Digital Mining Enterprise (DME): Integrated Application Landscape using SAP Solutions

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Disclaimer

Please note that, in this document, some of the predictions about mining industry related processes and technology are based upon our current understanding and foresight. Also, as the predictions relate to a mining enterprise of future, the long time-span makes visibility and predictability rather uncertain.

The predictions and future visualization in this document should be treated as indicative.
Agenda

Digital Mining Enterprise (DME)
- Characteristics
- Objectives
- Dimensions

DME: Application Dimension
- Enablement through SAP Manufacturing Integration and Intelligence (MII)

DME: Infrastructure and Connectivity Dimension
- CISCO-SAP Collaboration for DME
- Prioritized Work Areas
  - Remote Operations Centers (ROCs)
  - Expert-on-Demand
  - Incident Management and Safety
Rio Tinto chief executive unveils vision for ‘mine of the future’

18 January 2008

Key building blocks for automated mine-to-port iron ore operations are being commissioned by Rio Tinto. These include:

- Mine operations in the Pilbara to be controlled 1,300 kilometres away at a new centre in Perth;
- Driverless trains to carry iron ore on most of the 1,200 km of track;
- Driverless ‘intelligent’ truck fleet; and
- Remote control ‘intelligent’ drills

- Mining operations to be controlled from Remote Operations Center (ROC)
- Intelligent equipment have been making decisions based on the real-time working conditions
- Greater involvement of Field Robotics and Autonomous Haulage Systems
Digital Mining Enterprise (DME): Characteristics

Where a particular data gets entered into the “application landscape” of that mining company only once and…

• … is accessible across various other applications and to different people, depending upon:
  – Data mapping rules
  – Workflow rules
  – System authorizations etc.

• … is capable of being accessible across various kind of devices like:
  – Desktops and laptops
  – Tablets
  – Mobile phones
  – Smartphones
  – Handheld devices
  – Scanners
  – RFID devices etc.
  – and any others that may emerge over a period of time
Digital Mining Enterprise (DME): Characteristics (Contd.)

Where the mining organization has the capability of orchestrating information systems on-premise and on-demand with ease and confidence.

Where the system has adequate flexibility, scalability, security and interoperability to provide access to the company data or information to not only employees, but also external stakeholders like customers, suppliers, partners, regulatory agencies and public at large - depending upon the access authorizations for each person in specific.
Digital Mining Enterprise (DME): Characteristics (Contd.)

- Where integration and intelligence are available end-to-end across various functional areas like:
  - Mine planning, scheduling and operations
  - Processing operations: Planning and Execution
  - Equipment maintenance
  - Environment Health and Safety (EH&S)
  - Operational Reporting & Intelligence
  - Energy Management
  - Contract-to-Cash
  - Transportation & Logistics
  - Procure-to-Pay
  - Project Management
  - Financial & Cost Accounting
  - Human Resources etc.

Focus of today’s presentation
Digital Mining Enterprise (DME): Objectives

- Enhancing **Delivered Throughput** (Production + Processing + Transportation)
- Greater **operational efficiency and productivity** (taking into account the constraints like declining grades, inadequate skilled people availability, difficult terrains, greater depths, higher rock stress, impact on environment)
- Reduce the **operational costs** in Mines and Processing Plants
- Reduce the combined **Total Cost of Ownership (TCO)** of various applications running in the Mining, beneficiation, processing and transportation areas
- Improve **collaboration** among various functions
- Reacting **real-time to geological conditions** using intelligent and remote-controlled surface mining equipment AND underground mining equipment
- Increase **exploration efficiency** using Intelligent drilling rigs and improve the quantity and quality of data acquired from borehole

Have you prioritized the key drivers for your mining organization?
Digital Mining Enterprise (DME): Objectives (Contd.)

