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

Digital Mining Enterprise (DME): Sneak Preview

Press release

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…

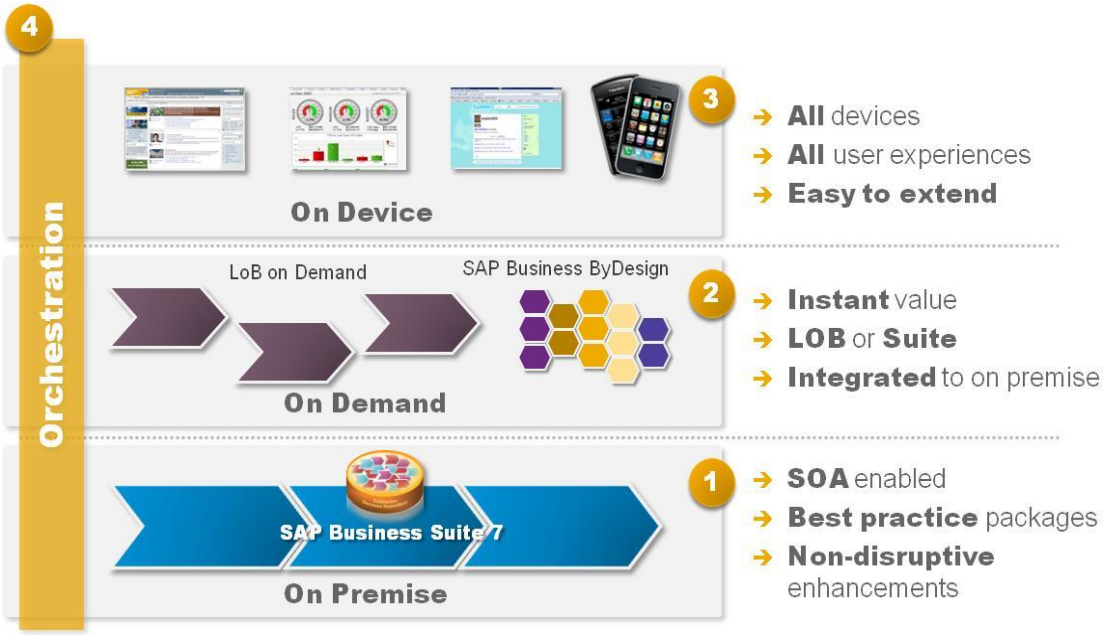
- … is accessible across various other applications and to different people, depending upon:
  - Data mapping rules
  - Workflow rules
  - System authorizations etc.

- … 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.)

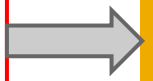
Where the mining organization has the capability of orchestrating information systems on-premise and on-demand with ease and confidence

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

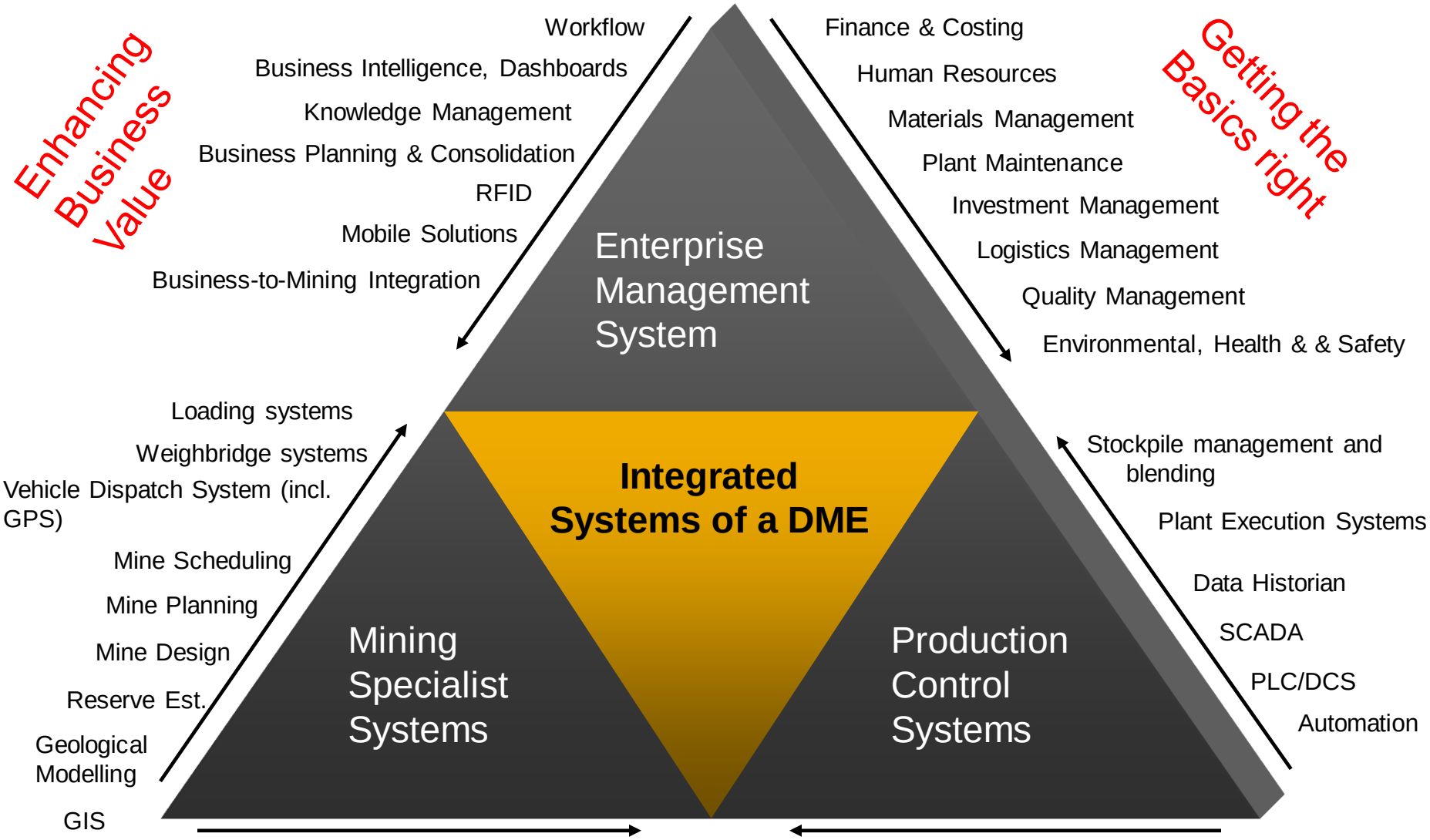
(Big) Data Management

Rugged Mobile and Handheld Devices

Information Access and Security

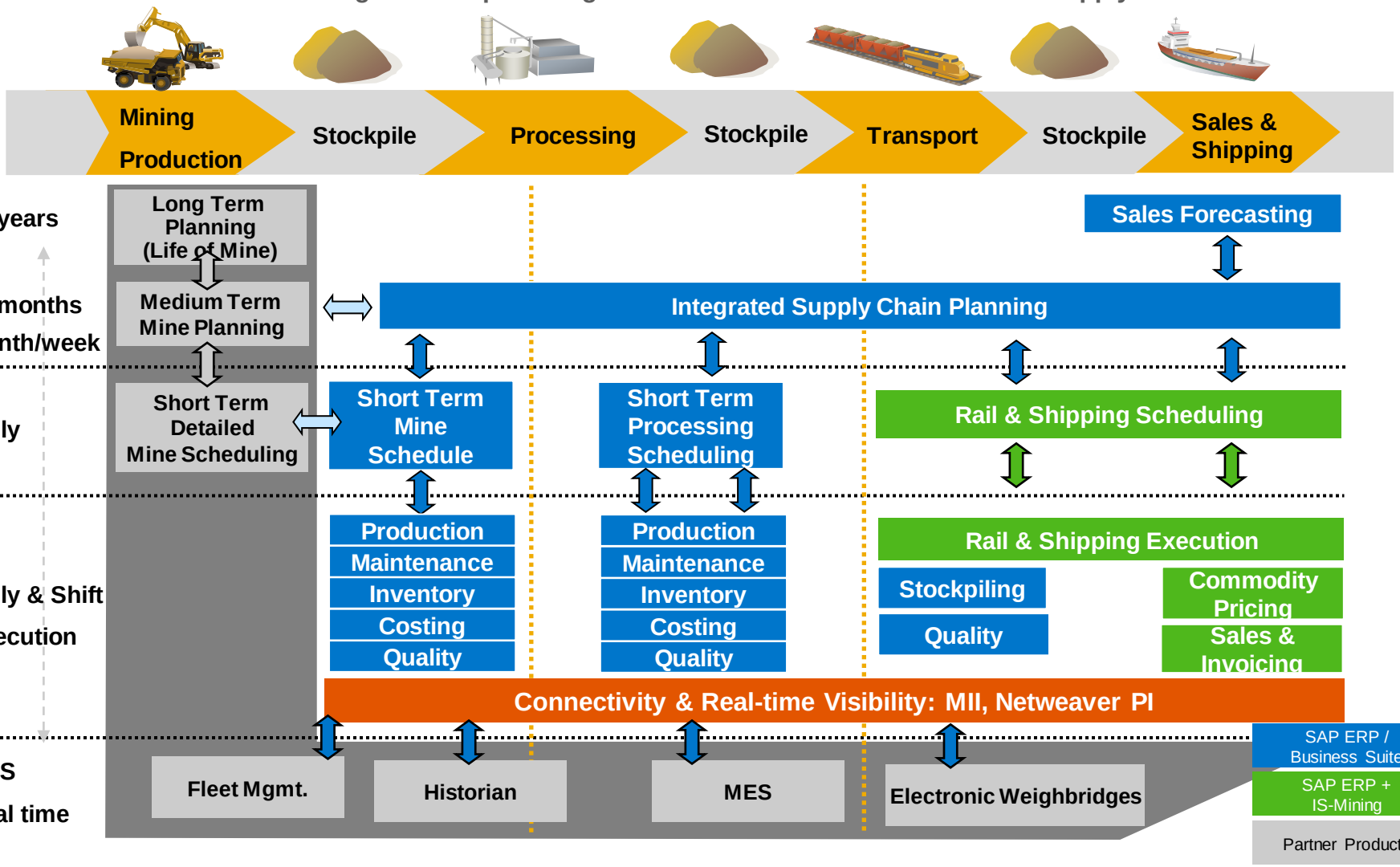
Digital Mining Enterprise: Application Dimension

