Enterprise Energy Effectiveness and Sustainability Management

Presented by **Osvaldo A. Bascur, Metals Industry Principal, OSIsoft, LLC**

.

Agenda
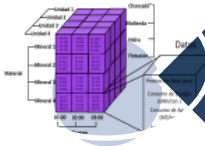
Overview of the Large Industrial Complexes

Comminution represents 70% Of Operating Costs

What is being done?
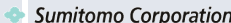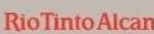
Real Time Information Integration and Standardization: Anglo American Platinum

Further work and Conclusions

PI System in Mining and Metals
Customers in all Commodity Segments

Coal & Energy	Iron Ore	Copper	Nickel, Zinc, Lead, Silver	PGM & Gold	Diversified and other Mining Companies

Mine to Metals Products

PI Visualization and Collaboration

PI Analytics and Notifications

OSIsoft

PI Server and Data Services

ENERGY PER TON OF COPPER, kWh/T (y-axis)
ORE GRADE, % copper (x-axis)

80%
90%
100%
70% RECOVERY

COMMINUTION ENERGY IS 72% OF MILLING ENERGY

5 Tons Water/Ton of Cu

TOTAL ENERGY (INCLUDING MILLING)

SMELTING

REFINING

Open pit:
Mining   3-5kWh/t ore
Milling   15-24 kWh/t   <100mesh grind, flotation

Underground:
Mining   12-40 kWt/ore
Milling   24-34 kWh/t   <200mesh grind, flotation

Energy & Minerals Initiative - Perth - 23 June 2009

Source :Douglas W. Fuerstenau Douglas W. Fuerstenau, University of California, Berkeley

Electricity consumption in copper concentration (%)
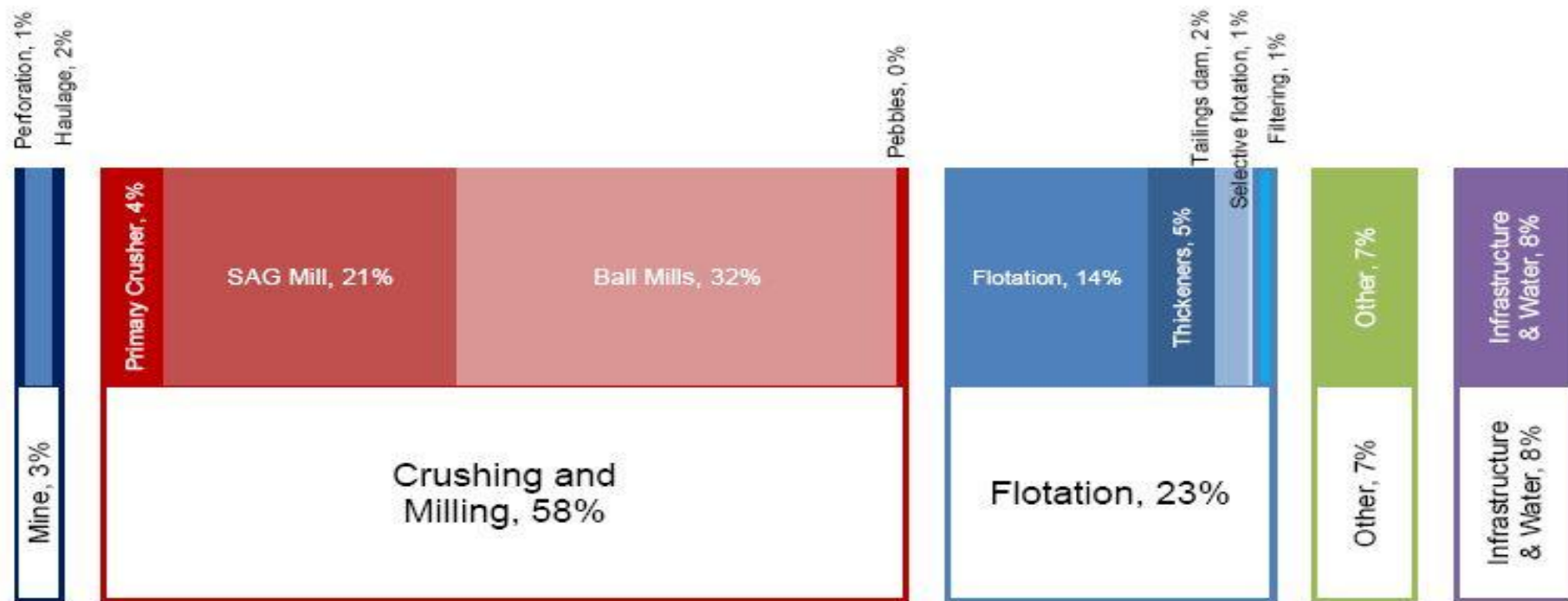
Overall Integrated Industrial Effectiveness

Results

Opportunities $

Mr. Porter Shared VALUE Strategy for SUSTAINABILITY

Long term PROFITS With Sustainability

E N V I R O M E N T A L	S A F E T Y	C O S T S	M A I N T E N A N C E	Q U A L I T Y	P R O D U C T I O N

Systems

Real Time Integrated Plant Systems
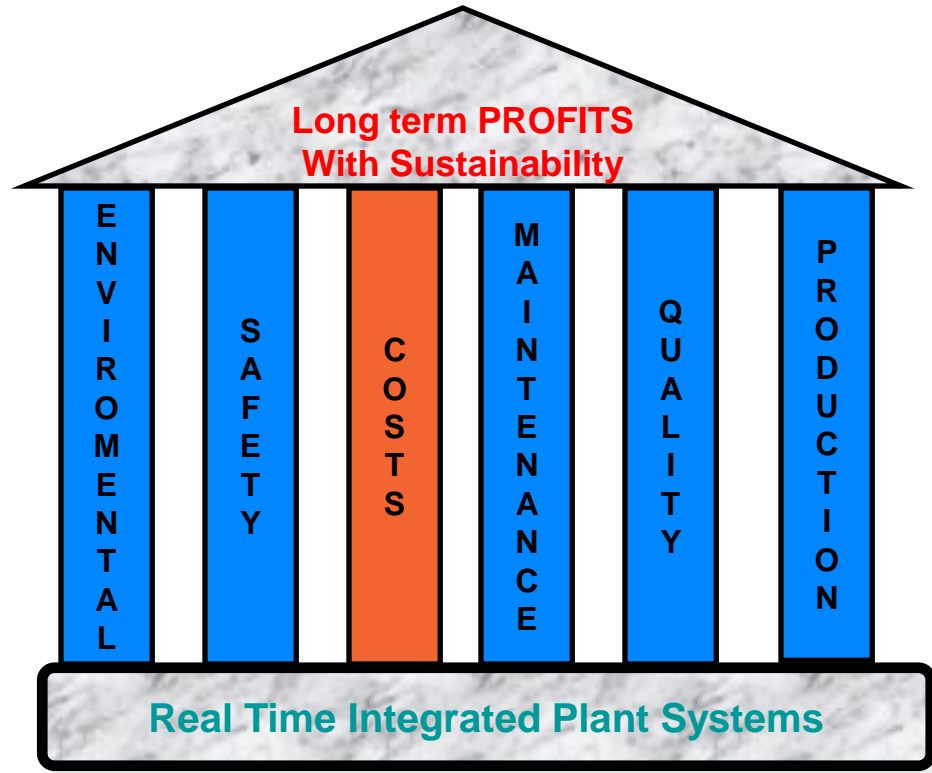
Local vs. Collaborative Decision Making

