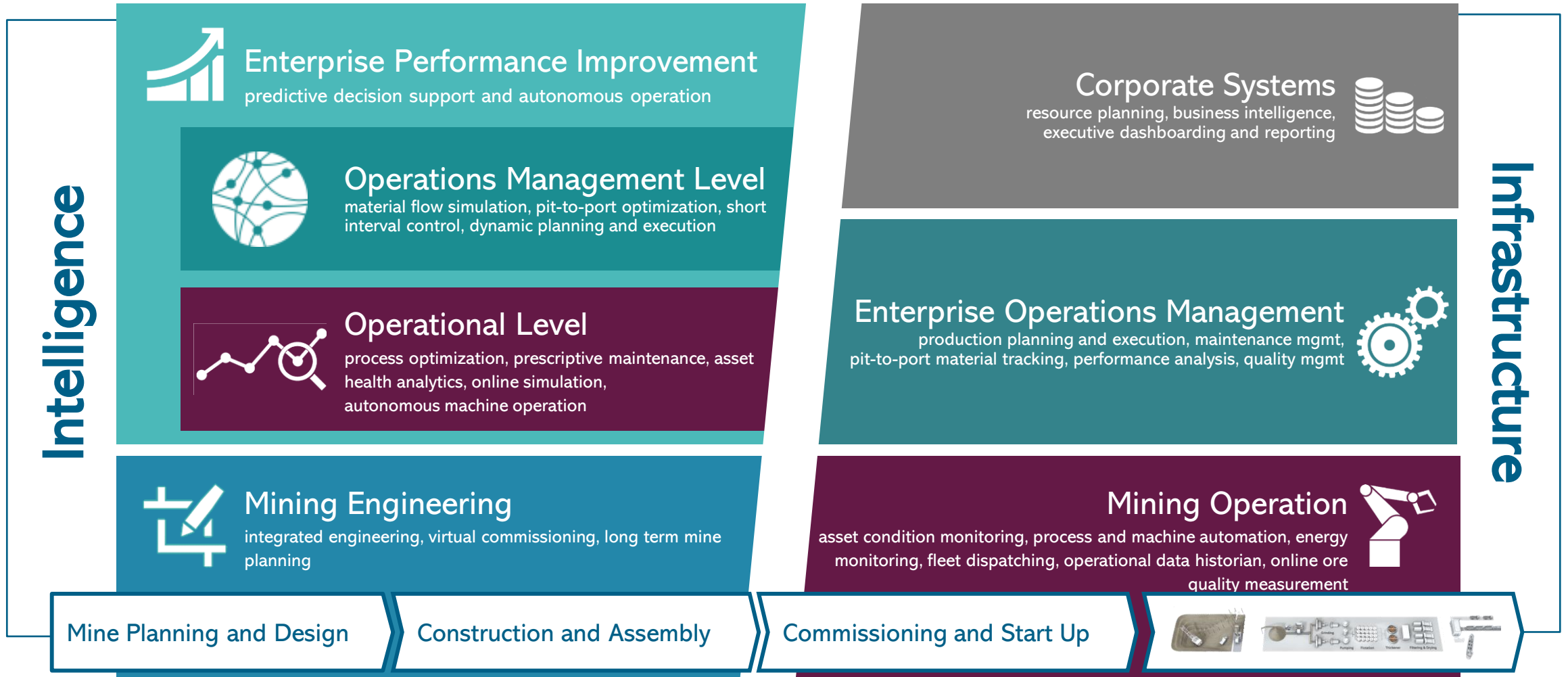
Output

- Increasing ore recovery
- Asset Efficiency & Reliability
- Production and Resources efficiency

Digital Architecture for Mining Enterprise

Empower customers to take right decisions along mining value chain

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Digital Solutions in Mining – Relevant Use Cases