Mining System Landscape: Myriad of Applications

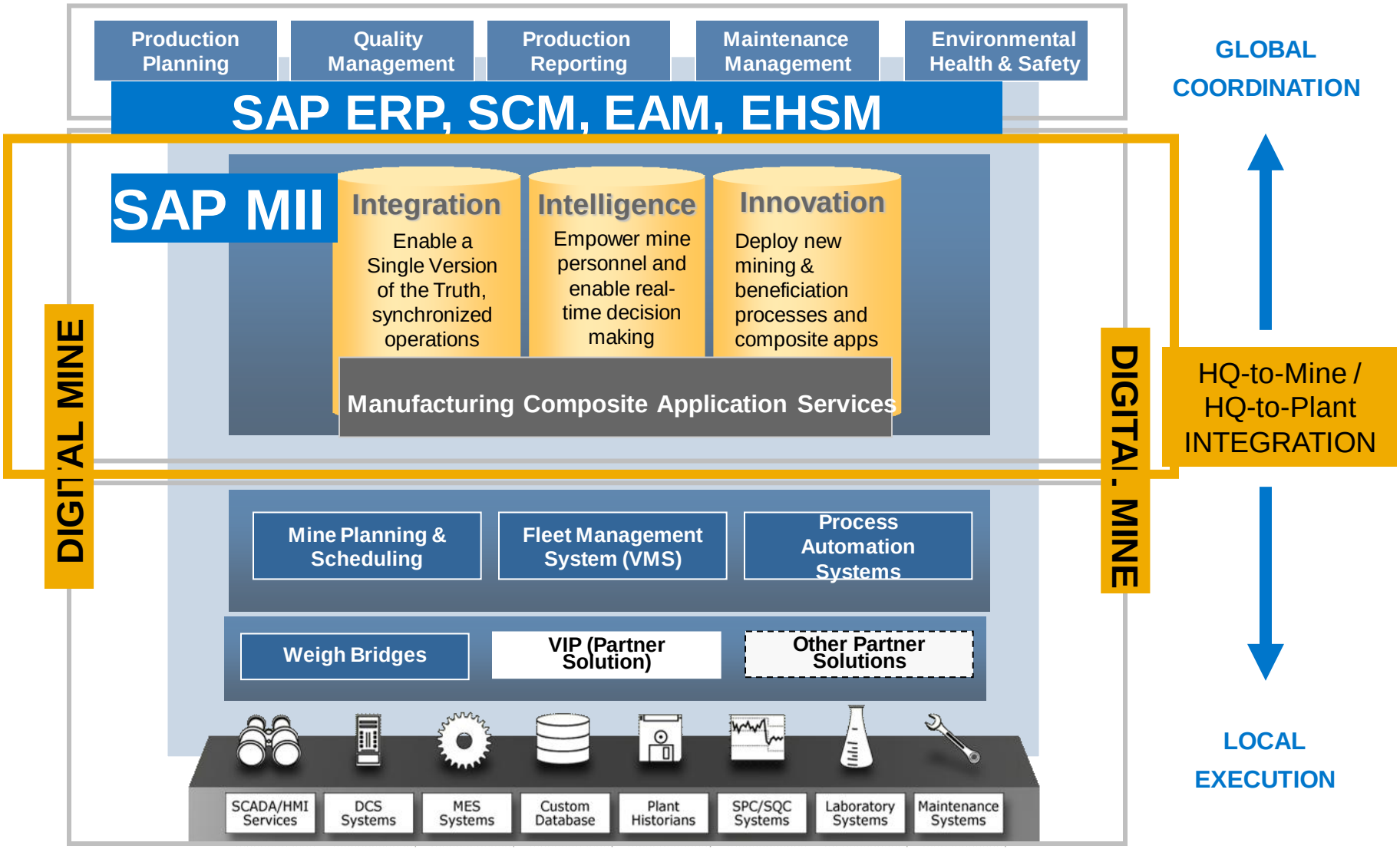


SAP Solutions for integrated mining supply chain (Pit-to-Port)

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



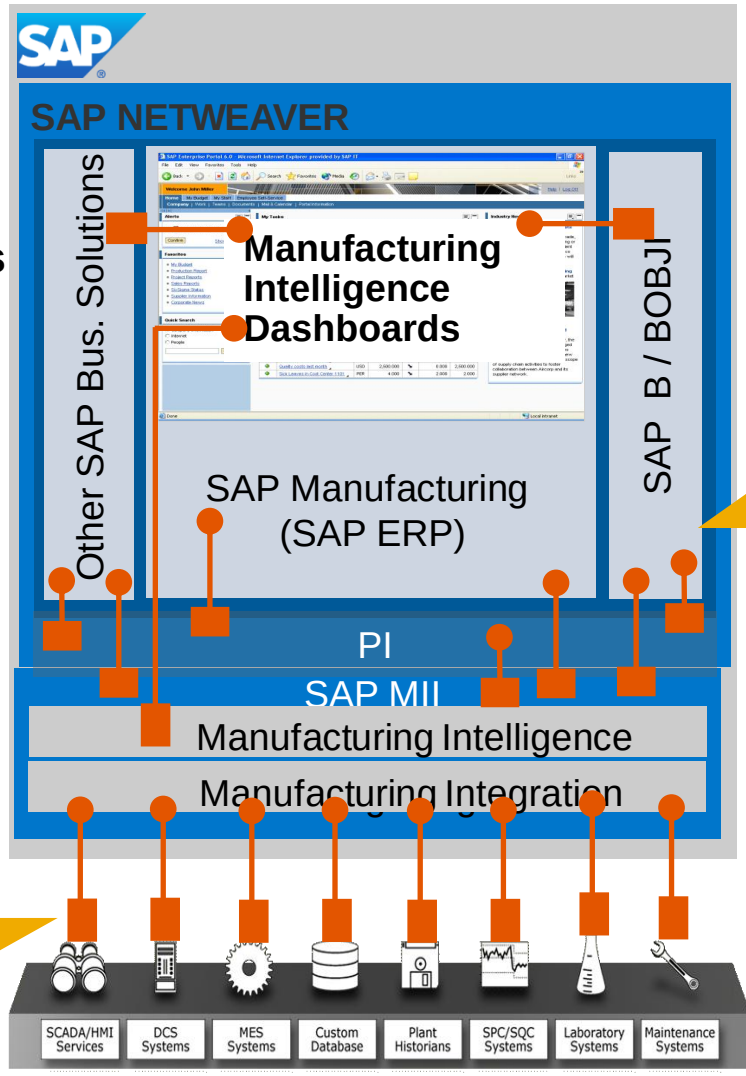
Integrated Landscape of a Digital Mining Enterprise: Using SAP Manufacturing Integration & Intelligence (MII)