KPI Examples: Production, Quality, Costs, Equipment Availability, Environmental and Safety alerts with fast resolution and improved decision making.

Continuous Improvement and Innovation

MONITOR

IMPROVE

In Control?

Satisfied?

Yes

No

KPIs ->

Identify Root Causes

Establish Alternatives

Operations/Maintenance

Local Operations/Maintenance

Strategic Competence Centers
Maintenance/Engineering/Management
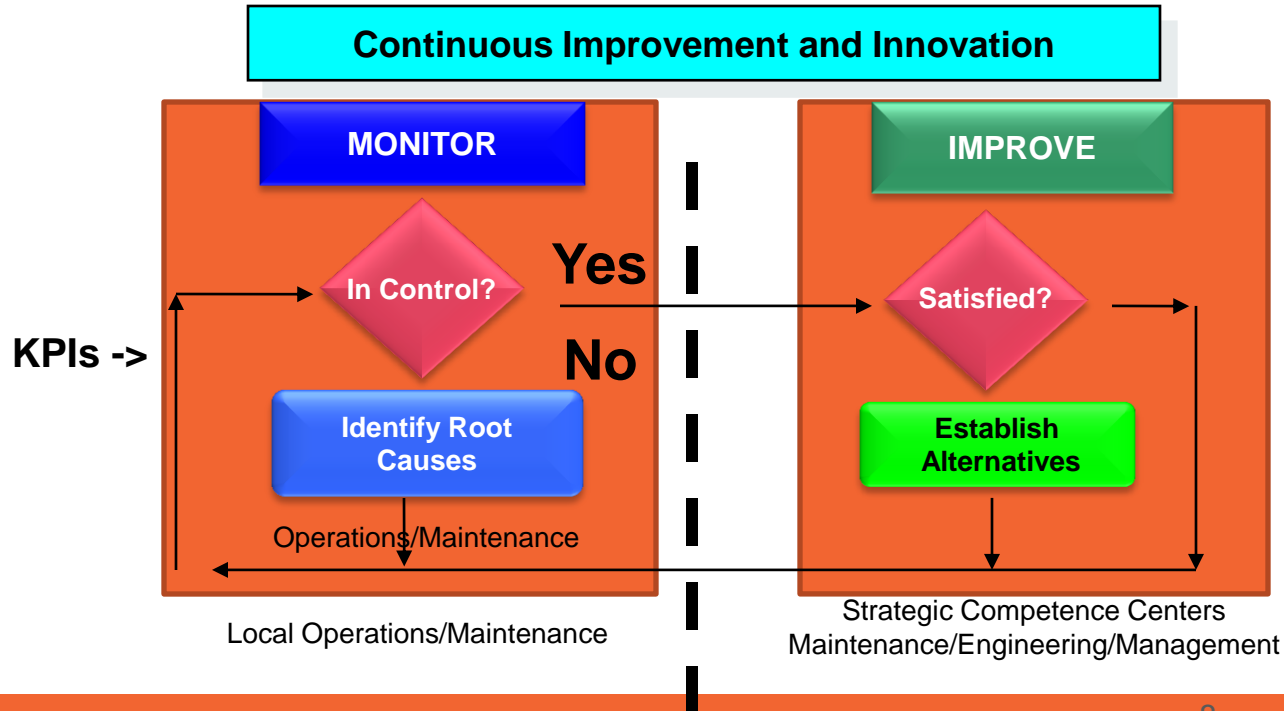
Large Metallurgical Complex

