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USERS CONFERENCE 2016

April 4-8, 2016 | San Francisco

TRANSFORM YOUR WORLD

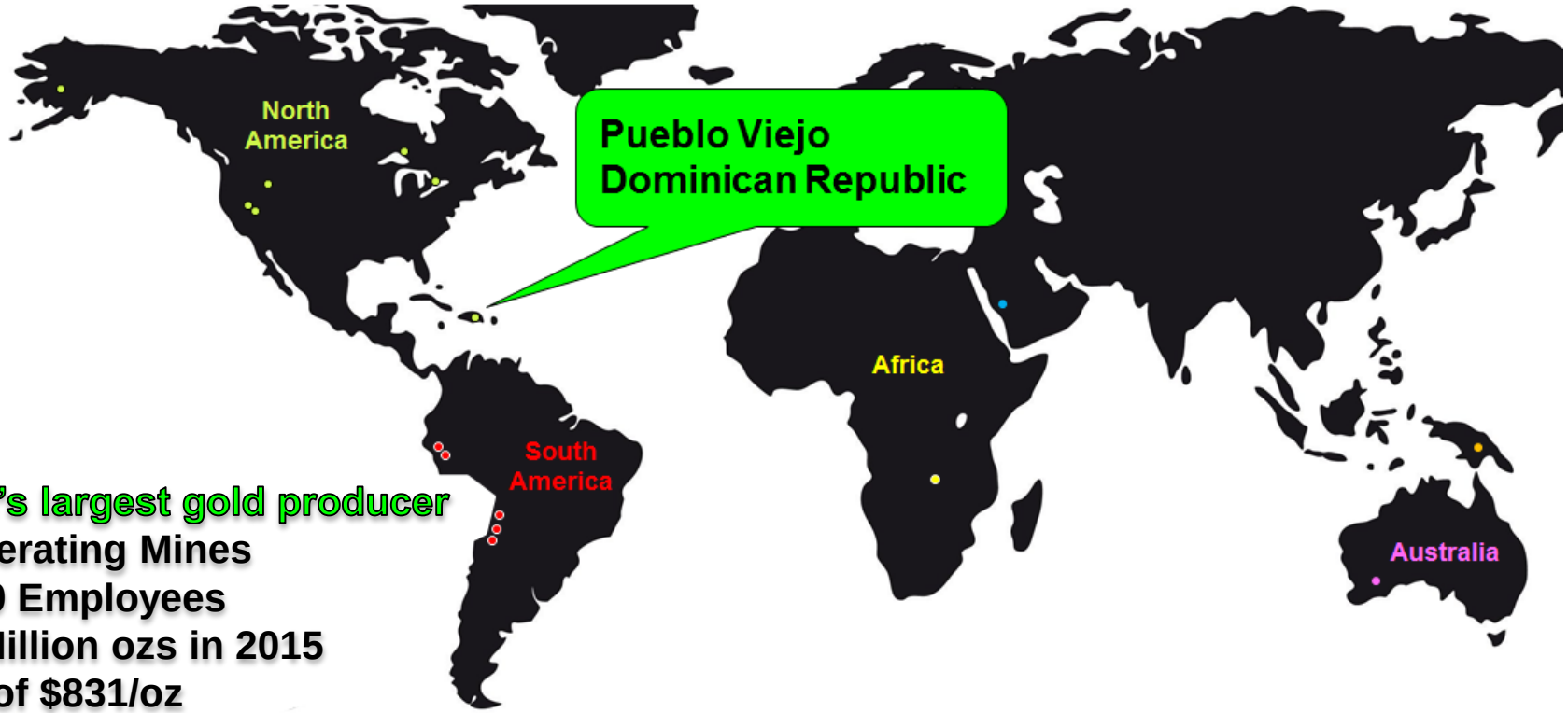
Operational Excellence with the PI System at Barrick Gold

Presented by **Lucas Marte,**
Metallurgy Technician
Barrick Gold Corporation- Pueblo Viejo