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**

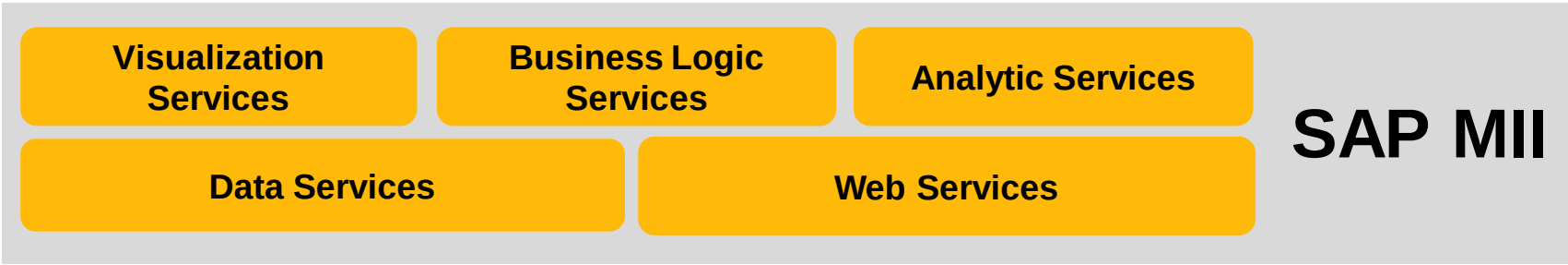
- **Planned Orders**
- **Bills of Material**
- **Production & Process Orders**
- **Material Inventory Levels**
- **Inspection Lots Data**
- **Master Recipes**
- **Material Details**
- **Batch Details**
- **Resources & Functional Locations**
- **Maintenance Work Order & Notification details**
- **Material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

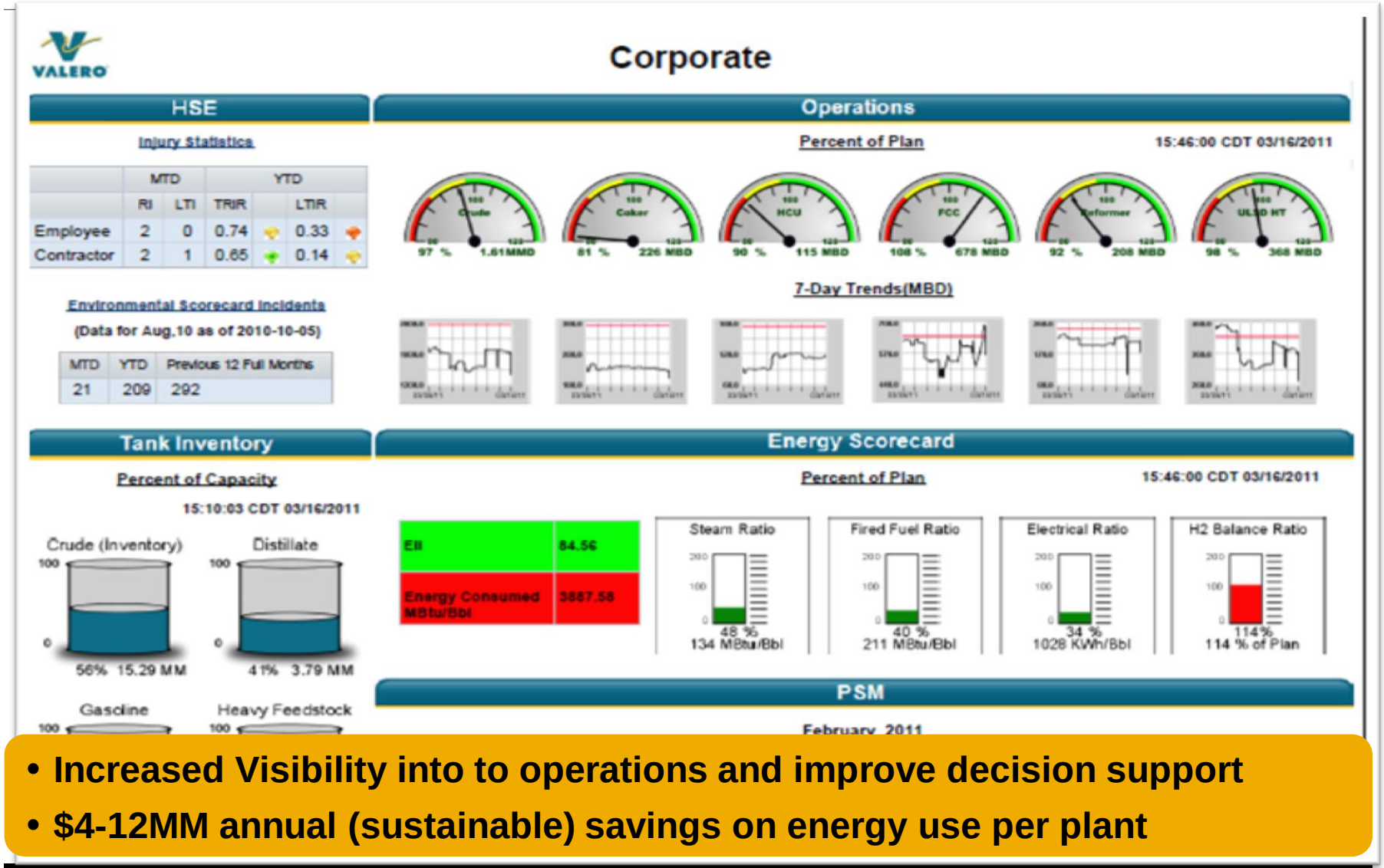
Business Logic Services

- 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.

Digital Mining Enterprise:
Operational Visibility and Control using SAP MII

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

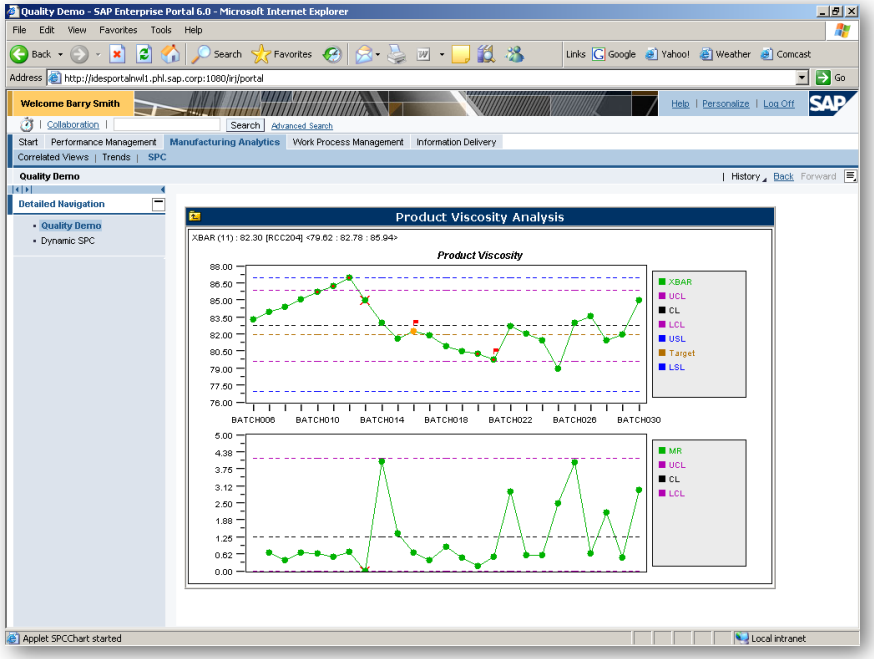


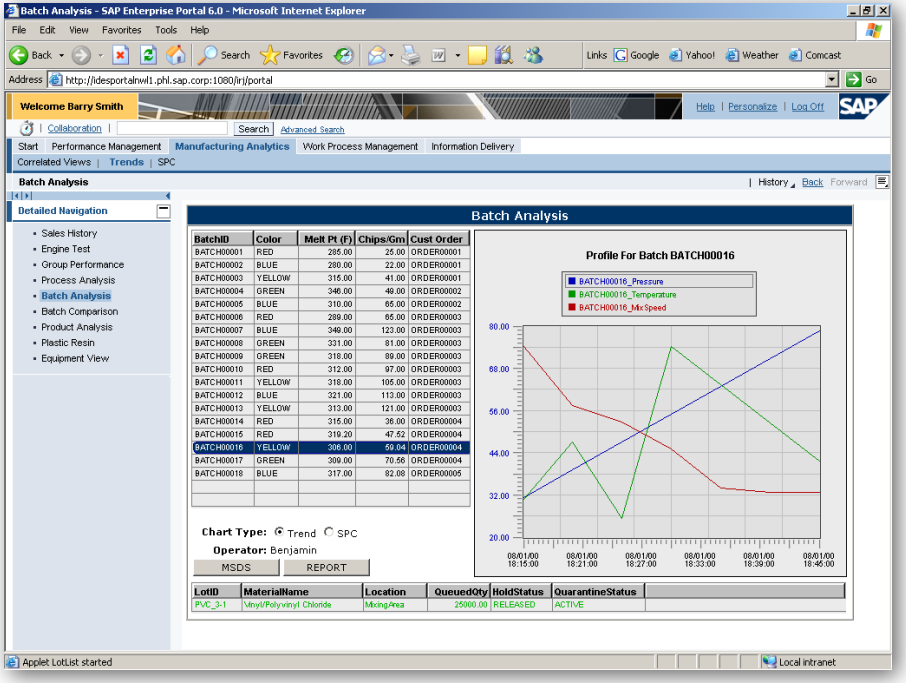
- **Increased Visibility into to operations and improve decision support**
- **$4-12MM annual (sustainable) savings on energy use per plant**