Rio Tinto
Kennecott
Utah Copper

Mining → **Mineral Processing** → **Smelter** → **Refinery**

Energy   Assets   Consumables   Safety   Environmental

INTEGRATE- FIND – ANALYZE- DELIVER-VISUALIZE
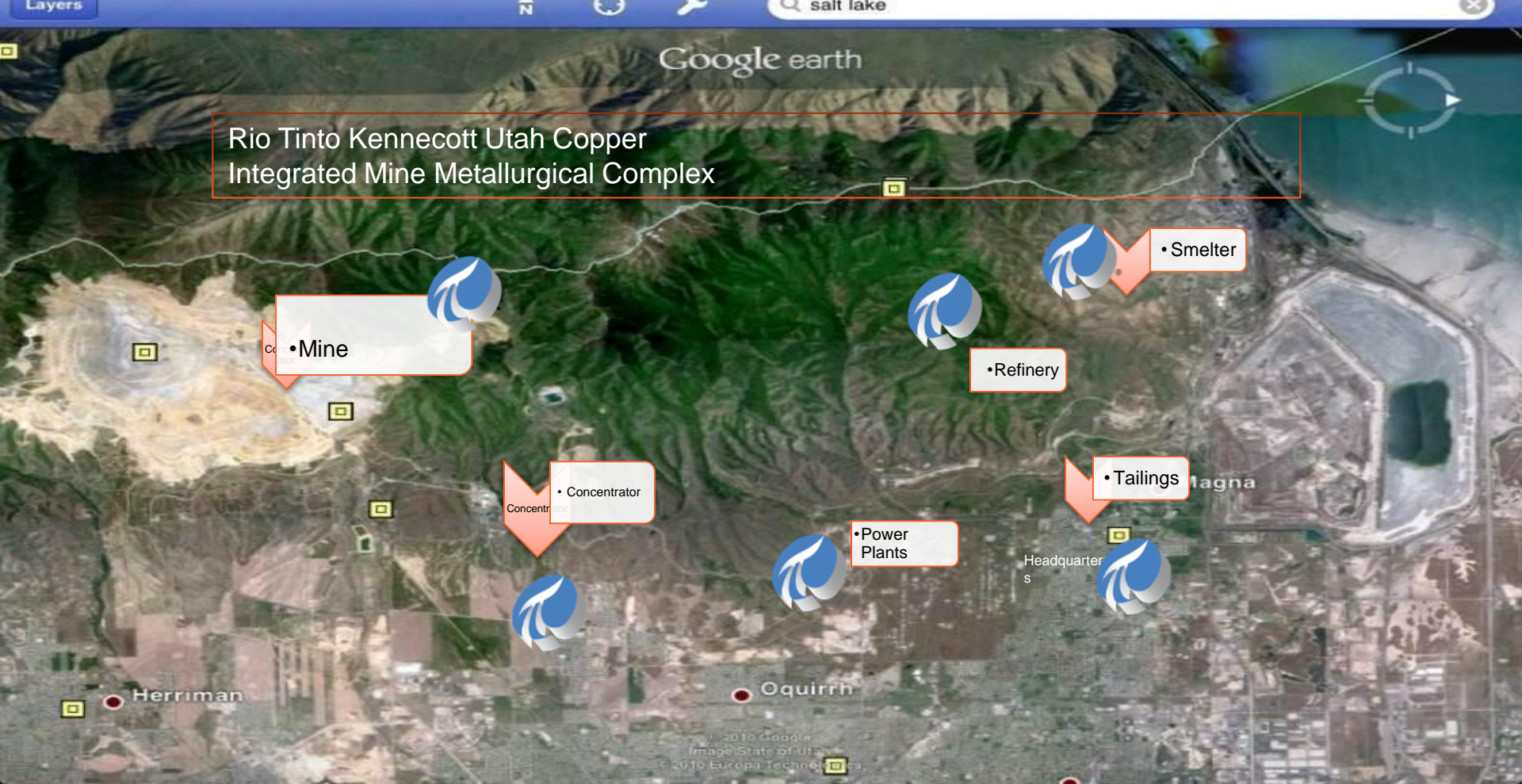
Rio Tinto Kennecott Utah Copper
Integrated Mine Metallurgical Complex

• Mine

• Smelter

• Refinery

• Concentrator

• Tailings

• Power Plants

Headquarters

4 Example of the development strategy for a tier 1 asset – Oyu Tolgoi

Production
Energy
Asset States

Production
Energy
Asset States

Production
Energy
Asset States

Production
Energy
Asset States

Production
Energy
Asset States

Excavation	Crushing	Storage	Grinding	Production	Shipping	Underground excavation
Open Pit	Primary crusher	Raw ore stockpile	Mill	Concentrator	Trucks	Underground Mine

First Excavation of open pit
2011

First ore from open pit
2012

First sales
2013

Underground Block Caving
2016

4 Long term investment strategy is focused on tier 1 assets – large, long life, low cost assets

Oyu Tolgoi
425ktpa Cu; 460kozpa Au
(1st quartile)

Kennecott Utah Copper
South wall pushback &
underground options
beyond 2050 (1st
quartile)

Resolution
600ktpa Cu
(1st quartile)

Grasberg – Block
cave & DMLZ
(240ktpd of mill
throughput)
(1st quartile)

La Granja
500ktpa Cu
(2nd quartile)

Escondida
1.3mtpa Cu
(3rd quartile)

Brownfield
Greenfield
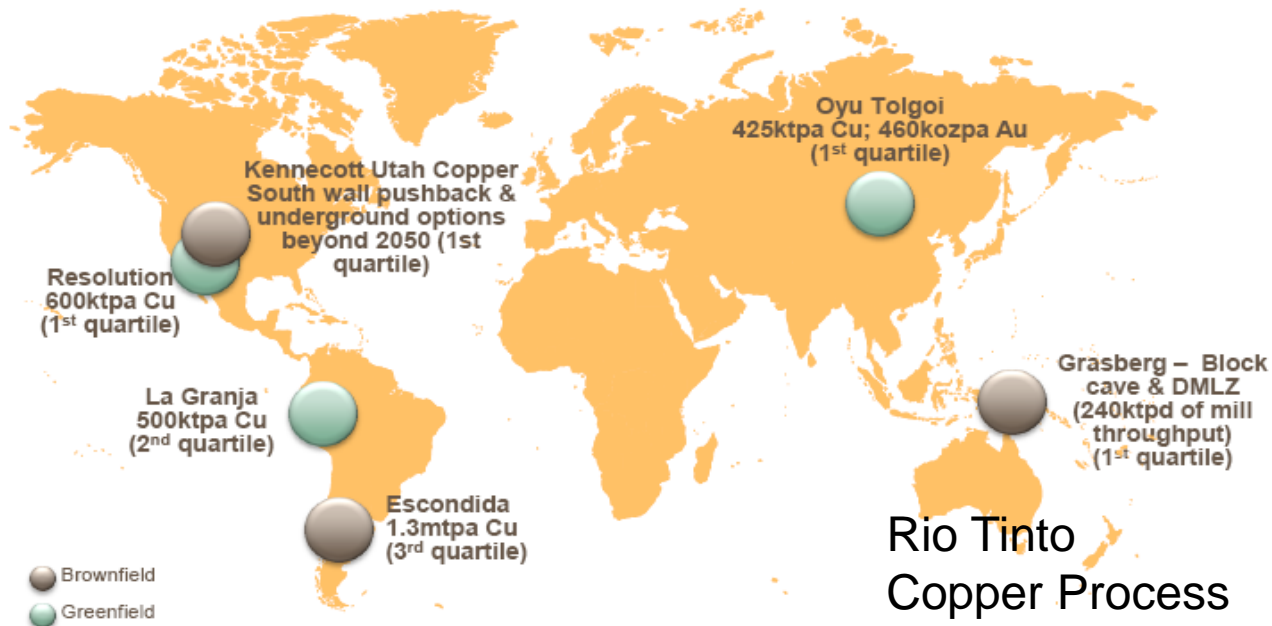
Rio Tinto
Copper Process
Excellence Support Center

Southern Peru Copper: Cuajone

- ➢ Cuajone
- ➢ Production 87,000 MT fine Copper per day.
- ➢ Conventional open-pit mine
- ➢ Concentrator - 10 Grinding Lines.