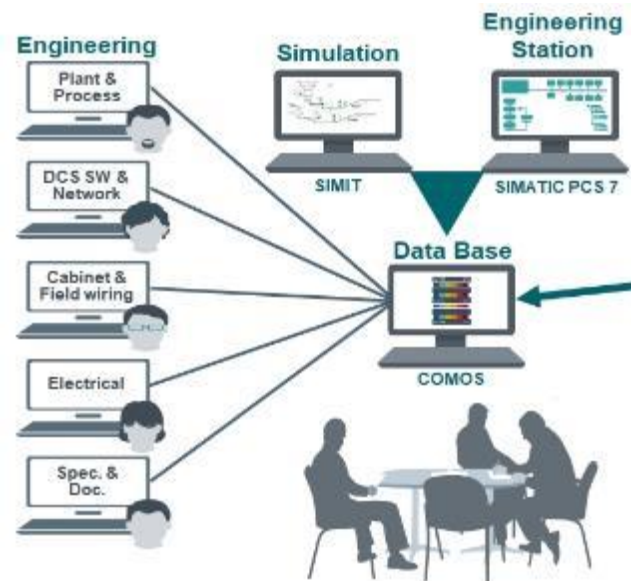
Mine Engineering

Integrated Engineering and Integrated Operations



From Integrated Engineering

- A common data-base for all engineering design, based on modularization of templates, improving efficiently and quality during engineering phase.
- Take the same data base as single point of configuration of process automation and simulation, in order to for faster and easier commissioning of automation systems and reduction of overall project implementation schedule.



- Establish baseline for improved operations management across the mine lifecycle, by building up asset management modules based on engineering data.



To Integrated Operations





Digitalization Focus Area

“Digital Mine” Initiative

Customer benefits

Integrated plant database for the entire life cycle of the mine

Faster development of process control system

Cost savings for following projects



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Project SIC (Short Interval Control, South Africa)

- Project start Dec. 2016, current open engineering contract
- **Vertical integration** from field to ERP, in operation in first mine
- Roll out to other mines planned - also to South America ↓

Project Digital Mine (Peru)

- Complete **horizontal integration** from engineering (COMOS) to operation (SIMIT/PCS7)
- Integrated engineering approach
- Roll out of SIC System intended
- Potential approach for all greenfield and expansion projects



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VALE S.A., Brazil

Enterprise Manufacturing Execution System for Mining Operations

Customer benefits

Integration of existing systems to automate the data extraction and transparent KPIs updated in real time. Proven Customer value: Saving US\$70 m up to 2020

Development and implementation of the new **MES** system in all units of iron ore and manganese for 38 sites. Siemens executed the phases conception, implementation, integrated tests and assisted operation for

- Excavation
- Material Beneficiation
- Material Stock and Shipment

Source: Vale Newsroom http://saladeimprensa.vale.com/en/Paginas/Articles.aspx?r=Vale_estimates_saving_more_than_USD_70_million_with_innovation_&s=Innovation_Technology&ID=1007&SID=4

Customer Press Release on value of Digitalization MES for Vale Brazil, considered the biggest MES Project in the world