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

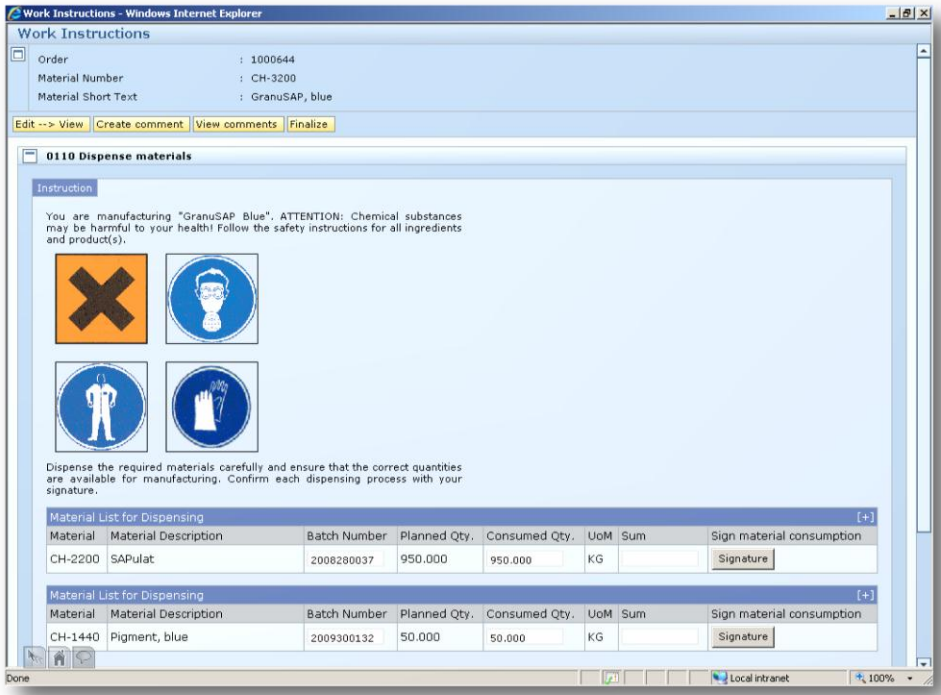


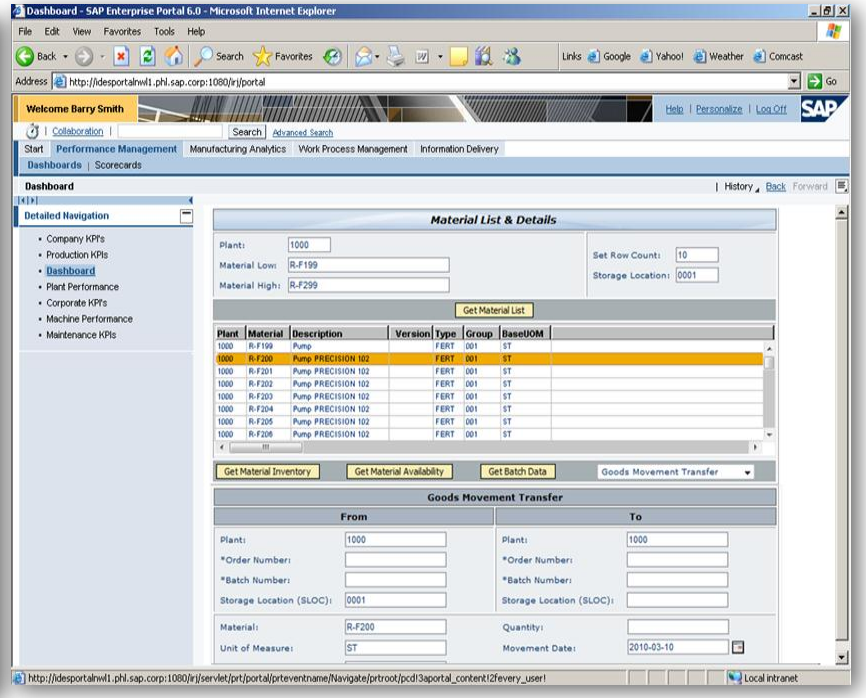


Digital Mining Enterprise:
Work Process Management using SAP MII

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

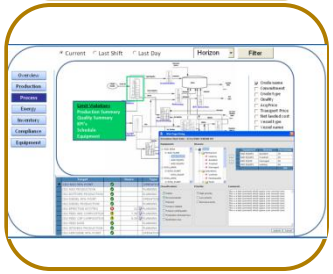




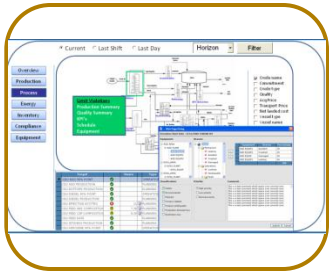
Digital Mining Enterprise:
Multiple-level Performance Management using SAP MII

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



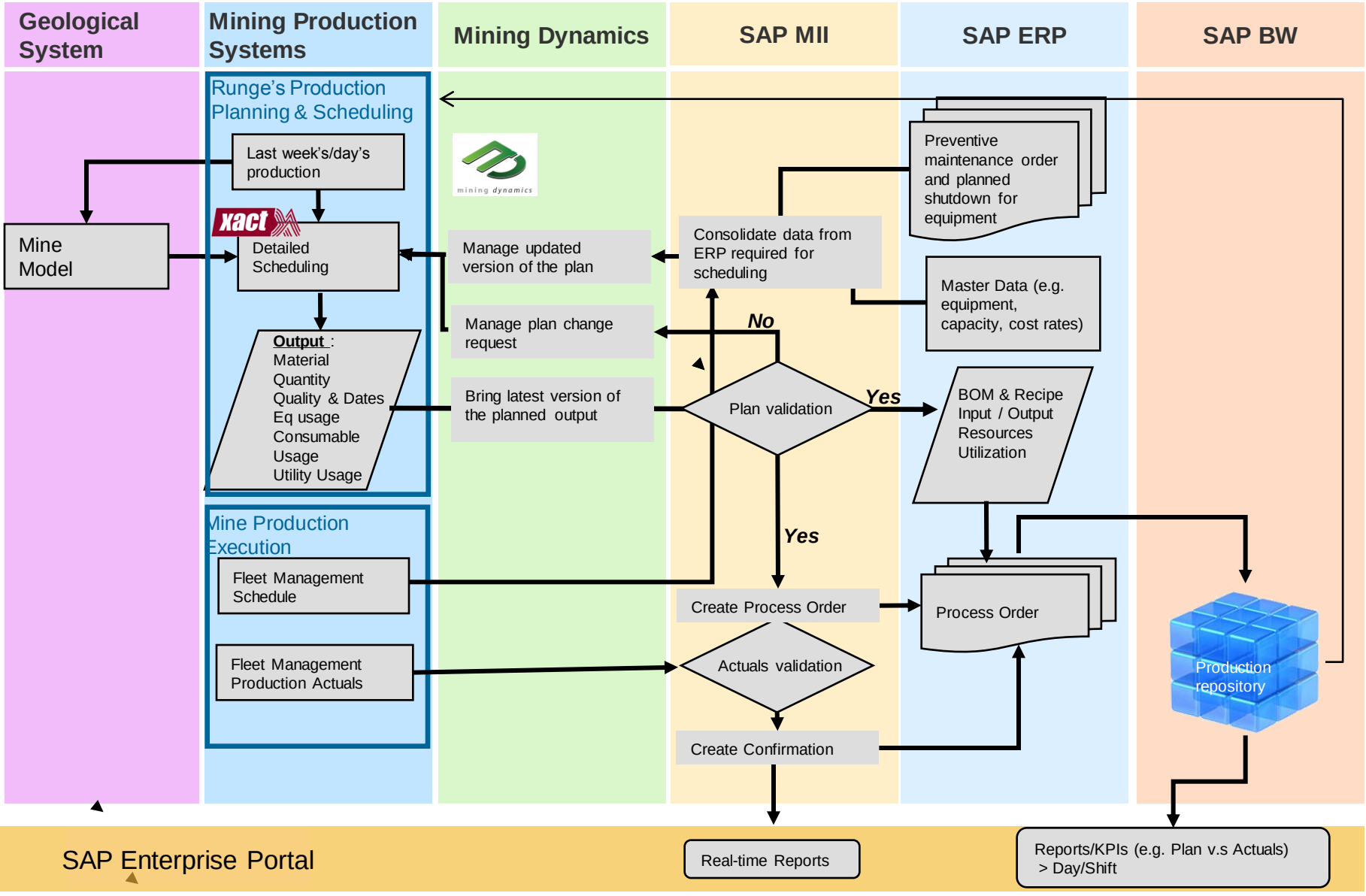
Area Performance Overview
- Key indicators for each area
- Top items of interest by area – not all details
- Identify key trends, forecasts