- Convert the current **sub-economic resources** to profitable reserves (esp. deep hard-rock metal resources; near surface radioactive & beach minerals etc. that can not be mined using current technology)
- Increase **Overall Equipment Efficiency (OEE)** based on Availability, Utilization, Efficiency, Quality
- Creating **visibility** into the operational and maintenance data
- Increase **Supply Chain & Logistics** Efficiency and Inventory Visibility
- Improve **safety and environmental compliance**
- Increase **Human Capital efficiency and productivity** by freeing up Mining manpower for more analytical and value-adding roles rather than regular mundane jobs
- Providing better **working conditions** to the Mining employees, often in “Remote Operations Centers” away from the Mining and processing plant shop-floor, that in turn will help in attracting and retaining the workforce

**Have you prioritized the key drivers for your mining organization?**
Digital Mining Enterprise (DME): How to Achieve it?  
Key Dimensions

Connectivity and Infrastructure (esp. in Remote Mine Sites)
- Data | Voice | Video
- Mesh networks
- Industrial Ethernet (Wired) and Wireless

IT Applications (Enterprise apps, Mobile apps)
- Usability
- Integration
- Collaboration
- Online and Offline functioning

Operational Technology (OT) and Automation
- Mining (including Remote Operations Centers – ROCs, GPS, GIS etc.)
- Processing plants

Integration of IT and OT

(Big) Data Management

Rugged Mobile and Handheld Devices

Information Access and Security
Digital Mining Enterprise: Application Dimension
Mining System Landscape: Myriad of Applications

Enterprise Management System

Workflow
- Business Intelligence, Dashboards
- Knowledge Management
- Business Planning & Consolidation
- RFID
- Mobile Solutions
- Business-to-Mining Integration

Finance & Costing
- Human Resources
- Materials Management
- Plant Maintenance
- Investment Management
- Logistics Management
- Quality Management
- Environmental, Health & Safety

Getting the Basics right

Stockpile management and blending
- Plant Execution Systems
- Data Historian
- SCADA
- PLC/DCS
- Automation

Enhancing Business Value

Integrated Systems of a DME

Mining Specialist Systems
- Loading systems
- Weighbridge systems
- Vehicle Dispatch System (incl. GPS)
- Mine Scheduling
- Mine Planning
- Mine Design
- Reserve Est.
- Geological Modelling
- GIS

Production Control Systems

Workflow
- Business Intelligence, Dashboards
- Knowledge Management
- Business Planning & Consolidation
- RFID
- Mobile Solutions
- Business-to-Mining Integration
SAP Solutions for integrated mining supply chain (Pit-to-Port)

SAP Best Practices for Mining delivers preconfigured scenarios for most areas of the supply chain.

- **Mining Production**
- **Stockpile**
- **Processing**
- **Stockpile**
- **Transport**
- **Stockpile**
- **Sales & Shipping**

**Dimensions:**
- **20 years**
- **18 months**
- **Month/week**
- **Daily**
- **Daily & Shift Execution**
- **MES Real time**

**Time Frames:**
- **Long Term Planning (Life of Mine)**
- **Medium Term Mine Planning**
- **Short Term Detailed Mine Scheduling**

**Areas of Supply Chain:**
- **Production**
- **Maintenance**
- **Inventory**
- **Costing**
- **Quality**
- **Sales Forecasting**
- **Integrated Supply Chain Planning**
- **Rail & Shipping Scheduling**
- **Rail & Shipping Execution**
- **Stockpiling**
- **Commodity Pricing**
- **Sales & Invoicing**
- **Connectivity & Real-time Visibility: MII, Netweaver PI**

**Connectivity & Real-time Visibility:**
- **Fleet Mgmt.**
- **Historian**
- **MES**
- **Electronic Weighbridges**

**SAP Products:**
- **SAP ERP / Business Suite**
- **SAP ERP + IS-Mining**
- **Partner Products**

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Integrated Landscape of a Digital Mining Enterprise: Using SAP Manufacturing Integration & Intelligence (MII)

**SAP ERP, SCM, EAM, EHSM**

**SAP MII**

- **Integration**
  - Enable a Single Version of the Truth, synchronized operations

- **Intelligence**
  - Empower mine personnel and enable real-time decision making

- **Innovation**
  - Deploy new mining & beneficiation processes and composite apps

**Manufacturing Composite Application Services**

**DIGITAL MINE**

- **Mine Planning & Scheduling**
- **Fleet Management System (VMS)**
- **Process Automation Systems**
- **Weigh Bridges**
- **VIP (Partner Solution)**
- **Other Partner Solutions**

**GLOBAL COORDINATION**

- HQ-to-Mine / HQ-to-Plant INTEGRATION

- LOCAL EXECUTION

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SAP MII synchronizes Mining & Processing Operations with the Enterprise, in heterogeneous IT landscapes

SAP MII extracts data from SAP ERP and provides real-time visibility and distribution to Mine / Plant Systems