Agenda

- Introduction
- Company Background
- Business Drivers
- Implementation Details
- Results Obtained and Business Impact
- Summary
- Conclusion

Barrick Gold: A global Company



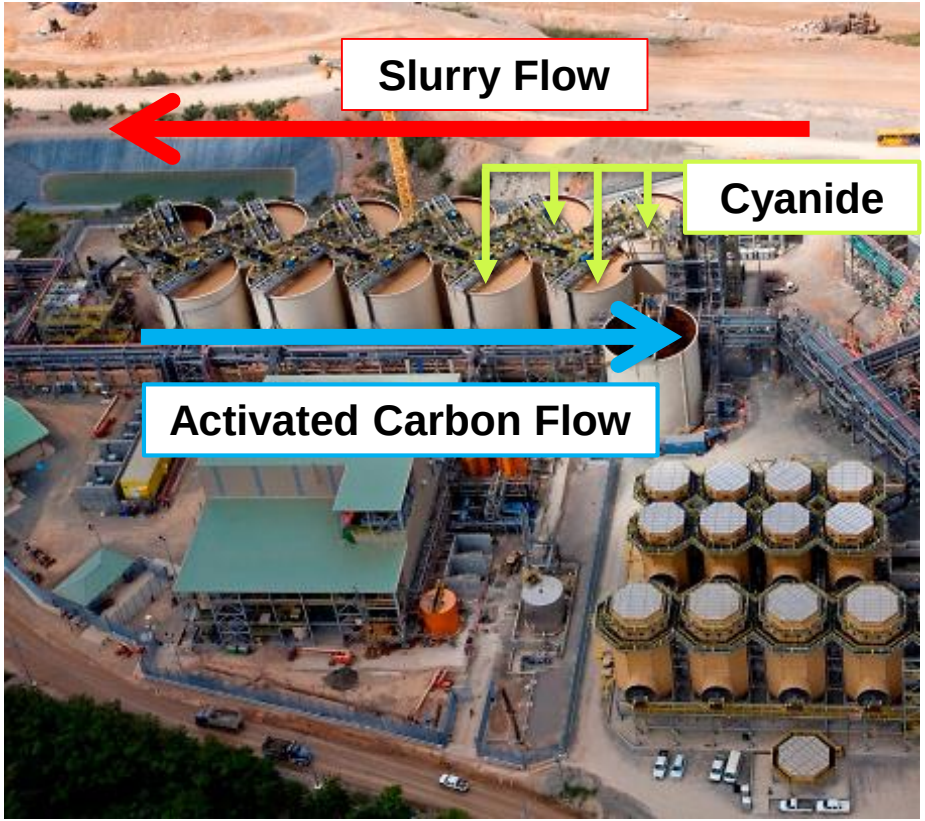
- World's largest gold producer
- 14 Operating Mines
- 17,500 Employees
- 6.12 Million ozs in 2015
- AISC of $831/oz

Barrick Gold Pueblo Viejo

- We are processing 24,000 ton/day, generates revenue of over $ 4,000,000 per day
- More than 2000 employees
- Pueblo Viejo produced 3 million ounces of gold in last 3 years