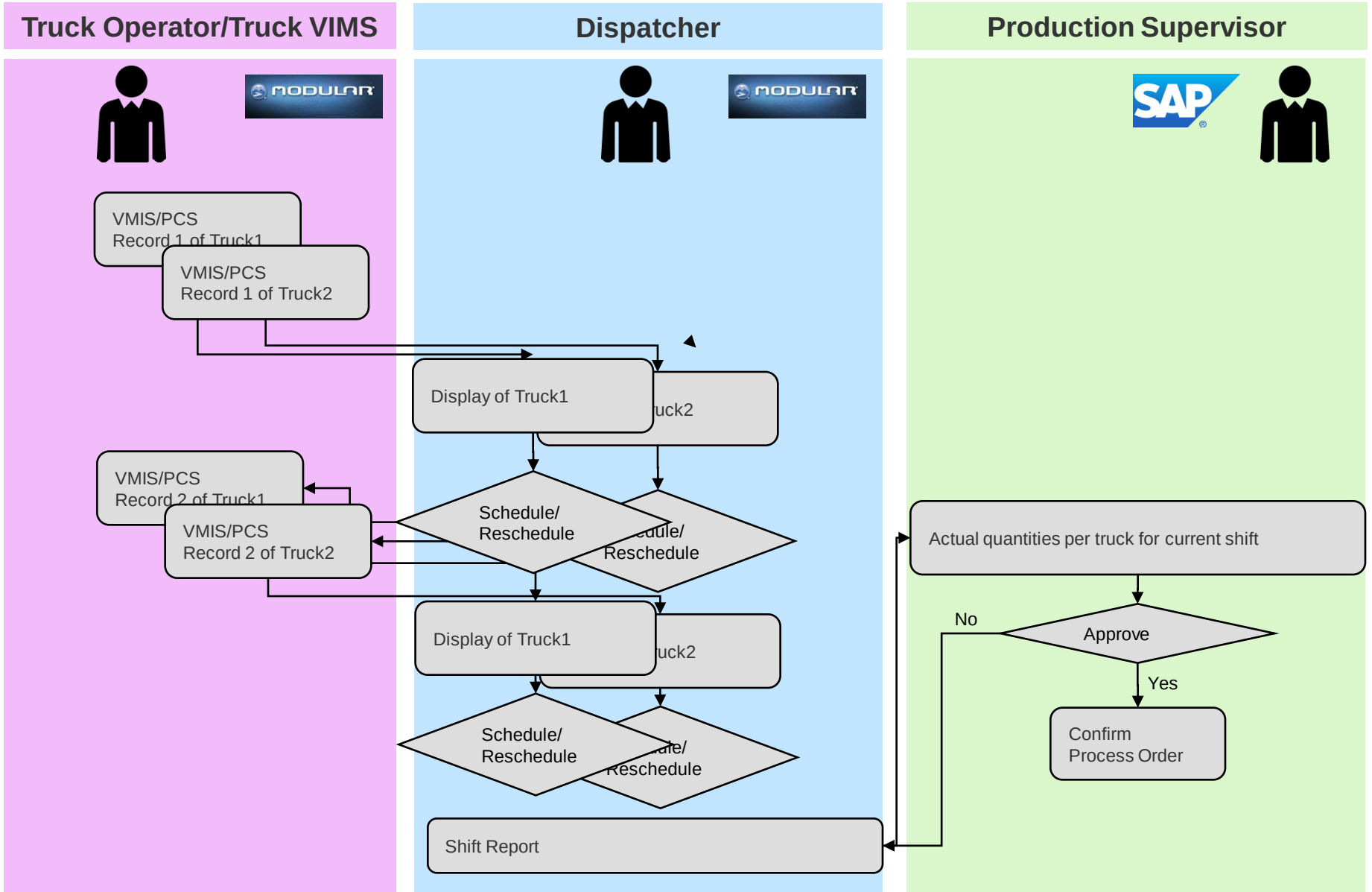
Production Performance Detail
- Single asset/single issue root cause analysis
- Production
  - inventories / projections
  - planning vs. actual
  - key quality, yield forecasts
- Equipment / Machine
  - Process overview graphic

Configuring the Views
- Wizard to ensure consistency
- Templates to simplify configuration, drive consistency

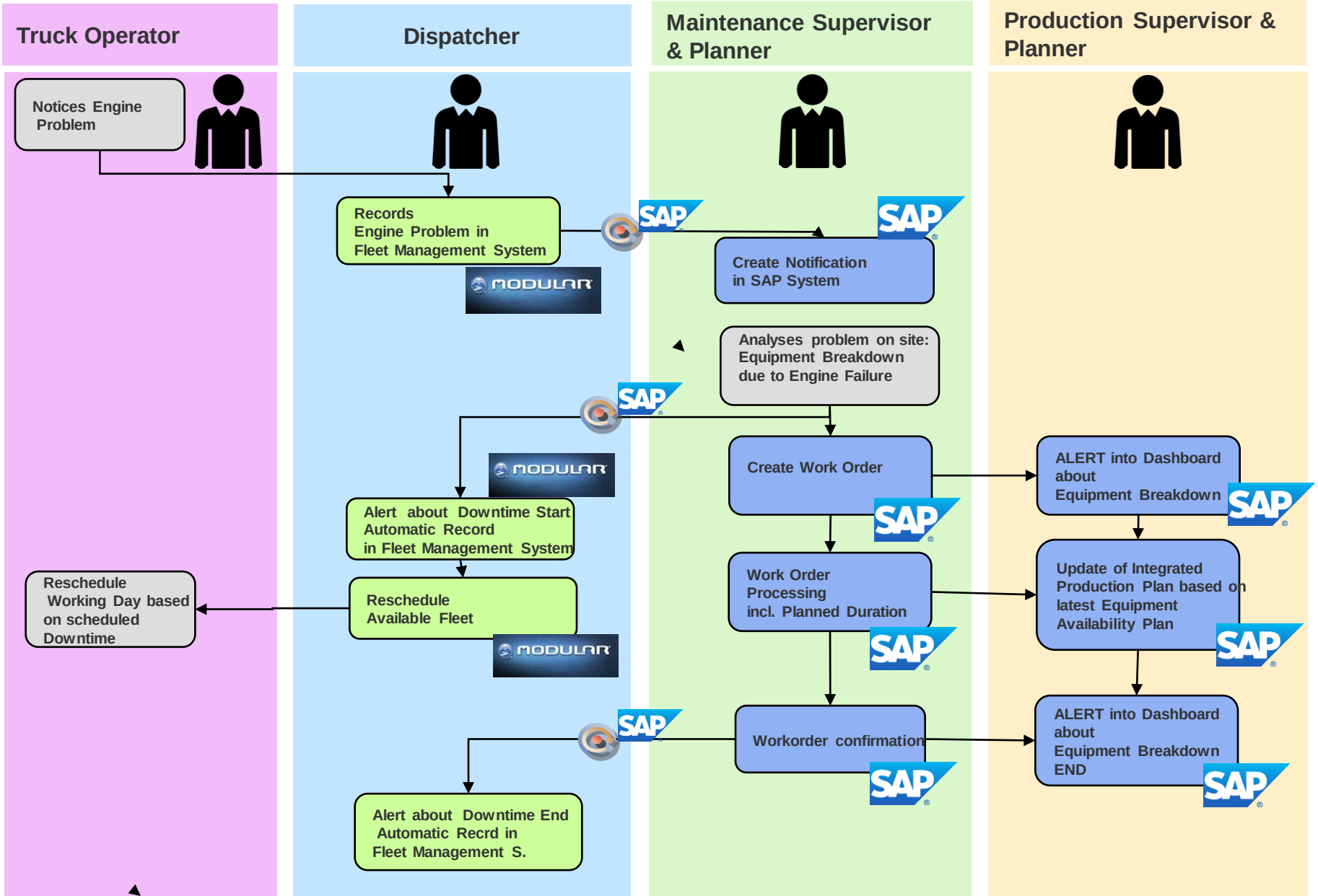
Digital Mining Enterprise:
Integrated Short-Term Mine Scheduling Process



