Digitalization in Mining Industry
- Pit to Port Optimization
Minerals Digital Architecture Concept
Foundation for continuous improvement across the complete lifecycle

Corporate Systems
- resource planning, supply chain management, sales manager, business intelligence, executive dashboarding and reporting

Enterprise Operations Management
- integrated operations center, production planning and monitoring, pit-to-port material management, integrated asset and maintenance management

Mining Operation
- asset condition monitoring, process and machine automation, energy monitoring, fleet dispatching, process historian, online ore quality measurement

Enterprise Performance Improvement
- predictive decision support and autonomous operation

Operations Management Level
- material flow simulation, pit-to-port optimization, short interval control, dynamic planning and execution

Operational Level
- process optimization, prescriptive maintenance, asset health analytics, online simulation, autonomous machine operation

Horizontal Integration / Integrated Engineering
- Integrated Engineering virtual commissioning, long term mine planning

Planning & Engineering

Commissioning & Operation

Improvement

Expansion
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

**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**
Minerals Digital Architecture Concept
Foundation for continuous improvement across the complete lifecycle

Corporate Systems
resource planning, supply chain management, sales manager, business intelligence, executive dashboarding and reporting

Enterprise Performance Improvement
predictive decision support and autonomous operation

Operations Management Level
material flow simulation, pit-to-port optimization, short interval control, dynamic planning and execution

Operational Level
process optimization, prescriptive maintenance, asset health analytics, online simulation, autonomous machine operation

Vertical Integration

Horizontal Integration / Integrated Engineering — Integrated Engineering virtual commissioning long term mine planning

Planning & Engineering
Commissioning & Operation
Improvement
Expansion
17 stockyards Morocco wide, 21 reclaimer, 37 stacker, 11 central control rooms

- Real time material inventory
- Driver-/man- less machine operation
- Communication network, CCTV, Condition Monitoring
- Material and quality tracking and monitoring
- Material blending & separation
- Stacking/ reclaiming methods (Coneshell, Chevron…)
- 3D- stockyard model
Minerals Digital Architecture Concept
Foundation for continuous improvement across the complete lifecycle

Corporate Systems
- resource planning, supply chain management, sales manager, business intelligence, executive dashboarding and reporting

Enterprise Operations Management
- integrated operations center, production planning and monitoring, pit-to-port material management, integrated asset and maintenance management

Mining Operation
- asset condition monitoring, process and machine automation, energy monitoring, fleet dispatching, process historian, online ore quality measurement

Enterprise Performance Improvement
- predictive decision support and autonomous operation

Operations Management Level
- material flow simulation, pit-to-port optimization, short interval control, dynamic planning and execution

Operational Level
- process optimization, prescriptive maintenance, asset health analytics, online simulation, autonomous machine operation

Horizontal Integration / Integrated Engineering
- Integrated Engineering virtual commissioning long term mine planning

Planning & Engineering

Commissioning & Operation

Improvement

Expansion
Utilization of machine learning algorithms for early detection of anomalies and mal-functioning on the tippling operations of wagons e.g. material handover from railway to terminals.
Minerals Digital Architecture Concept
Foundation for continuous improvement across the complete lifecycle

Corporate Systems
resource planning, supply chain management, sales manager, business intelligence, executive dashboarding and reporting

Enterprise Operations Management
integrated operations center, production planning and monitoring, pit-to-port material management, integrated asset and maintenance management

Mining Operation
asset condition monitoring, process and machine automation, energy monitoring, fleet dispatching, process historian, online ore quality measurement

Enterprise Performance Improvement
predictive decision support and autonomous operation

Operations Management Level
material flow simulation, pit-to-port optimization, short interval control, dynamic planning and execution

Operational Level
process optimization, prescriptive maintenance, asset health analytics, online simulation, autonomous machine operation

Vertical Integration

Horizontal Integration / Integrated Engineering
Integrated Engineering virtual commissioning long term mine planning

Planning & Engineering
Commissioning & Operation
Improvement
Expansion
Just-in time Production is Everywhere, BUT not yet in Mining

Current mining operations are managed in silos
• Mining production is decoupled from the purchase order
• Operations are planned individually and are decoupled
• Optimization initiatives focus on individual operations

Current challenges in managing mining operations
Geology uncertainty in deposit affects product quality
Extreme climate conditions lead to short-term production shortage
Challenges of coordinating highly distributed operations make it difficult to meet delivery
Bottlenecks can lead to shortage of supply
Volatility of commodity markets increases the pressure on mining companies to rethink the current management approach
Understanding the material flow is the key to drive efficiency of mining value chain to the next level

Voice of Customer

Material Flow in mining consists of different movements and storage along the value chain

Mass flow

Quality flow

Voice of Customer
From complete operational transparency to maximize global business excellence

Centre of Integrated Operations (CIO)
- Consolidated Data & Complete transparency in technical and business process

Centre of Intelligence Operations (CIO)
- Converting challenges in opportunities
- Forecasting and Proactive planning approach
- Alignment of overall supply & demand
- Dynamic reactions to operational changes

Technologies needed for optimization:
- Digital Twin of Material Flow
- Discrete Event Simulation
- Combinatorial Optimization
- Predictive Analytics
OptiMining Web App empowers miners to leverage optimization potentials along entire value chain.

Main Functionalities
- Demand driven planning
- Virtual test environment
- Dynamic scheduling
- Inventory forecasting
- Shopfloor integration

Potential optimization use cases
- Deposit utilization
- Supply chain mgmt.
- Ore recovery
- Price realization

Operations Monitoring and Management System (e.g. MES, ERP, mine and plant systems)
Long-term vision: Digitalizing the whole value chain
Central MES providing full transparency along E2E operations

End-to-End Operations Management Solution
integration of management and production levels, BI functionalities, E2E dashboard, real-time and historic KPIs, planning & scheduling functionalities of operation and maintenance

Material Flow Information Model

- Drilling
- Blasting
- Loading
- Hauling / Hoisting
- Crushing
- Processing plant
- Logistics
- Transportation
- Smelting

- Optimize planning and execution of drilling, blasting, loading, hauling
- Enable real time ore tracking
- Enable personnel and equipment tracking
- Monitoring of production performance to improve decision-making

- Control equipment operability
- Ensure high recovery rate
- Maximize utilization of capacity
- Decrease of OPEX

SIEMENS
Introducing Centre of Intelligence Operations to the Mining Industry
Contact

Dipl.-Ing. Yun Zeng
Director Digitalization
Minerals
Siemens AG
Mobile: +49 (152) 2270 8329
E-mail: yun.zeng@siemens.com

Bernardo Marinho
Digitalization Sales and BD Manager
Minerals
Siemens AG
Mobile: +49 1520 4728265
E-mail: bernardo.marinho@siemens.com