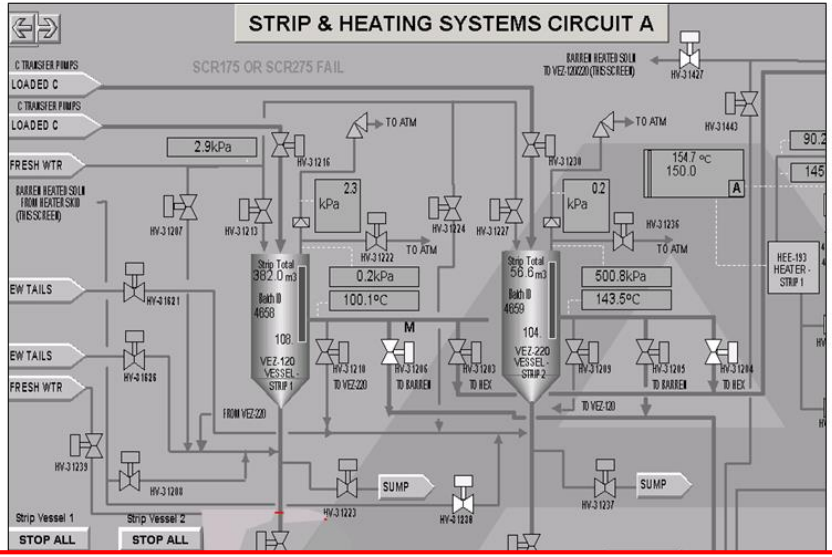
CIL Circuit

- CIL circuit is a continuous process.
- Cyanide is added in numerous tanks to dissolve gold and silver
- The dissolved gold and silver is adsorbed by activated carbon
- Activated Carbon is pumped countercurrent to the slurry to improve adsorption
- Loaded carbon is then stripped and regenerated in batches and returned to the CIL circuit



Metal Recovery Circuit (Acid Wash, Elution, Electrowinning)

- Metal recovery circuit recovers the metal from the loaded carbon and produces a sludge of gold and silver to be smelted
- 4 Acid wash columns (AW) to clean carbon
- 4 Elution columns (EL) (2 columns per parallel electrowinning circuits) – recover and produce sludge
- Carbon is then pump to regeneration kiln or returned to the CIL circuit



PROBLEM: Carbon can be pumped from any AW column to any EL column. Tracking was manual and paper based.

Barrick Business Drivers

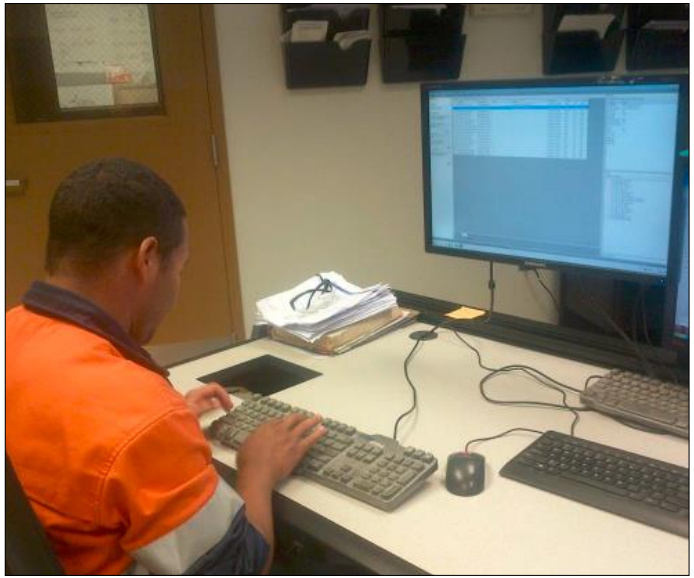
- Drive **report time reduction** through creation of a smart structure
- Drive **operator decision improvement** through **Real-time information**
- Drive **High-Speed scalability** while improving **Business impact** and **operational efficiency**
- Drive **standard data collection** and calculation of metrics for reporting

Based Design Smart Structure - Requirements

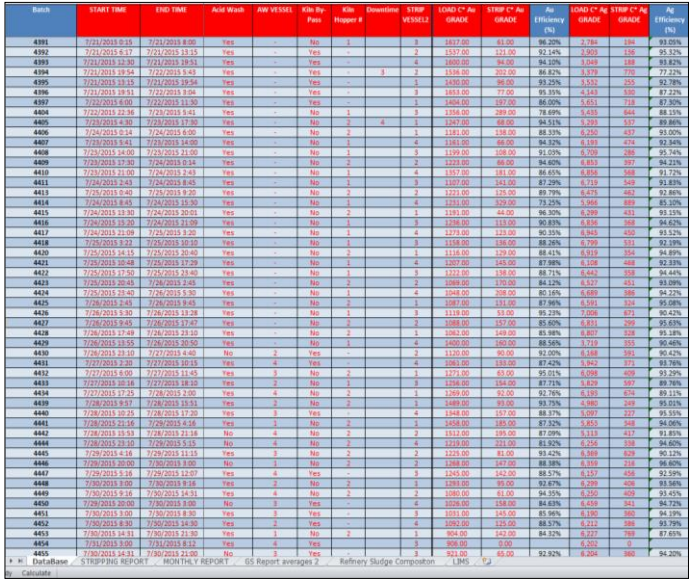
- Use **Asset Framework** to automatically generate batches
- Build up attributes to get **Streaming Data**
- Create **Connectivity** between different databases
- Handle **Big Data** to generate reports automatically
- **Visualize** Batch ID in the DCS Screen **(Real-time)**
- Change paradigms, based on actions plan to get a positive **Business Impact**