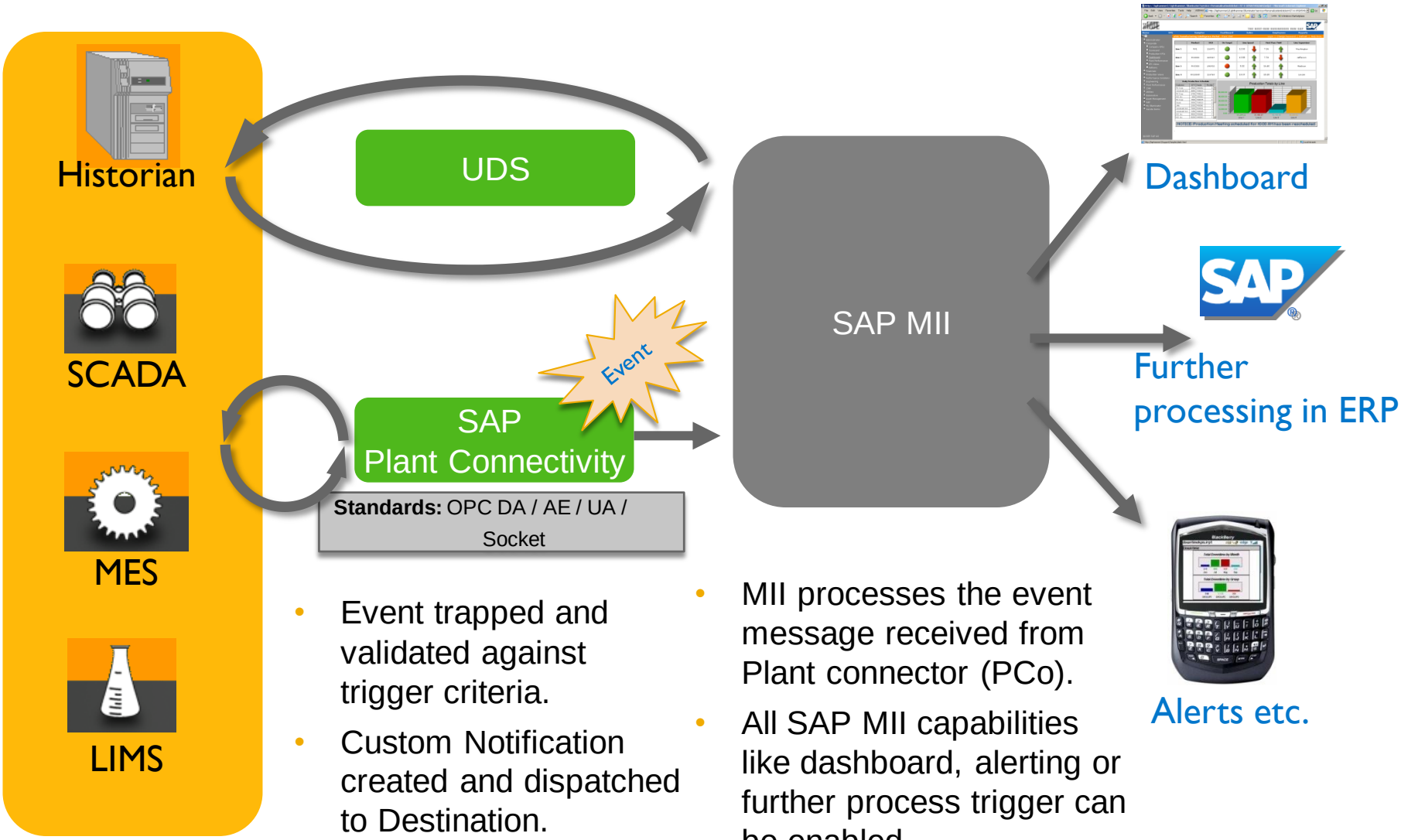
Digital Mining Enterprise:
Integrated Short-Term Mine Scheduling Process



Digital Mining Enterprise:
Integrated Truck Maintenance Process: EXAMPLE



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

Industry Value Network (IVN) for Mining

Driving co-innovation with our customers & partners

- **Mine planning and scheduling**
- **Fleet Management**
- **Metallurgical reconciliation**

runge

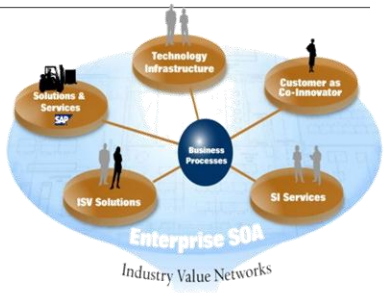
CAT Minestar

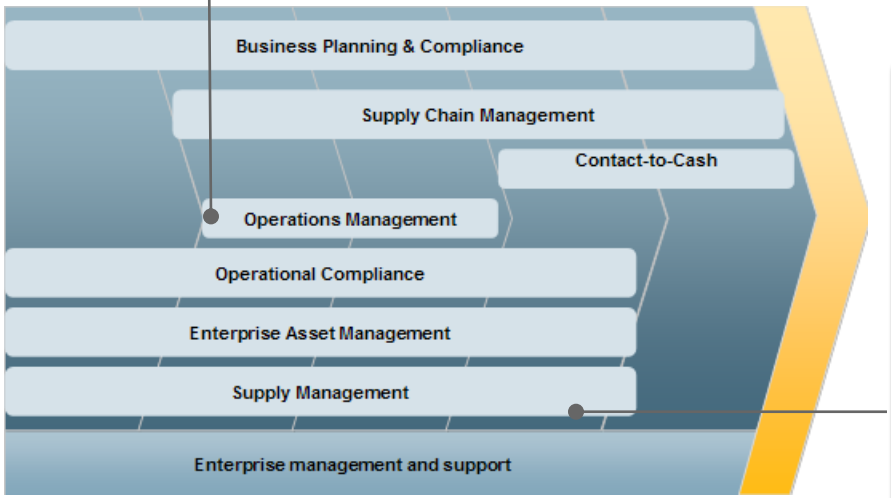
MODULAR

OSIsoft. PERFORMANCE-DRIVEN INTELLIGENCE

IVN Facilitator

SAP





- **Downtime Recording**
- **Reliability Centered Maintenance**
- **Asset information management**

Citect

meridium
Profit from a new perspective

NRX

- **Infrastructure and Connectivity**

cisco

- **Mining Industry Council**

bhpbilliton

CODELCO

RioTinto

ANGLO AMERICAN

exxaro
POWERING POSSIBILITY

CONSOL ENERGY

- **Implementation Partners**

accenture

Deloitte.

WIPRO
Applying Thought

Digital Mining Enterprise: Infrastructure and Connectivity Dimension

CISCO-SAP Collaboration Project

Connected Mining
Benefits

Improve Operations Management

Maximize Employee Productivity

Increase Asset Utilization

Foundation
- Ethernet to the factory
- Secure Wireless
- Physical Security
- Consolidated Data Centers

Collaboration
- Collaborative Innovation
- Connected Mine Information System
- Connected Factory Floor
- High Performance Computing

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

Minimize risk & Maximize Security

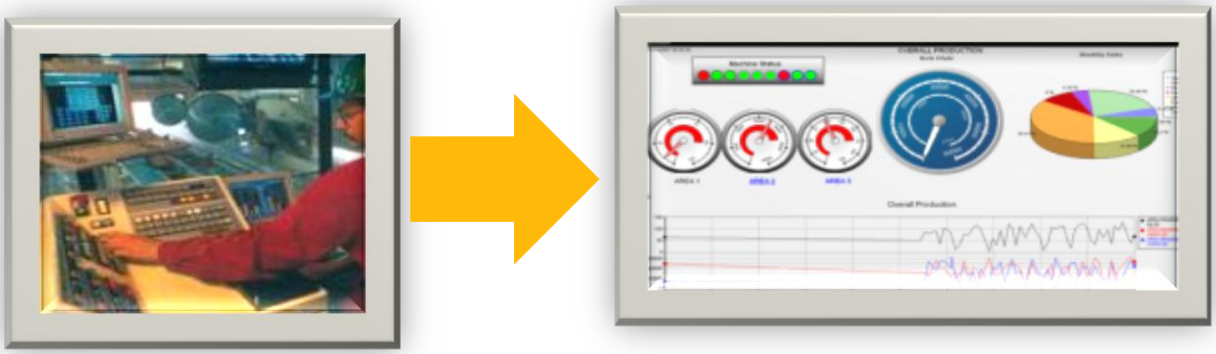
Support Environment & Regulatory Compliance