Management Indicators: KPI's

Alarm system and start/stop equipment, sub-standard conditions of processes and operations, etc. (PI – ACE)

PI System PI ACE

Control System Conc. Plant

PDA & Tablet PC's

Real Time Information — Currency of the New Decade

Mining Crushing Grinding Flotation Dewatering
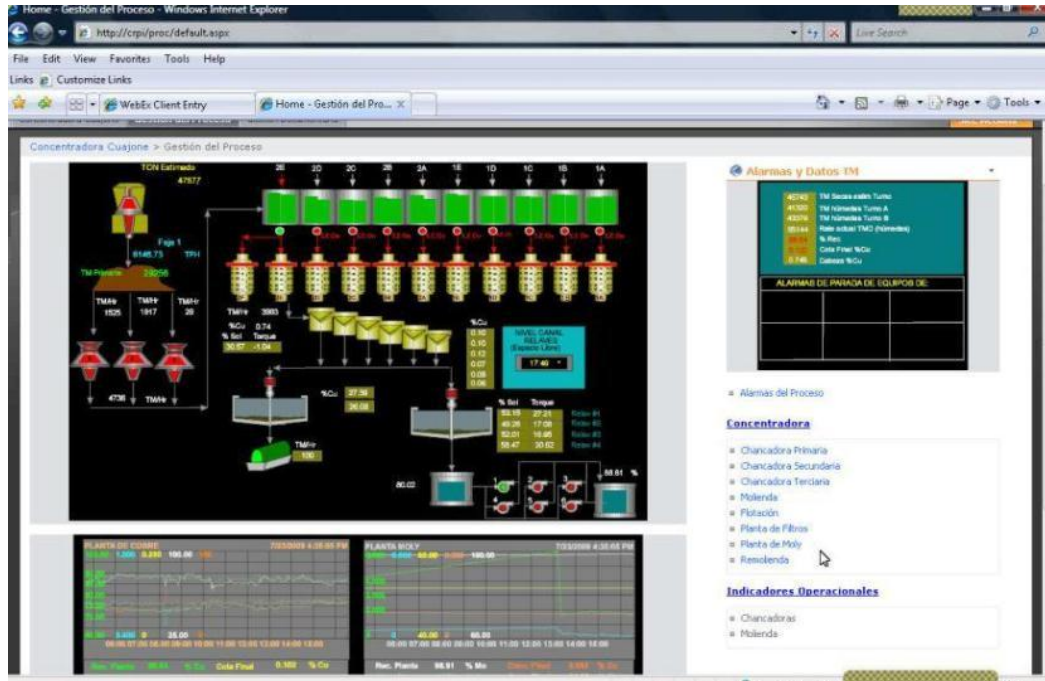
Nelver Benavides et al, Southern Peru Copper, UC2010, www.osisoft.com
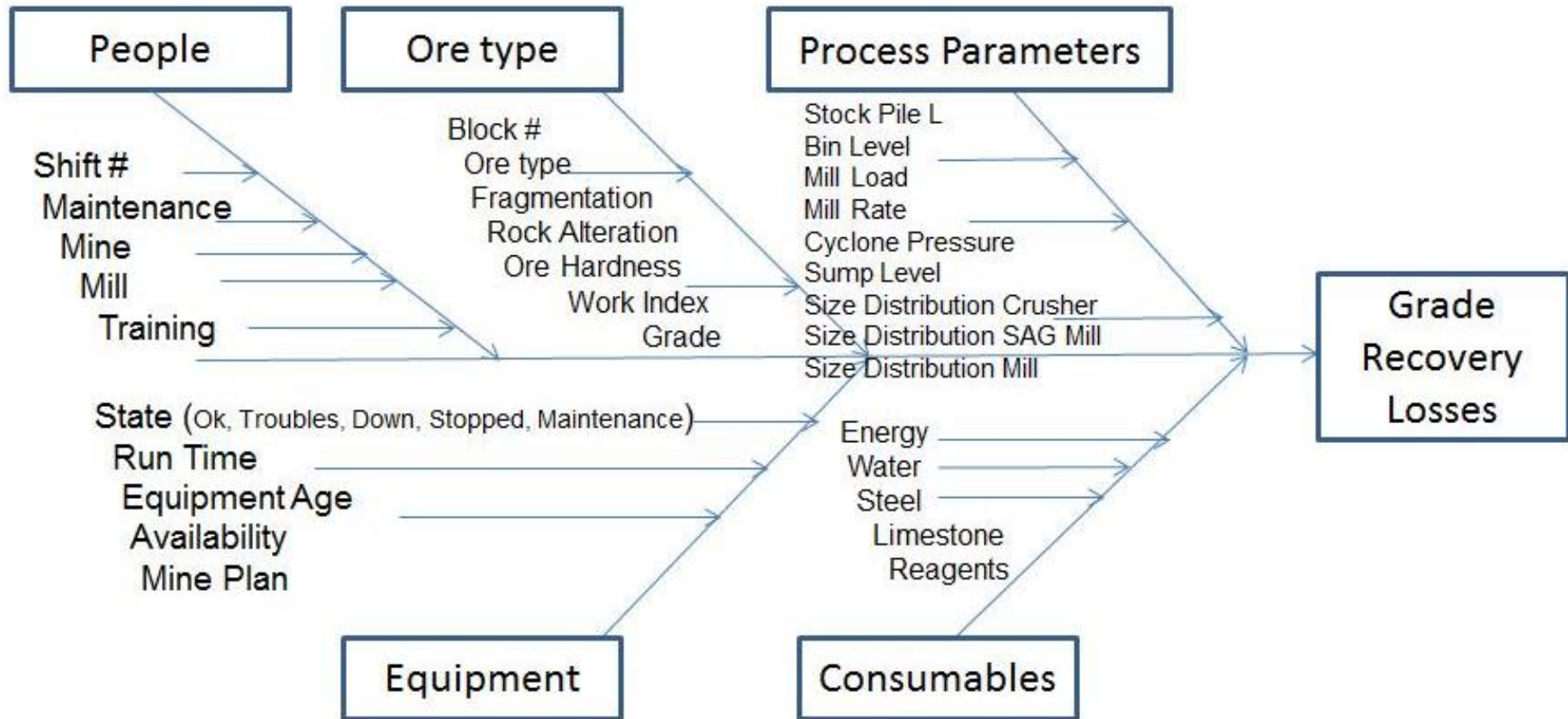
Strategy for Operational Data Mining