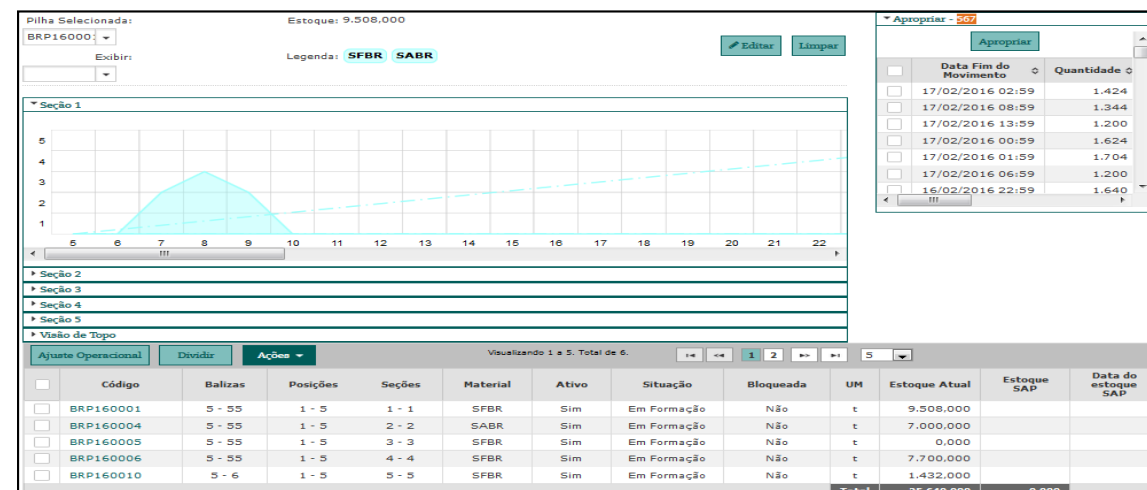
05/18/2017

Vale estimates saving more than USD 70 million with innovation



Developed in partnership with Chemtech, the new system is being implemented in the iron and manganese ore mines in Brazil

Vale, in partnership with Chemtech, is implementing a new management system for iron and manganese ore units of the company in Brazil, replacing 17 other systems that were being used. Overall, 38 mines, plants and warehouses will have the new system, called Vale Production Management - Mining (GPV-M). The implementation has been completed in 20 units of Minas Gerais, Maranhão and Pará. This initiative will provide more than USD 70 million in savings until 2020.



Source: Vale Internet Newsroom

http://saladeimprensa.vale.com/en/Paginas/Articles.aspx?r=Vale_estimates_saving_more_than_USD_70_million_with_innovation_&s=Innovation_Technology&rID=1007&sID=4



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OCP Group, Morocco

Stockyard Management and Autonomous Machine Operation



Customer benefits

Increased efficiency of the reclaiming process and greater machine availability due to autonomous machines operation

Real-time operating data, such as status of machinery and overall stock levels

Development and implementation of a stockyard management systems **MAQ** for 17 potash stockyards (21 Reclaimers and 37 Stackers).

Main functionalities include:

- Job handling (stacking/reclaiming)
- Autonomous operation of the machines
- Collision prevention
- Real-time material inventory, Reporting
- Interface to the plant's MES



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Digitalization Focus Area

Asset Health Analytics for Critical Mining Equipment Gearless Mill Drives

Customer benefits

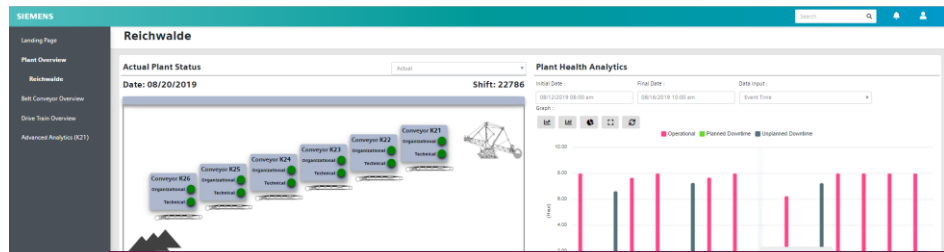
Cost savings and higher availability of equipment through optimized maintenance plans (corrective and preventive maintenance replaced by predictive maintenance)

Earlier failure detection and real-time advisory for counter measures

Comprehensive Condition Monitoring System for the Gearless Mill Drive and the mill, but also for other major process equipment (e.g. conveyor drives) based on **Siemens Drive Train Analyzer**.

Data analytics solution with detection of looming incidents based on GMD operational fingerprints and using AI algorithms to provide decision advisory for timely counter measures.

GMD Asset Health Analytics is currently operational within the **Drive Train Analytics** platform.