- Planned Orders
- Bills of Material
- Production & Process Orders
- Material Inventory Levels
- Inspection Lots Data
- Master Recipes
- Material Details
- Batch Details
- Resources & Functional Locations
- Maintenance Work Order & Notification details
- Material & Order Costs

SAP MII’s ability to perform transaction execution into SAP also enables automated, plant-level creation of:

- Production Confirmations
- Process Messages
- Material Receipts
- Material Consumptions
- Material transfers
- Inspection results recording
- Quality Notifications
- Batch Characteristic recording
- Work Orders & results recording
- Maintenance Notifications
SAP MII: Services Based Architecture

**SAP MII** is a service-based composition environment that leverages unique services for rapid development of Manufacturing Integration and Intelligence applications across all industries served.

**Data Services**
- **Real-time integration** of data with plant floor systems, applications and legacy systems.

**Visualization Services**
- Extensible presentation layer presented via web pages. Family of **configurable UI objects** provide manufacturing views in **role based dashboards** or via wireless PDAs.

**Business Logic Services**
- Flow based logic engine, enables **data aggregation** and **transformation of disparate data**. **Transactions** can be triggered or scheduled. **KPI Calculations**, **business rules**, and **alerts** are easily developed and executed.
The real-time visibility of what happens on the shop floor and the possibility of all those involved in the manufacturing and delivery process working together is essential to improve processes, reduce costs and intermediate stock levels and moreover the improvement in various industry operational indicators.
Digital Mining Enterprise: Operational Reporting and Dashboards using SAP MII

- Increased Visibility into operations and improve decision support
- $4-12MM annual (sustainable) savings on energy use per plant
Digital Mining Enterprise: Analytics for Mining and Processing using SAP MII

Manufacturing Analytics (for Mining & Processing)

• Complete SPC analysis suite delivers actionable real time variable and attribute analysis
• Trending functions enable relation of process analytics to orders, lots or batches
• Drill down functionality empowers users to quickly execute root-cause analysis
Digital Mining Enterprise: Work Process Management using SAP MII

Work Process UI

- Facilitates integrated, automated, safe and compliant execution of all work process steps along execution.
- Out of the box templates for easy adjustments and maximum adaptation
- Built in integration to SAP Business Suite avoids data duplication and provides lowest TCO
Digital Mining Enterprise: Multiple-level Performance Management using SAP MII

**Multi Site Performance Overview**
- High level view of multiple facilities
- Integrated with corporate and supply chain performance metrics

**Site Performance Overview**
- Key metrics for primary areas
- Raw, WIP, finished inventories
- Key unit metrics – throughput, yields
- Overall Equipment Effectiveness KPI’s
- Asset Utilization KPI’s
- Compliance KPI’s

**Area Performance Overview**
- Key indicators for each area
- Top items of interest by area – not all details
- Identify key trends, forecasts

**Production Performance Detail**
- Single asset/single issue root cause analysis
- Production
  - inventories / projections
  - planning vs. actual
  - key quality, yield forecasts
- Equipment / Machine
  - Process overview graphic

**Configuring the Views**
- Wizard to ensure consistency
- Templates to simplify configuration, drive consistency
Digital Mining Enterprise: Integrated Short-Term Mine Scheduling Process

Geological System

Mining Production Systems

Runge’s Production Planning & Scheduling

- Last week's/day's production
- Detailed Scheduling

Output:
- Material Quantity
- Quality & Dates
- Eq usage
- Consumable Usage
- Utility Usage

Mine Model

Mine Production Execution

- Fleet Management Schedule
- Fleet Management Production Actuals

Mining Dynamics

- Manage updated version of the plan
- Manage plan change request
- Bring latest version of the planned output

SAP MII

- Consolidate data from ERP required for scheduling

SAP ERP

- Preventive maintenance order and planned shutdown for equipment
- Master Data (e.g. equipment, capacity, cost rates)
- BOM & Recipe Input / Output Resources Utilization

SAP BW

Production repository

SAP Enterprise Portal

Reports/KPIs (e.g. Plan v.s Actuals) > Day/Shift

Real-time Reports

No

Plan validation

Yes

Create Process Order

Process Order

Yes

Actuals validation

Create Confirmation
Digital Mining Enterprise: Integrated Short-Term Mine Scheduling Process