Definition of Production Unit States
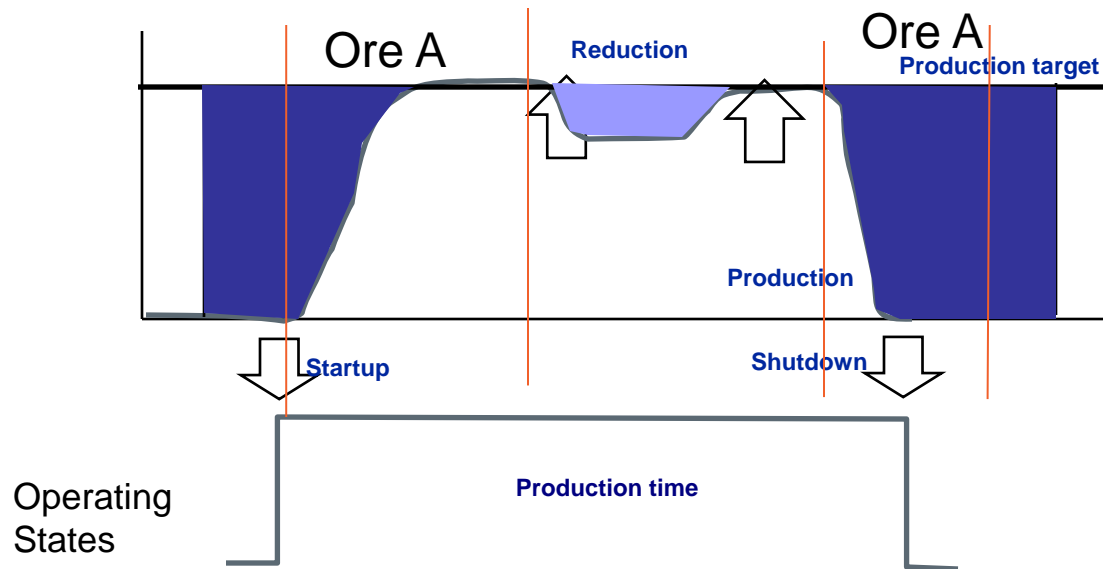
Operating States

Running	= Key Variables within acceptable range
Down	= Equipment broke
Stopped	= Equipment idle
Trouble	= Equipment not meeting Production target, Environmental, Quality
Maintenance	= Scheduled Maintenance

Southern Peru Copper: Cuajone

Sharepoint, PI AF, PI Slicers and PI Cubes
Using Latest Power Pivot in Memory technologies
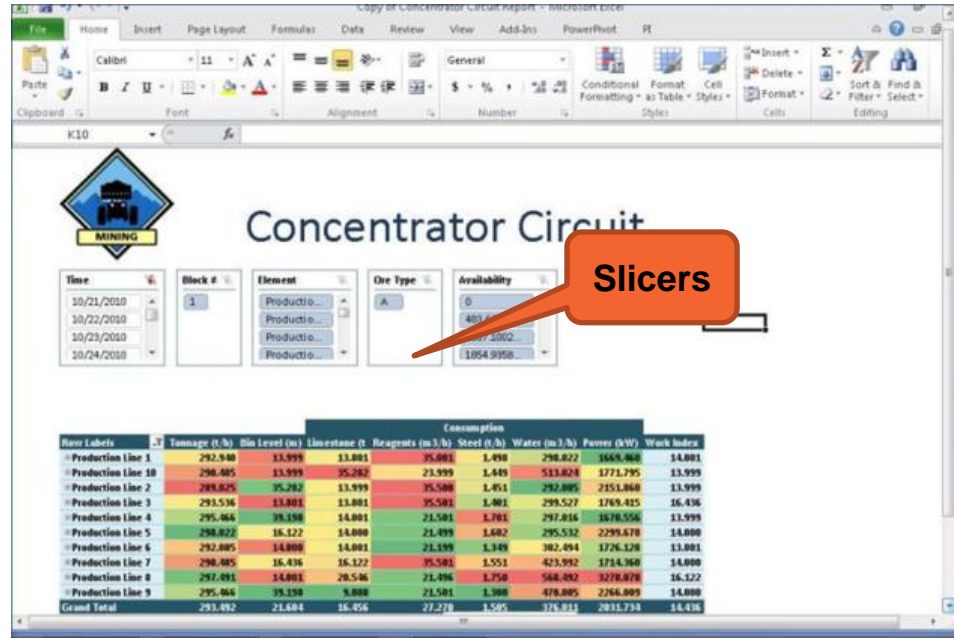
Tangible benefits: Advanced Mine to Mill Integration

UC 2010

Production Benefits:

Economic Benefits:

➢ Increase of ore milling: 4.6%
➢ Decrease of mil power: 3.9%
➢ Decrease of fresh water consumption: 6.8%

➢ Net profit: US$ 31.8 million (period: 2009/04/04 to 2009/12/31
➢ PI System contribution: US$ 7.95 million (same period)

Integration of Mine Feed Knowledge with Milling, Flotation and Dewatering.

- **Operating Profit: US$ 6,164 millions**
- **EBITDA: US$ 8,686 millions**

Refined production	2012
Platinum (troy ounces)	2,378.6
Palladium (troy ounces)	1,395.9
Rhodium (troy ounces)	310.7
Gold (troy ounces)	105.2
PGMs (troy ounces)	4,640.6
Nickel (tonnes)	17.7
Copper (tonnes)	11.4
Revenue ($m)	**2012**
Subsidiaries and joint ventures	5,258
Associates	231
Revenue	5,489

http://www.youtube.com/watch?v=wNS0C-DQYTU
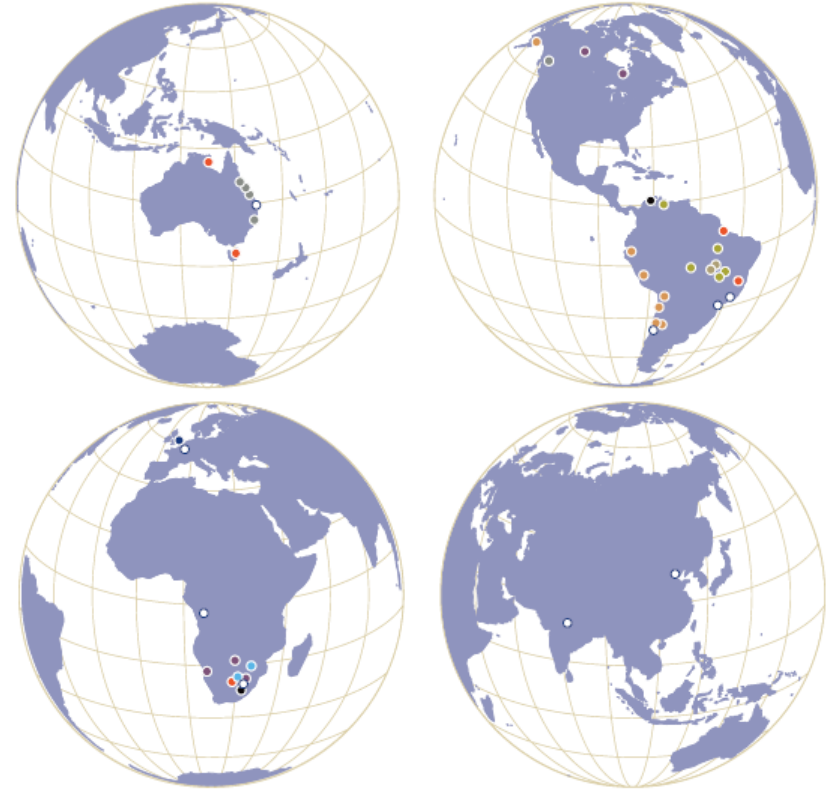
Ref.: Anglo American Sustainable Development Report 2012