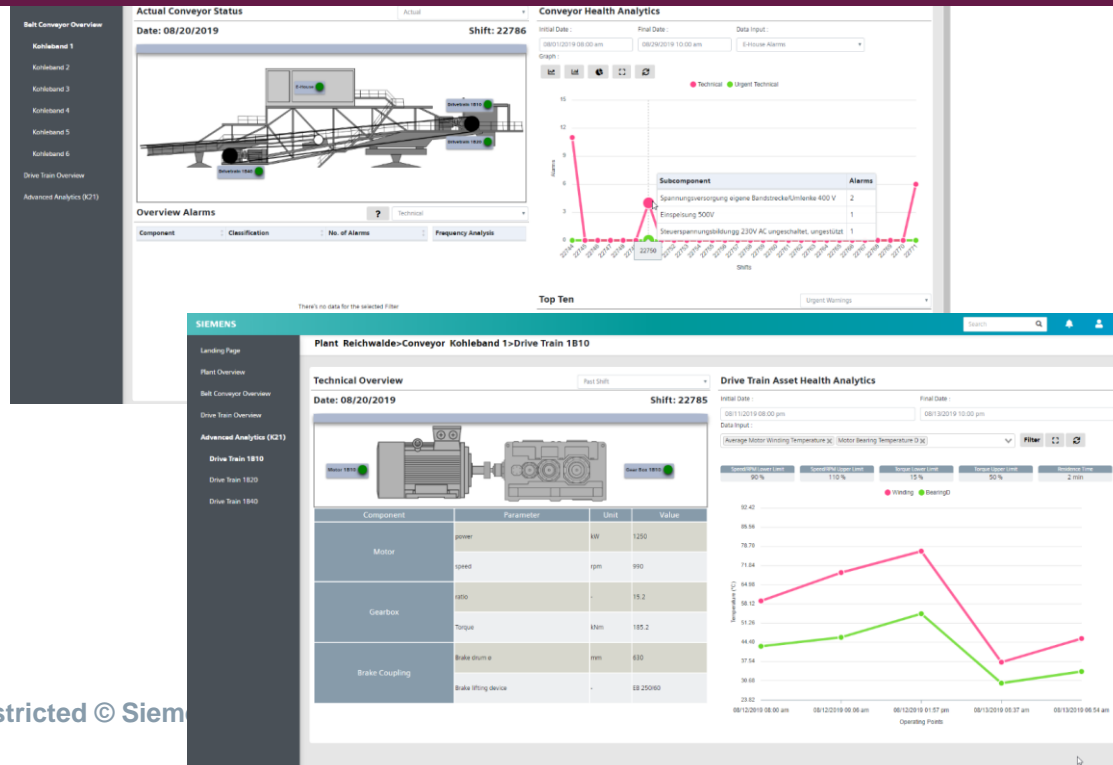


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Digitalization Focus Area

Asset Health Analytics for Critical Mining Equipment

Belt conveyors



1. Asset health condition overview

Asset specific alert and fault notification records, incl. most frequent and longest duration alerts

2. Asset data overview

Asset specific KPIs, such as operation hours, specific temperature points

3. Plant overview

Connected assets, incl. asset name, asset state and connection status



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Reference Australia

Digital Twin of a Conveyor System

Customer benefits

The customer could define the best way to increase the capacity of the existing conveyor belt with limited investment
Prediction of possible critical areas on the conveying system during operation