**Truck Operator/Truck VIMS**
- VMIS/PCS Record 1 of Truck1
- VMIS/PCS Record 1 of Truck2
- VMIS/PCS Record 2 of Truck1
- VMIS/PCS Record 2 of Truck2

**Dispatcher**
- Display of Truck1
- Display of Truck2
- Schedule/Reschedule
- Schedule/Reschedule

**Production Supervisor**
- Actual quantities per truck for current shift
- Yes
- No
- Approve
- Confirm Process Order

Digital Mining Enterprise: Integrated Short-Term Mine Scheduling Process
Digital Mining Enterprise: Integrated Truck Maintenance Process: EXAMPLE

**Truck Operator**
- Notices Engine Problem
- Reschedule Working Day based on scheduled Downtime

**Dispatcher**
- Records Engine Problem in Fleet Management System
- Alert about Downtime Start
  - Automatic Record in Fleet Management System
- Reschedule Available Fleet

**Maintenance Supervisor & Planner**
- Create Notification in SAP System
- Analyses problem on site: Equipment Breakdown due to Engine Failure
- Create Work Order
- Work Order Processing incl. Planned Duration
- Workorder confirmation

**Production Supervisor & Planner**
- ALERT into Dashboard about Equipment Breakdown
- Update of Integrated Production Plan based on latest Equipment Availability Plan
- ALERT into Dashboard about Equipment Breakdown END
Digital Mining Enterprise: Processing Plant Enablement through SAP MII and Plant Connectivity (PCo)

- Event trapped and validated against trigger criteria.
- Custom Notification created and dispatched to Destination.

- MII processes the event message received from Plant connector (PCo).
- All SAP MII capabilities like dashboard, alerting or further process trigger can be enabled.

Standards: OPC DA / AE / UA / Socket

Historian
SCADA
MES
LIMS

SAP MII

Dashboard
Further processing in ERP
Alerts etc.
Industry Value Network (IVN) for Mining
Driving co-innovation with our customers & partners

- Mine planning and scheduling
- Fleet Management
- Metallurgical reconciliation

**IVN Facilitator**

- Business Planning & Compliance
- Supply Chain Management
- Contact-to-Cash
- Operations Management
- Operational Compliance
- Enterprise Asset Management
- Supply Management
- Enterprise management and support

**Implementation Partners**

- CITECT
- Meridium
- Accenture
- Deloitte

**Mining Industry Council**

- BHP Billiton
- Rio Tinto
- Anglo American
- Codelco
- Exxaro
- CONSOL Energy

**Infrastructure and Connectivity**

- Cisco

**Downtime Recording**

- Reliability Centered Maintenance

- Asset information management
Digital Mining Enterprise: Infrastructure and Connectivity Dimension

CISCO-SAP Collaboration Project
Connected Mining

Benefits

- **Improve Operations Management**
  - Ethernet to the factory
  - Secure Wireless
  - Physical Security
  - Consolidated Data Centers

- **Maximize Employee Productivity**
  - Collaborative Innovation
  - Connected Mine Information System
  - Connected Factory Floor
  - High Performance Computing

- **Unique to Mining**
  - Tracking & Scheduling
  - Risk Management
  - Automation of Leaching Process
  - Tailings Monitoring
  - Pipeline Monitoring & Control

- **Minimize risk & Maximize Security**

- **Support Environment & Regulatory Compliance**

- **Expand Visibility into Operations**

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Customer Challenge

Multiple and disparate networks exist in many mining operations and there is growing demand to integrate the networks to provide increased end-to-end visibility into the production operations for the following reasons:

- Increase of cyber threats for process control systems.
- Abundance of COTS – Tools, Patches - All add to risk of security breaches
- Increased demand to securely link operation and corporate networks.
- Requirements for remote access, real-time, visibility, and post incident analysis.
- Ability to capture forensic information to help troubleshooting and improve real-time decision making.
- Optimize enterprise-wide operational performance and efficiency from disparate systems
Tracking & Scheduling
Logical Overview

By utilising a unified standards based IP infrastructure
You can leverage multiple applications and services..