Anglo American Platinum

- Anglo American Platinum is the world's premier PGM producer, supplying approximately 40% of the world's newly refined Platinum.
- Process Division:
  - 14 Concentrators
  - 3 Smelters
  - 2 Refineries
  - 9 geographic operating areas

Business Challenge

- Large number of instruments across the group approximately 100,000

- Large amount of data, approx. 700,000 variables are logged

- Mineral processing plants are a harsh environment for instruments

- Instruments form the basis of all control and information systems

- Certain instruments are critical to safety.

- The quality of the data leads to better quality of information

- Anglo American Platinum need a mechanism to:

  - Monitor the quality of the instrumentation/data

  - Clean/Reconstruct the data where practical

Enterprise Architecture
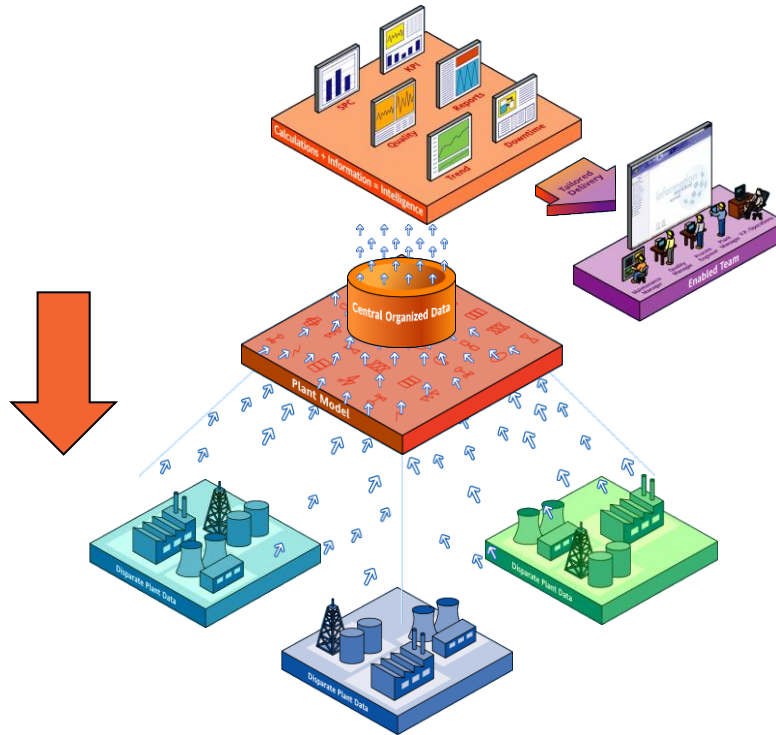
- Distributed Architecture - Limited Network Bandwidth

- Local Calculations

- Select Data Rolled-up to Central PI System

- Master PI Asset Framework Replicated to Sites

Process Flow Diagram For Concentrator Model

- Scaling the Enterprise into a UNIT Template

Crushing	Grinding	Flotation	Thickening	Tailings
Energy Ore Water	Energy Flow Water	Energy Flow Water	Energy Flow Water	Energy Flow Water

Plant Model

- The plant model provides context to the data

- The models are aligned to the S95/S88 standards

- The models are consistent across all sites

  - The models are maintained on the central PI System
  - The models are replicated to the sites.
  - This is currently a manual process. However, it will be "automated" shortly.

Asset Framework: Modeling and Analysis Tool
One element template called UNIT

Analytics

UNIT

Derived

Event Frames

Notifications

Time Intelligent Tagging (intervals) Event Frames
Time Derived Variables
  Min
  Max
  Standard Deviation
  Rate of Change
  Totalizers
Formulas for Inferential Calculations
Pulse Estimation
Notifications for ACTION

PI Analytics. EventFrames Business Rules Triggers

Plant History of all Events for all UNIT based on the BASIC UNIT TEMPLATE.

Classification of Gross Errors

Classification of states: Good, Troubles, Not Running, Missing, Inferred, NA

Operational Management Report

Assets Optimization Report
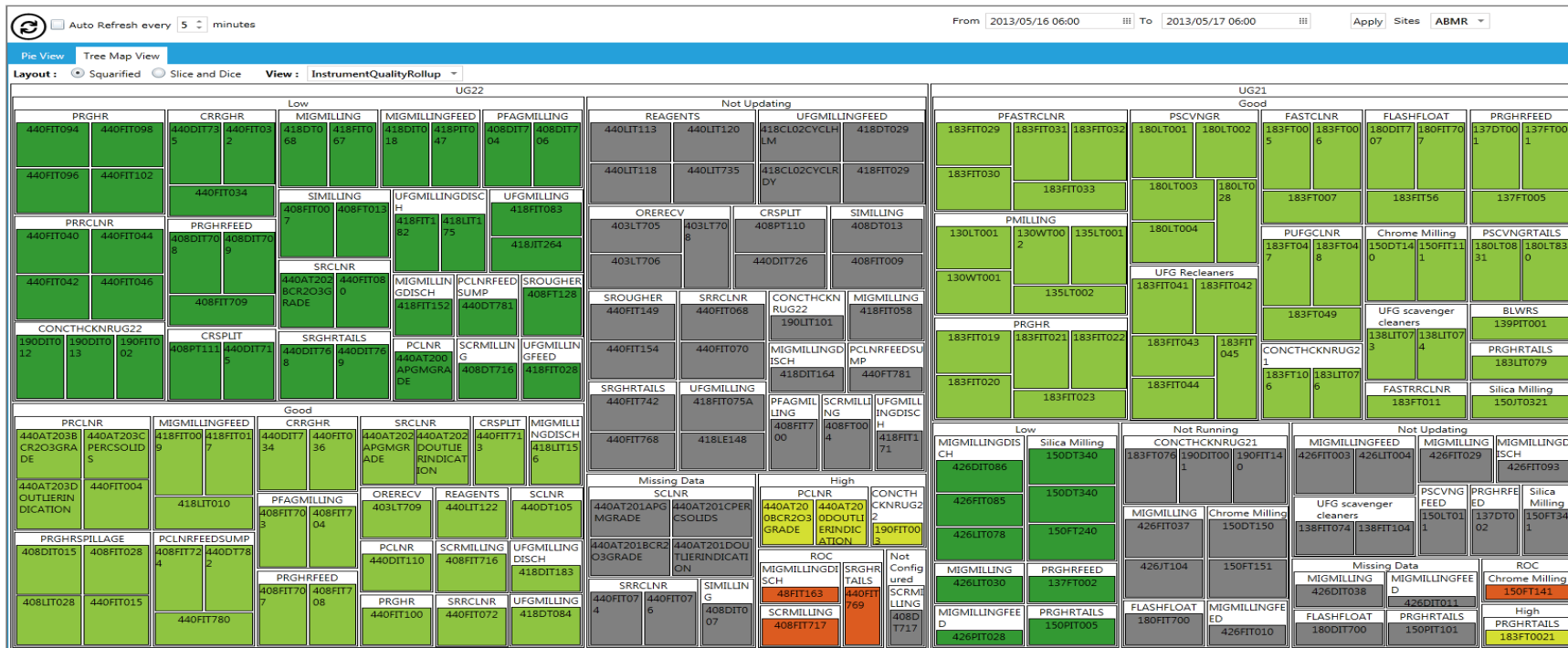
Microsoft BI with PI - Architecture