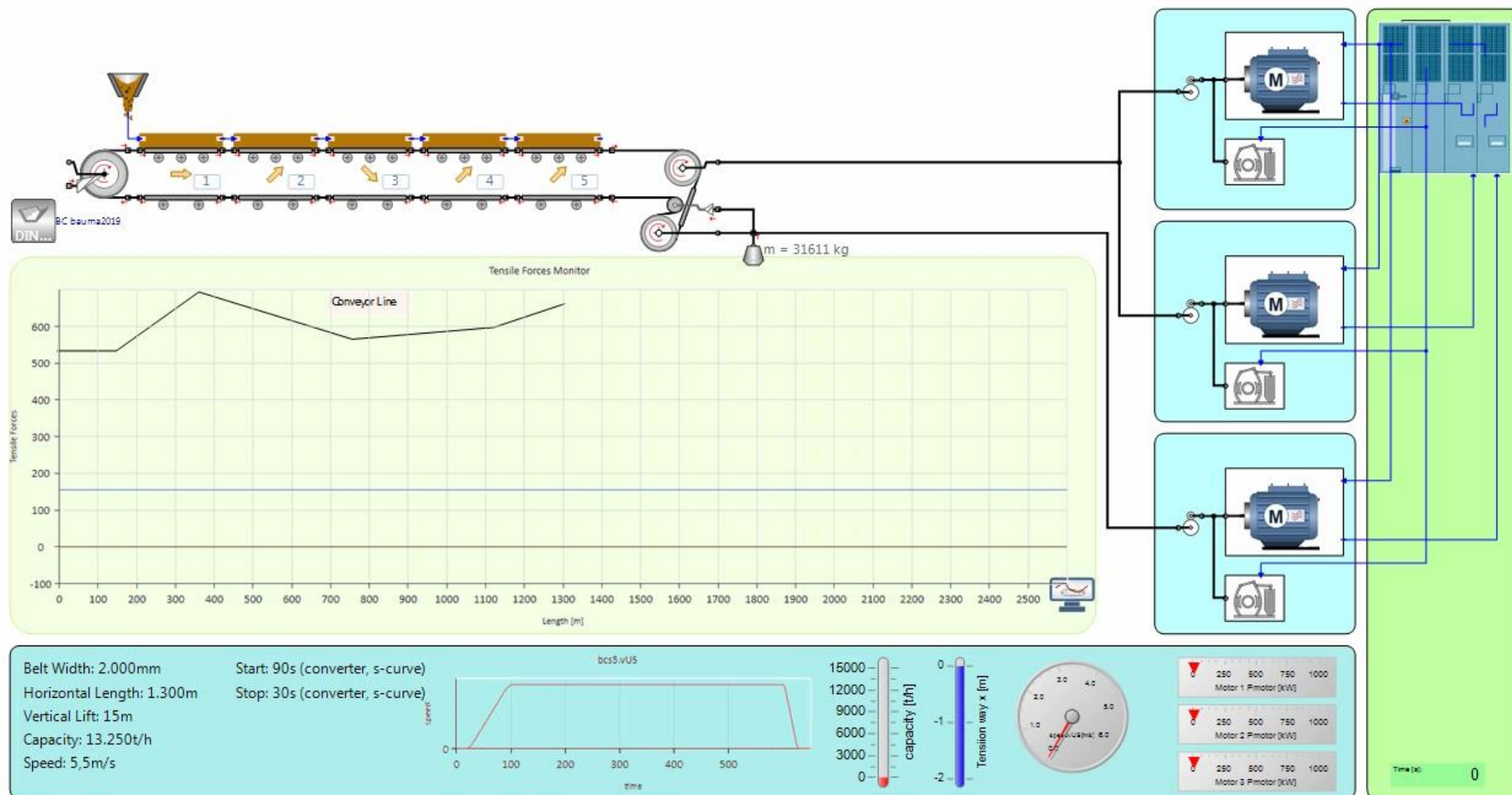
Creation of a digital twin of an existing conveyor in order to simulate equipment behavior:

- Formulate methodologies and design solutions for ramping up tonnage in conveyor from 1500 TPH to 1900 TPH.
- Combination of loading rate / speed that consumes the least amount of motor power, simulating effects on the conveying system
- Investigate largest losses, e.g. idler width/spacing and rotating mass