Change paradigms, First step

Previous method for data entry



Manual Data entry



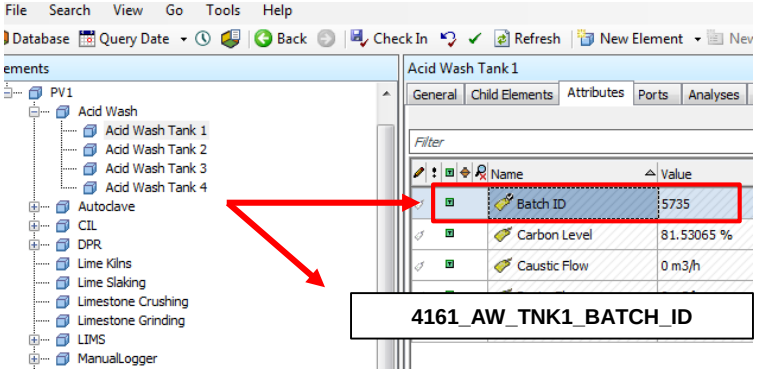
Batch	START TIME	END TIME	Acid Wash	AW VESSEL	Kiln By Pass	Kiln Hopper #	Downtime	STRIP VESSEL	LOAD C° Au GRADE	STRIP C° Au GRADE	Au Efficiency (%)	LOAD C° Ag GRADE	STRIP C° Ag GRADE	Ag Efficiency (%)
4391	7/21/2015 0:15	7/21/2015 8:00	Yes	-	No	1		3	1617.00	61.00	96.20%	3,784	184	93.05%
4392	7/21/2015 6:17	7/21/2015 13:15	Yes	-	Yes	-		2	1537.00	121.00	92.14%	3,903	136	95.32%
4393	7/21/2015 12:30	7/21/2015 19:31	Yes	-	Yes	-		4	1600.00	94.00	94.10%	3,049	188	93.82%
4394	7/21/2015 19:54	7/22/2015 5:43	Yes	-	Yes	-	3	3	1536.00	202.00	86.82%	3,379	770	77.22%
4395	7/21/2015 13:15	7/21/2015 19:54	Yes	-	Yes	-		1	1430.00	96.00	93.25%	3,532	255	92.78%
4396	7/21/2015 19:51	7/22/2015 3:04	Yes	-	Yes	-		3	1653.00	77.00	95.35%	4,143	530	87.22%
4397	7/22/2015 6:00	7/22/2015 11:30	Yes	-	Yes	-		1	1404.00	197.00	86.00%	5,651	718	87.30%
4404	7/22/2015 22:36	7/23/2015 5:41	Yes	-	No	1		3	1356.00	289.00	78.69%	5,435	644	88.15%
4405	7/23/2015 4:30	7/23/2015 17:30	Yes	-	No	2	4	1	1247.00	88.00	94.51%	3,293	537	89.86%
4406	7/24/2015 0:14	7/24/2015 6:00	Yes	-	No	2		1	1181.00	138.00	88.33%	6,250	437	93.00%
4407	7/23/2015 5:41	7/23/2015 14:00	Yes	-	No	1		4	1161.00	66.00	94.32%	6,193	474	92.34%
4408	7/23/2015 14:00	7/23/2015 21:00	Yes	-	No	1		3	1199.00	108.00	91.05%	6,709	286	95.74%
4409	7/23/2015 17:30	7/24/2015 0:14	Yes	-	No	2		2	1223.00	66.00	94.60%	6,853	397	94.21%
4410	7/23/2015 21:00	7/24/2015 2:43	Yes	-	No	1		4	1357.00	181.00	86.65%	6,856	568	91.72%
4411	7/24/2015 2:43	7/24/2015 8:45	Yes	-	No	1		3	1107.00	141.00	87.29%	6,719	549	91.83%
4413	7/25/2015 0:40	7/25/2015 9:20	Yes	-	No	2		2	1223.00	125.00	89.79%	6,475	462	92.86%
4414	7/24/2015 8:45	7/24/2015 15:30	Yes	-	No	1		4	1231.00	329.00	73.25%	5,968	689	85.10%
4415	7/24/2015 13:30	7/24/2015 20:01	Yes	-	No	2		1	1191.00	44.00	96.30%	6,299	431	93.15%
4416	7/24/2015 15:20	7/24/2015 21:09	Yes	-	No	1		3	1296.00	113.00	90.83%	6,836	368	94.62%
4417	7/24/2015 21:09	7/25/2015 3:20	Yes	-	No	1		4	1273.00	123.00	90.35%	6,945	450	93.52%
4418	7/25/2015 3:22	7/25/2015 10:32	Yes	-	No	1		3	1158.00	138.00	88.26%	6,799	551	92.19%
4420	7/25/2015 14:15	7/25/2015 20:40	Yes	-	No	2		1	1116.00	129.00	88.41%	6,919	354	94.89%
4421	7/25/2015 10:48	7/25/2015 17:29	Yes	-	No	1		4	1207.00	145.00	87.98%	6,108	468	92.33%
4422	7/25/2015 17:50	7/25/2015 23:40	Yes	-	No	1		3	1222.00	158.00	88.71%	6,442	358	94.44%