PI Real-Time Data

OLAP Cubes

Data Warehouse

SAP

LOB

Microsoft PerformancePoint

Excel Services & DLES

Reporting Services

OSIsoft PI WebParts & other Web Parts
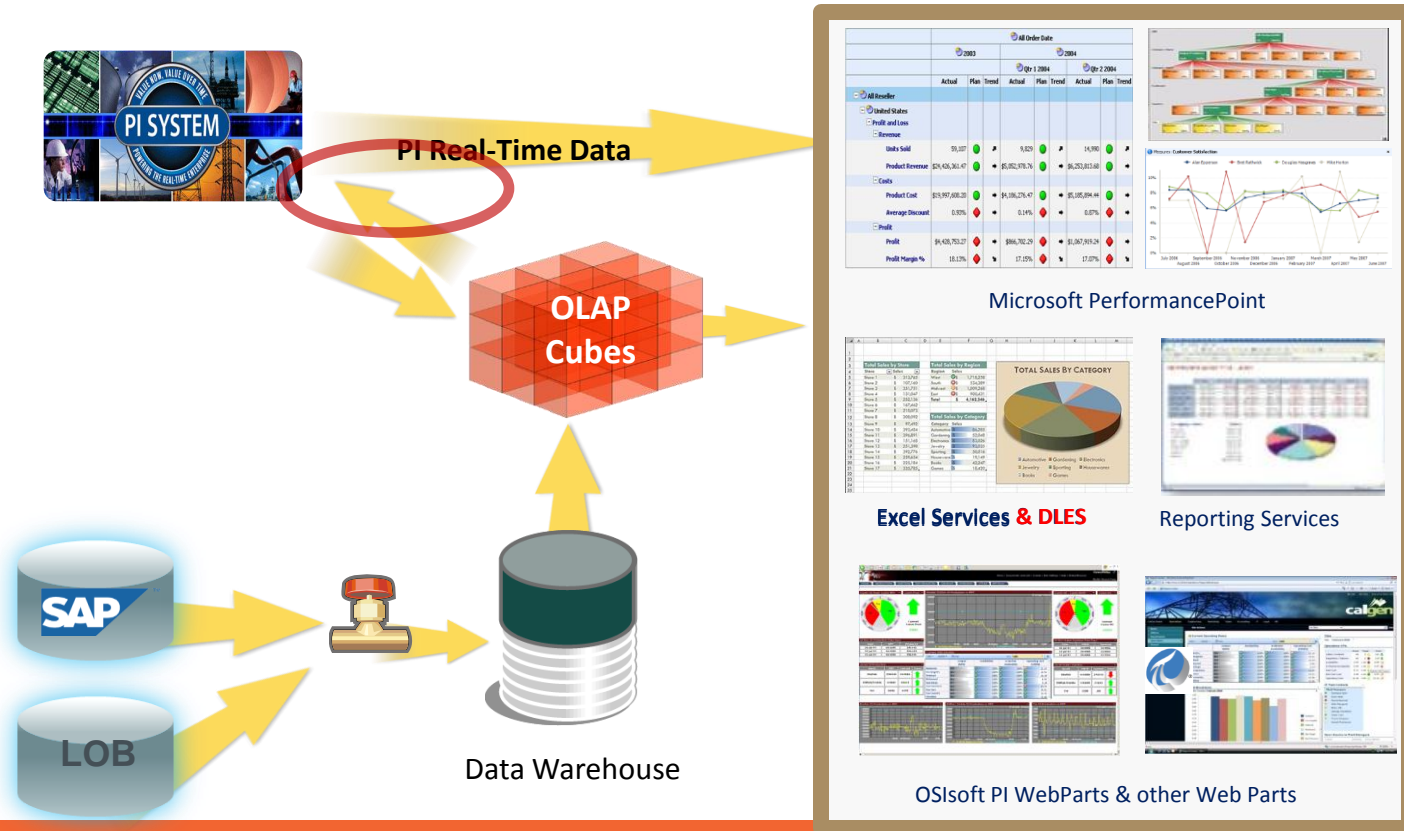
Real Time Operational Monitoring and Diagnostic Center

Anglo Platinum - Energy Monitoring

"Implementing high level metrics and analyses linked to production clearly shows were the power is used allowing focused energy reduction initiatives. A roll out to the concentrators is in the planning stages. Due to the scale of the concentrator operations the potential benefits are enormous."

Thobile Mukuna
Process Engineer
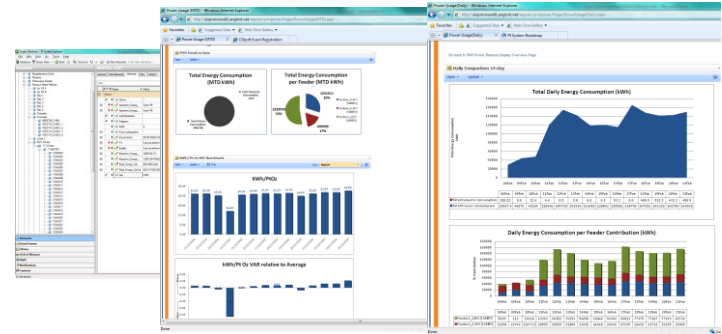
Business Challenge

- Large electricity consumption - 450 GWh/month
- Target 15% reduction in electricity consumption 2008 to 2014
- Company-wide integrated approach to energy saving is required

Solution

- Use PI AF - granularity and roll-up
- Visibility - power use at every level
  - PI WebParts and SharePoint, Silverlight
- High level metrics - KPIs
- Provided ability for users to drill down to every level of granularity

Results and Benefits

- Enterprise visibility of all electrical consumption
- Significant time reduction for analysis
- Easy construction of BI cubes
- Just making the data visible resulted in a 1% reduction in electrical power use.