Simulation of belt conveyors

Optimum start of full belt with variable speed drive

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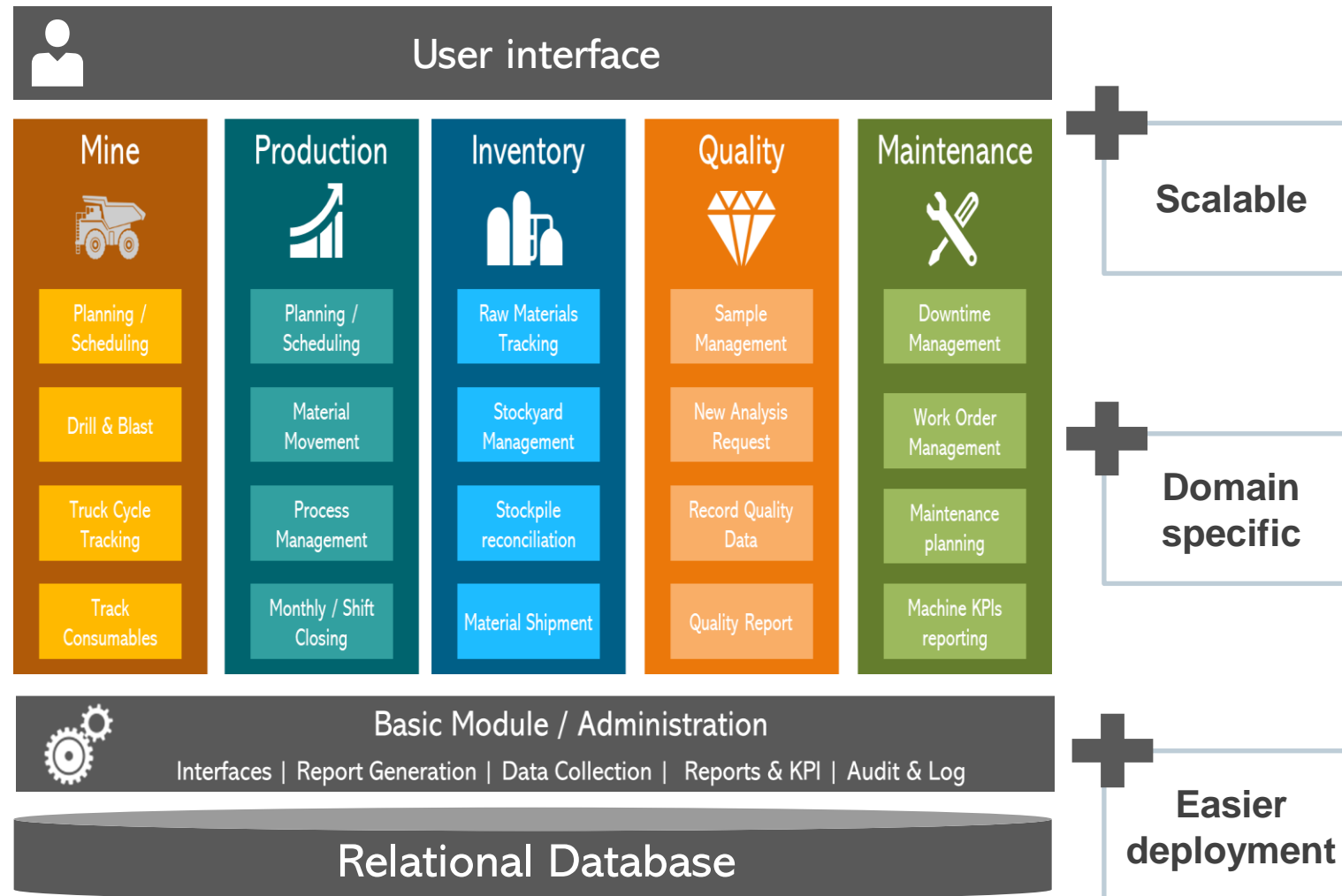
Siemens Minerals approach for implementing digital solutions

Cutting-edge IT technologies to create mining applications



Highly flexible and **modular system architecture** offers the perfect environment to create customized applications:

- Modern **user interface**, with web and mobile access
- Solution based framework with **standard basic modules**
- **Service-oriented architecture** (SOA) with loosely coupled services
- **Common data model** (single source of truth)
- **Open connectivity with API based interface** between modules and with external systems



Minerals Digital Architecture Concept

Major Benefits of a Structured Architecture



Clear Responsibility & System Boundaries

Each system is serving the tasks that is designed for.