Expand Visibility into Operations

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



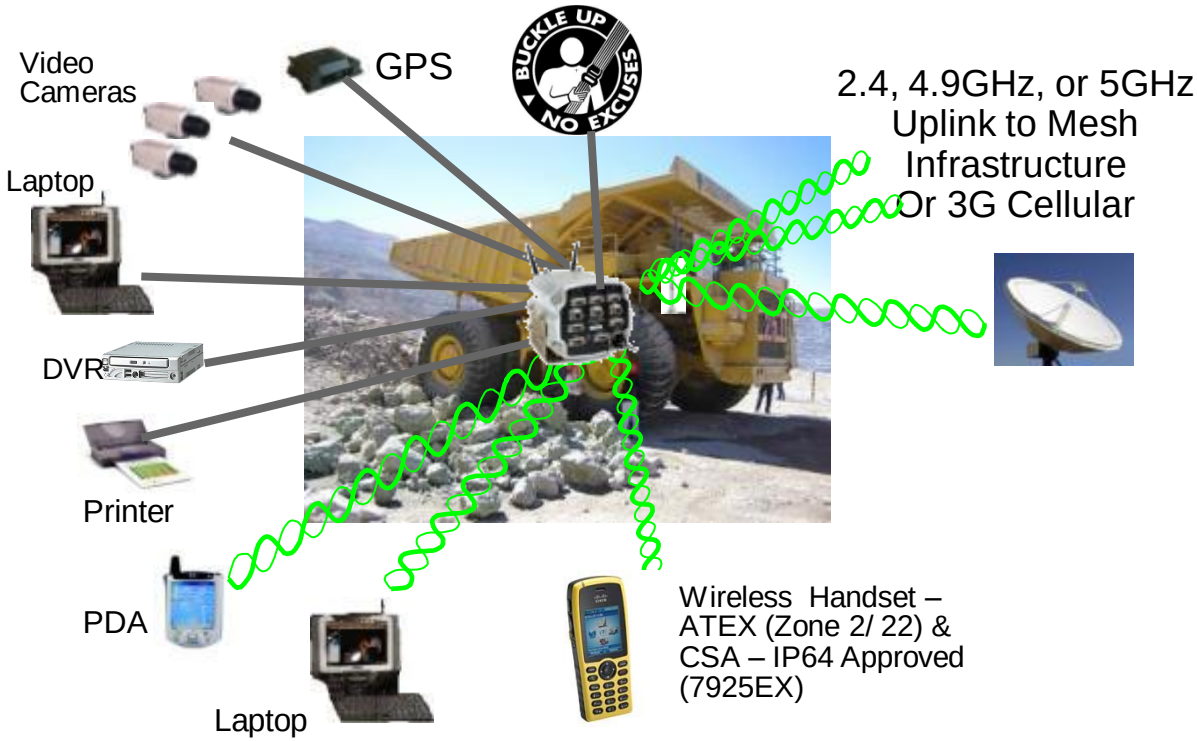
Tracking & Scheduling

Logical Overview

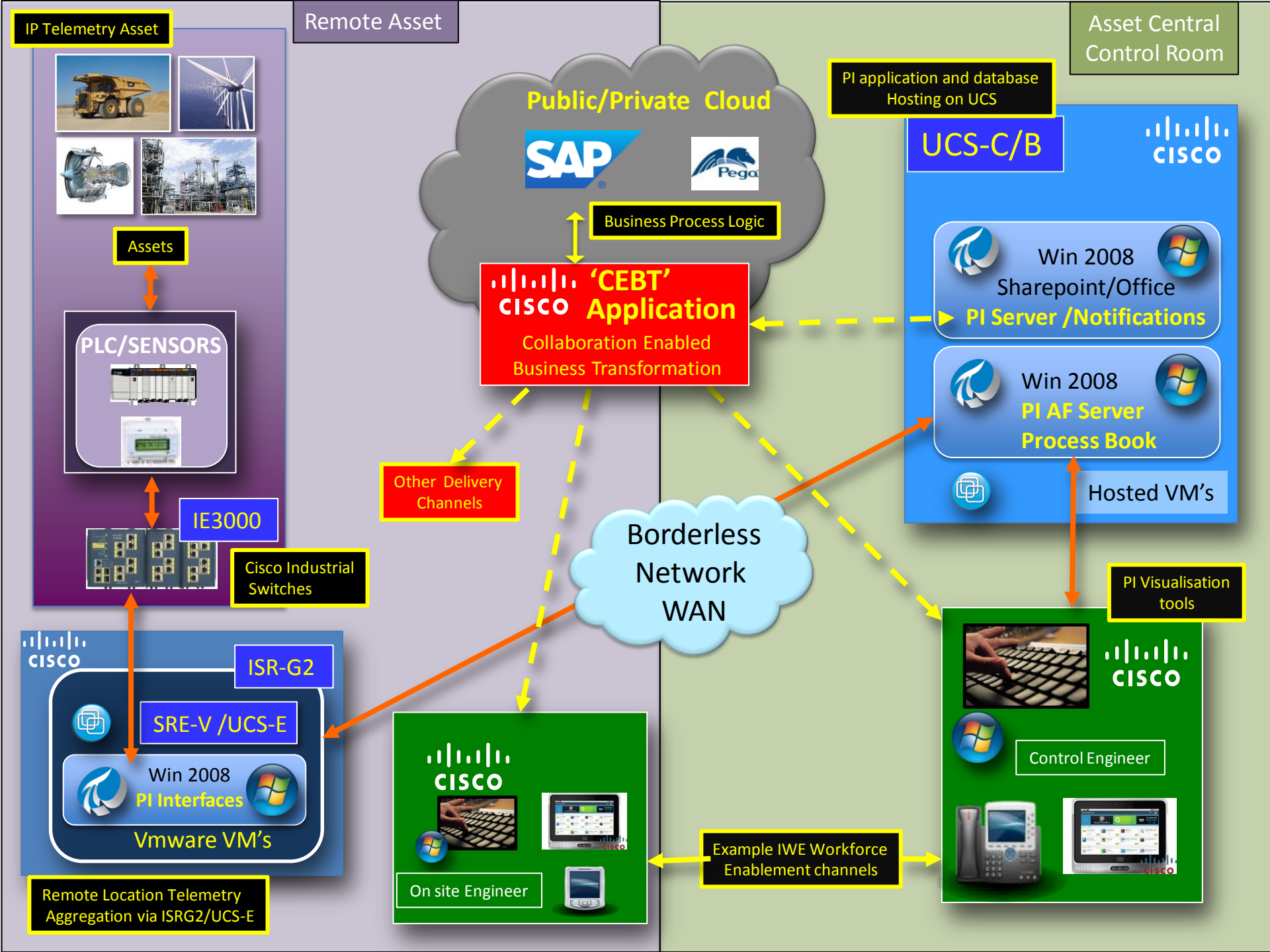
By utilising a unified standards based IP infrastructure
You can leverage multiple applications and services..

Improves:

- Operations
- Maintenance
- Safety
- Logistics



Voice Video Data


IP Telemetry Asset
Remote Asset
Asset Central Control Room
Public/Private Cloud
SAP
Pega
Business Process Logic
PI application and database Hosting on UCS
UCS-C/B
CISCO
Assets
'CEBT' Application
Collaboration Enabled Business Transformation
Win 2008 Sharepoint/Office
PI Server /Notifications
PLC/SENSORS
Win 2008
PI AF Server
Process Book
Hosted VM's
Other Delivery Channels
IE3000
Cisco Industrial Switches
Borderless Network WAN
PI Visualisation tools
ISR-G2
SRE-V /UCS-E
Win 2008
PI Interfaces
Vmware VM's
Control Engineer
On site Engineer
Example IWE Workforce Enablement channels
Remote Location Telemetry Aggregation via ISRG2/UCS-E

Connected Mining

A Solutions Approach of CISCO

Customer Challenges

Solution Requirements

Engineering Design

Integration of Technologies

Validation & Implementation of Solution

HIPROM

Rockwell Automation

OSIsoft.

Intermec

Dàtria

AeroScout Enterprise Visibility Solutions

cti Coleman Technologies, Inc.

SAP

JIGSAW TECHNOLOGIES A Leica Geosystems company

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

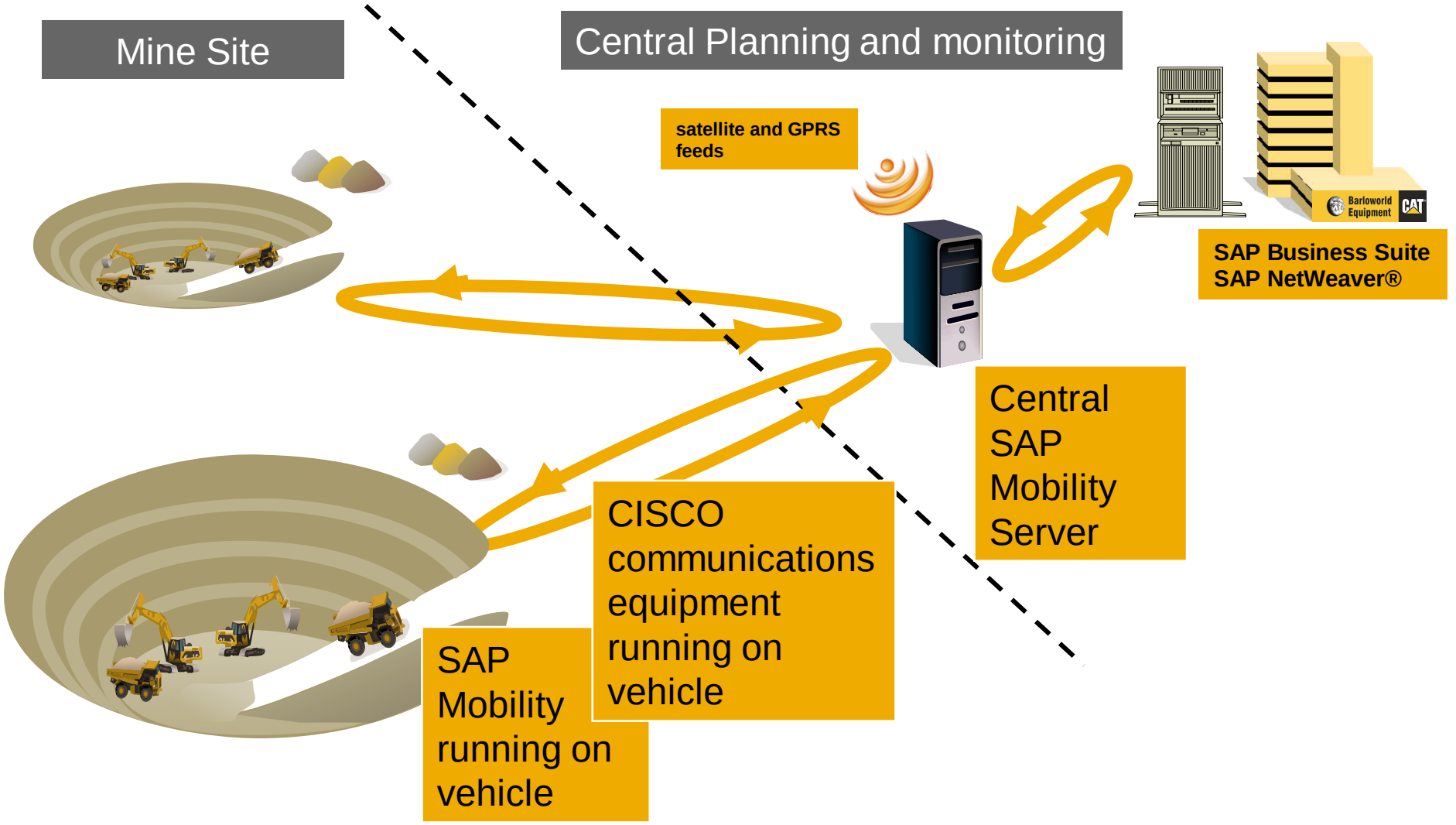
3. **SAP Incident Management enabled through CISCO Infrastructure**