Improves:
• Operations
• Maintenance
• Safety
• Logistics

2.4, 4.9GHz, or 5GHz
Uplink to Mesh
Infrastructure
Or 3G Cellular

Voice
Video
Data

Wireless Handset –
ATEX (Zone 2/22) &
CSA – IP64 Approved
(7925EX)
Connected Mining
A Solutions Approach of CISCO
Prioritized Work Areas for CISCO-SAP Collaboration for Mining Industry

1. Remote Operations Centers (ROC) enabled by CISCO infrastructure AND SAP Manufacturing Integration & Intelligence (MII) solution

2. “Expert-On-Demand” solution using:
   - CISCO’s “Remote Expert” (an umbrella solution with components like Telepresence, Jabber, QUAD etc.)
   - SAP HCM, Maintenance, Visual Enterprise solutions

3. SAP Incident Management enabled through CISCO Infrastructure
1. Remote Operations Centers (ROC)

Enabled by:

- CISCO infrastructure AND
- SAP Manufacturing Integration & Intelligence (MII) solution
Digital Mining Enterprise: SAP Mobility with CISCO Infrastructure for Mine Equipment

- Mine Site
- Central Planning and monitoring
  - satellite and GPRS feeds
  - SAP Business Suite
  - SAP NetWeaver®
  - Central SAP Mobility Server
  - CISCO communications equipment running on vehicle
  - SAP Mobility running on vehicle
Video Wall – Remote Operations Centres
SAP MII with CISCO

CISCO delivered live video feeds
CISCO infrastructure collecting and communicating sensor information

Collection
Aggregating information from various Sensors / Plant Automation systems and transferring to SAP solutions using CISCO’s infrastructure (routers, switches, Digital Media System-DMS, UCS etc.).

Visualization
Video Wall and individual PC production data visualization delivered using SAP MII and Business Objects
Tracking & Scheduling
Mobile Equipment

Operations
- Scheduling Applications
- Production Accounting

Maintenance
- Pro-Active & Predictive Maintenance

Safety
- Video Services
- Expanded visibility for truck drivers

Logistics
- Traffic Control
- Locations based services (GPS)

Operational Efficiency
- Reduced costs for incidents and unexpected shutdowns
- Improves operational efficiency and productivity
- Increased worker productivity
- Better Visibility into Supply Chain
SAP MII with CISCO Solutions for Mobile Control Room

For underground and open cut mines, having flexible / mobile control rooms and video conferencing facilities is ideal.

The Video Wall picture on the last slide would ideally be displayed in the container.

The mobile control room can also have quick access to teleconferencing facilities.
SAP MII / Business Objects with CISCO Solutions for Crib Room Services

Bring a space optimised, ruggedized “Kiosk” into crib rooms to provide interactive services for:

- Human Resources services from SAP
- Blasting times
- Safety messages from SAP
- Production plans and actuals from SAP
- Maintenance events from SAP
- Shift status reporting from SAP
- Delay accounting

... using CISCO’s Infrastructure for data and video feed
2. “Expert-On-Demand” solution

Enabled by:

- CISCO’s “Remote Expert” (an umbrella solution with components like Telepresence, Jabber, QUAD etc.) and
- SAP HCM, Maintenance, Visual Enterprise solutions
Inspection Operator sees corrosion, uncertain if it is a real problem...uses mobile communicator to find expert...connects call

... Using hand held wireless EX camera, has collaboration session with experts, recording where needed

Value

- Reduced time to evaluate critical and non critical issues
- Reduction in downtime due to better decisions and leveraging remote experts
- Reduction time to intervention on drilling * avg cost/hr of drill rig
- Reduction of risk of incidences vs. average cost per incident

Cisco 7925-EX or Smart Phone Integration with UC and Mobility
SAP Mobile Solutions with CISCO for Maintenance and Production

Embed CISCO “voice calling”, “video feed” and “CISCO Webex social networking functionality” into SAP Syco Mobility solution for access to expert-on-demand for:

1. Visual Inspection and advice
2. Maintenance Processing
3. Production scheduling
3. Mine Safety solution

Enabled by:

- CISCO Infrastructure and
- SAP Incident Management
Connected Mining Information System
Collaboration & Visibility

Corporate Messaging
- Executive announcements
- Company Information

Live Video
- One to many Messaging & Video e.g. Entertainment

Point of Use
- Safety Warning's
- Production Data, Status & Statistics

Video on Demand
- Operational procedures (Set-up)
- Training

Safety & Operational Efficiency
- Regulatory Compliance (Safety, Labour, Environment)
- Reduced costs for incidents and unexpected shutdowns
- Improves operational efficiency and productivity
- Increased worker productivity
Thank you

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