4423	7/25/2015 20:45	7/26/2015 2:45	Yes	-	No	2		2	1069.00	170.00	84.12%	6,527	451	93.09%
4424	7/25/2015 23:40	7/26/2015 5:30	Yes	-	No	1		4	1048.00	208.00	80.16%	6,689	386	94.22%
4425	7/26/2015 2:45	7/26/2015 9:43	Yes	-	No	2		1	1087.00	131.00	87.96%	6,591	324	95.08%
4426	7/26/2015 5:30	7/26/2015 13:28	Yes	-	No	1		3	1119.00	53.00	95.23%	7,006	871	90.42%
4427	7/26/2015 9:45	7/26/2015 17:47	Yes	-	No	2		2	1088.00	157.00	85.60%	6,831	299	95.63%
4428	7/26/2015 17:49	7/26/2015 23:10	Yes	-	No	2		1	1062.00	149.00	85.98%	6,807	328	95.18%
4429	7/26/2015 13:55	7/26/2015 20:50	Yes	-	No	1		4	1400.00	160.00	88.58%	6,719	555	90.48%
4430	7/26/2015 23:10	7/27/2015 4:40	No	2	Yes	-		2	1120.00	90.00	92.00%	6,188	591	90.42%
4431	7/27/2015 2:30	7/27/2015 10:15	Yes	4	Yes	-		4	1061.00	133.00	87.42%	5,942	371	93.76%
4432	7/27/2015 6:00	7/27/2015 11:45	Yes	3	No	2		1	1271.00	65.00	95.01%	6,098	409	93.29%
4433	7/27/2015 10:16	7/27/2015 18:10	Yes	2	No	1		3	1296.00	184.00	87.71%	5,829	597	89.76%
4434	7/27/2015 17:25	7/28/2015 2:00	Yes	4	No	2		1	1269.00	92.00	92.76%	6,195	674	89.11%
4439	7/28/2015 9:57	7/28/2015 15:31	Yes	2	No	2		1	1489.00	93.00	93.75%	6,980	249	95.01%
4440	7/28/2015 10:25	7/28/2015 17:20	Yes	3	Yes	-		4	1348.00	157.00	88.37%	6,097	227	95.55%
4441	7/28/2015 21:16	7/29/2015 4:16	Yes	1	No	2		1	1458.00	185.00	87.32%	5,853	348	94.06%
4442	7/28/2015 13:53	7/28/2015 21:16	No	4	No	2		2	1512.00	195.00	87.09%	5,113	417	91.85%
4444	7/28/2015 23:10	7/29/2015 5:15	No	4	No	2		4	1219.00	221.00	81.92%	6,256	538	94.60%
4445	7/29/2015 4:16	7/29/2015 11:15	Yes	3	No	2		2	1223.00	81.00	93.42%	6,589	629	90.12%
4446	7/29/2015 20:00	7/30/2015 3:00	No	1	No	2		2	1268.00	147.00	88.38%	6,359	218	96.60%
4447	7/29/2015 5:16	7/29/2015 12:07	Yes	4	Yes	-		3	1245.00	142.00	88.57%	6,157	458	92.59%
4448	7/30/2015 3:00	7/30/2015 9:16	Yes	2	No	2		1	1398.00	95.00	92.87%	6,299	426	93.56%
4449	7/30/2015 9:16	7/30/2015 14:31	Yes	4	No	2		2	1080.00	61.00	94.35%	6,250	409	93.45%
4450	7/29/2015 20:00	7/30/2015 3:00	No	3	Yes	-		4	1026.00	158.00	84.63%	6,459	341	94.72%
4451	7/30/2015 3:00	7/30/2015 8:30	Yes	3	Yes	-		3	1031.00	145.00	85.96%	6,190	560	94.19%
4452	7/30/2015 8:30	7/30/2015 14:30	Yes	2	Yes	-		4	1092.00	125.00	88.57%	6,211	386	93.79%
4453	7/30/2015 14:31	7/30/2015 21:30	Yes	1	No	2		1	904.00	142.00	84.32%	6,227	769	87.65%
4454	7/31/2015 3:00	7/31/2015 8:12	Yes	4	Yes			3	908.00	0.00		6,202	0	
4455	7/30/2015 14:31	7/30/2015 21:00	No	3	Yes	-		3	921.00	65.00	92.92%	6,204	380	94.20%