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



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.).

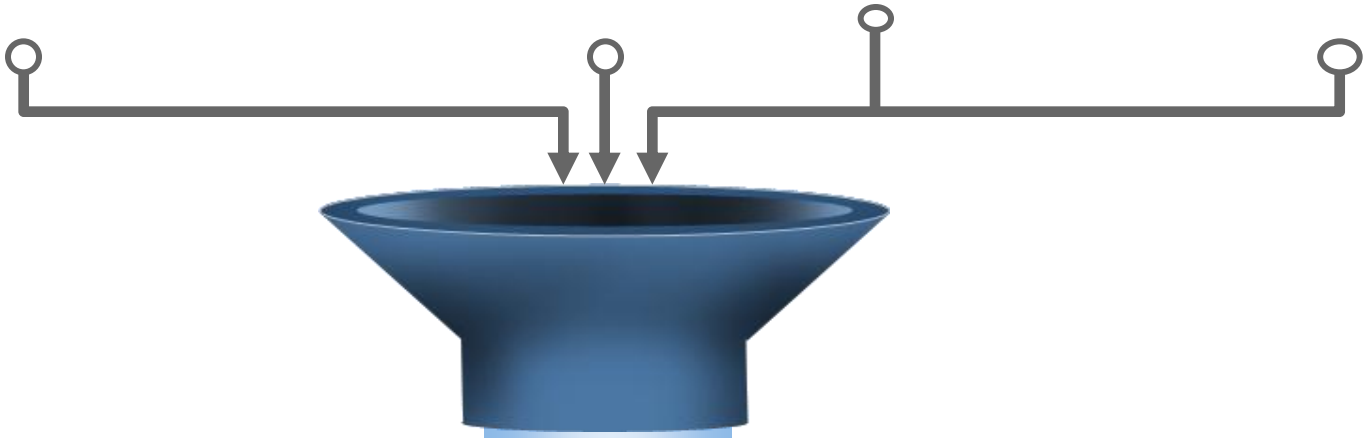
Visualization

Video Wall and individual PC production data visualization delivered using SAP MII and Business Objects

Tracking & Scheduling

Mobile Equipment

Operations	Maintenance	Safety	Logistics
• Scheduling Applications • Production Accounting	• Pro-Active & Predictive Maintenance	• Video Services • Expanded visibility for truck drivers	• Traffic Control • Locations based services (GPS)



Operational Efficiency

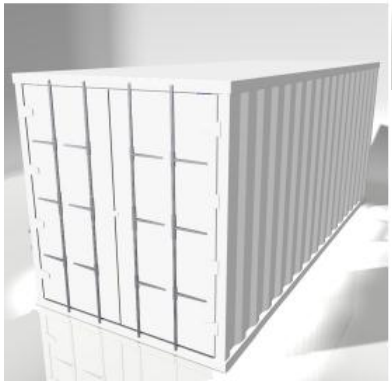
- **Reduced costs for incidents and unexpected shutdowns**
- **Improves operational efficiency and productivity**
- **Increased worker productivity**
- **Better Visibility into Supply Chain**

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

Video Equipment Inspection

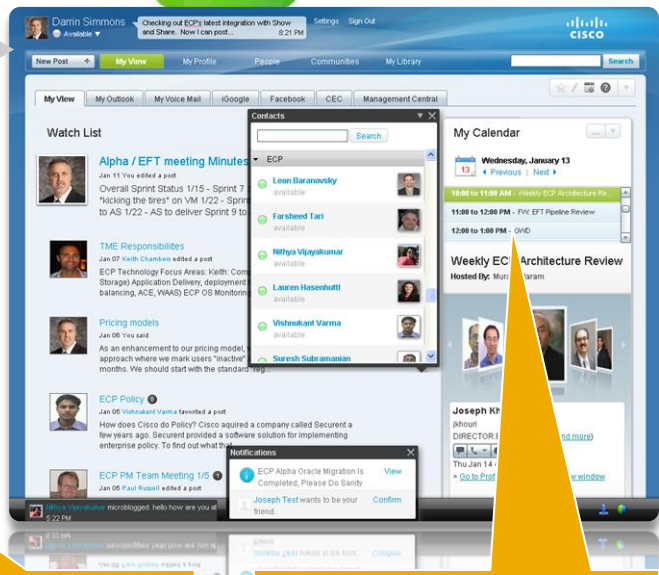
Based on: Field Mobile Video service

Cisco 7925-EX or Smart Phone Integration with UC and Mobility

Inspection Operator sees corrosion, uncertain if it is a real problem…uses mobile communicator to find expert…connects call

ATEX/CSA rated (zone 2)

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



Cisco Cius (Not ATEX Rated)

Upload to **Cisco Webex Social** for **Show and Share** - Replay Voice & Video for knowledge transfer

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

SAP Mobile Solutions with CISCO for Maintenance and Production

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

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

3. Mine Safety solution

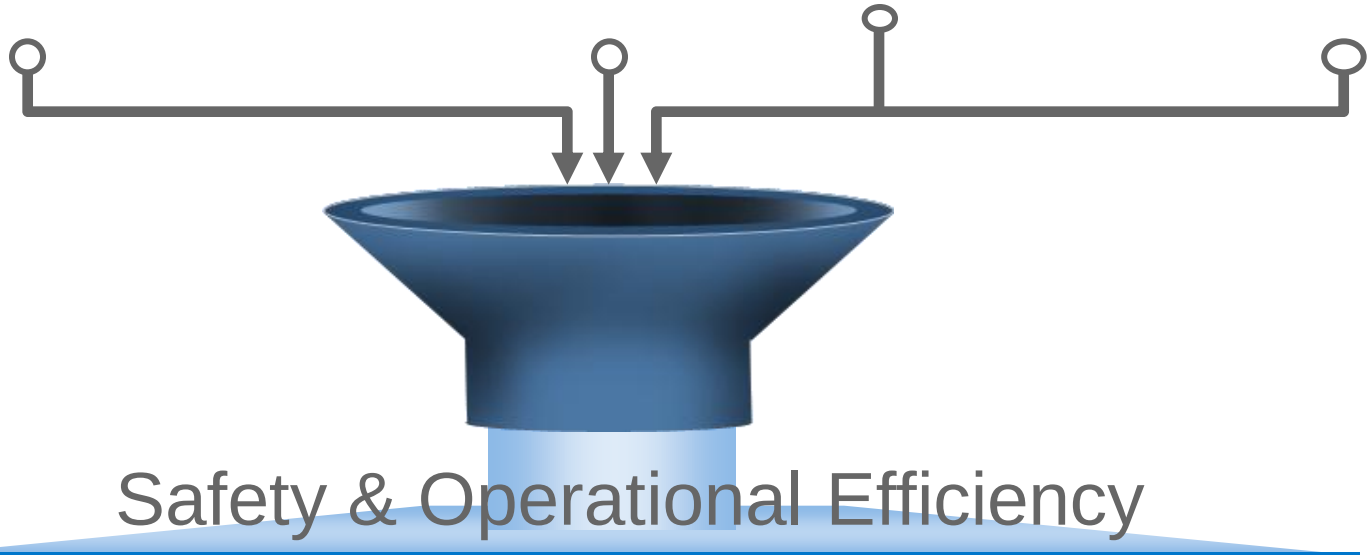
Enabled by:

- CISCO Infrastructure and
- SAP Incident Management

Connected Mining Information System

Collaboration & Visibility

Corporate Messaging	Live Video	Point of Use	Video on Demand
• Executive announcements • Company Information	• One to many Messaging & Video e.g. Entertainment	• Safety Warning's • Production Data, Status & Statistics	• 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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