Solution – Based on Event Frames
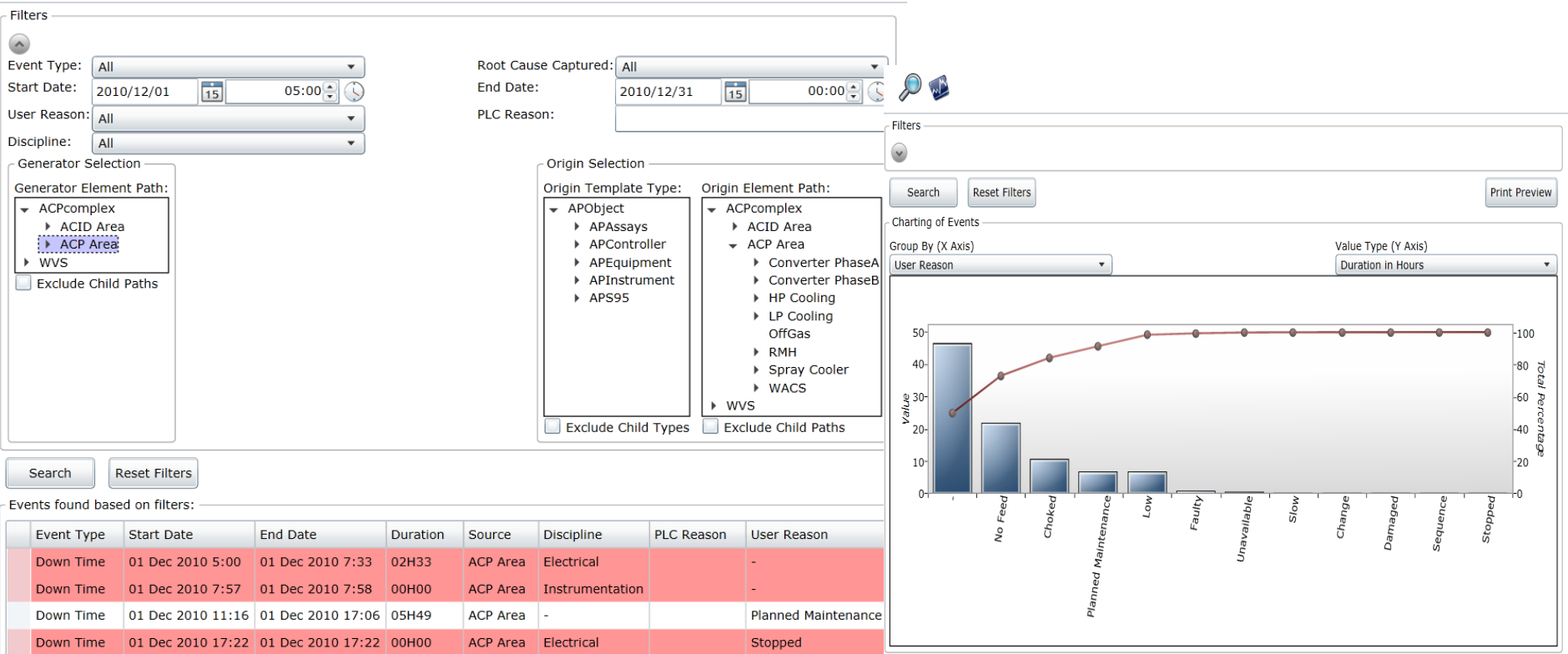
Anglo Platinum – Process Diary

Started out with condition based maintenance in mind. The resulting "Process Diary" can be used for Downtime, Slowtime, KPI's, basically anything that can be configured."

Michael Halhead
Lead Process Control Engineer
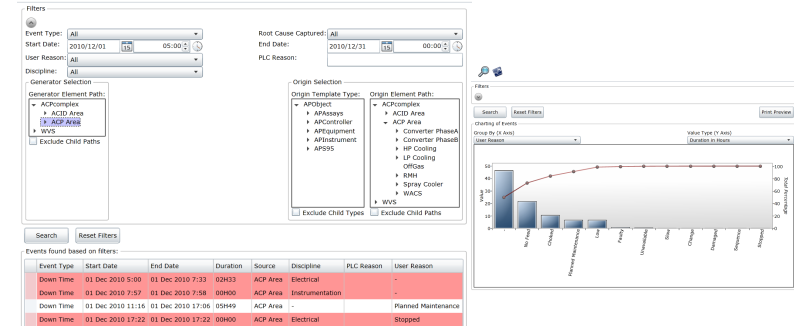
Business Challenge

- Non-standard methods
- Time consuming
- Replace Excel solution
- Provide Enterprise easily configurable solution

Solution

- PI Event Frames and PI AF
- PI ACE to create events, now PI EV
- Custom Silverlight screens using PI AF controls

Results and Benefits

- Time savings
- Enterprise-wide standardization
- Flexibility – not just CBM
- Compare years of data
- User configurable

Conclusion

- A large number of OSIsoft's products have been used to complete this solution in under 2 months using only internal staff
- The Enterprise Agreement (EA) facilitates the solution by:
- Technical Support 24hrs 7 days 365 days per years
- Center of Excellence (COE) advice and strategic recommendations
- Unlimited product license, no tag counting, multiple interfaces.
- The Network Operating Center (NOC) OSIsoft effectively monitors the overall health of the integrated systems which has proven to be invaluable.
- Continuous Support and Innovations as new implementations are uncovered

OSIsoft.

Conclusions

- ✓ **Dynamic Performance Management Infrastructure with Centralized Operational Collaborative Services**

- ✓ **PI Asset Framework standardization and cross-pollination at the local plant and at the Enterprise**

- ✓ **PI Asset Notification and PI Real Time Process Analytics using Performance Metrics and Statistical Tools**

- ✓ **Visibility Using Internet Web Services with standard BI tools.**

- ✓ **RESULTS: Improvements in sustainability management with large operational cost reductions**

Thanks for your attention

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