Modular & Standardisation

Reduction of maintenance cost and roll out cost



Transparency

Creation the base for the enterprise transparency and KPIs



Benchmarking

Creation the base / possibility for enterprise benchmarking



Flexibility

Flexible for further development and new technologies

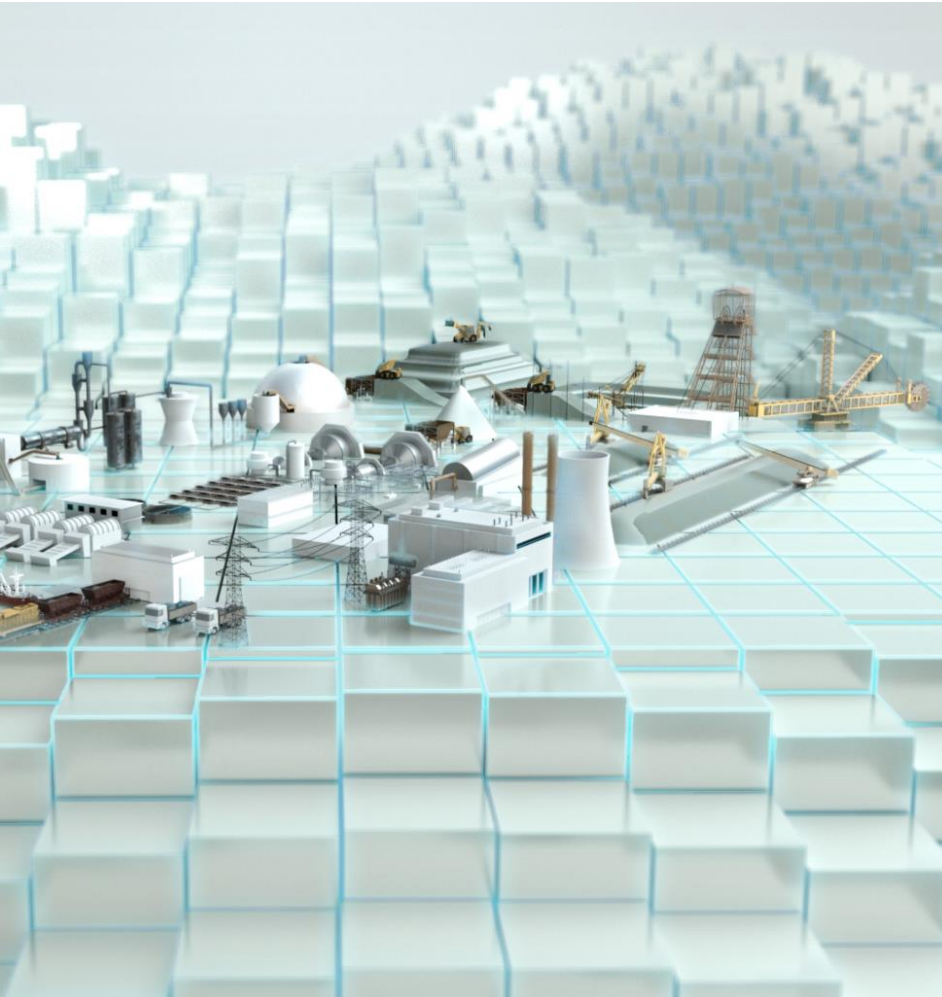


Reliability

No system is overloaded and well designed for the tasks to be fulfilled

Thank you !

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