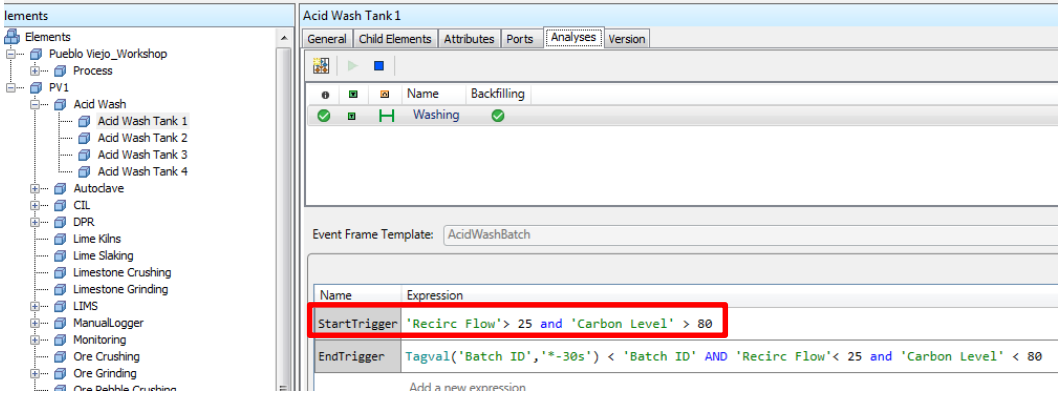
DataBase | STRIPPING REPORT | MONTHLY REPORT | GS Report averages 2 | Refinery Sludge Composton | LIMS | Calculate

Smart Structure – Asset Framework (AF)

- Batch ID Creations
- Easy **Trigger Definition** based on DCS

Once the Acid wash column is loaded (above 80%) and the acid flow reaches 25 m3/h the Batch ID is created and subsequently transferred to the correct elution column with the carbon

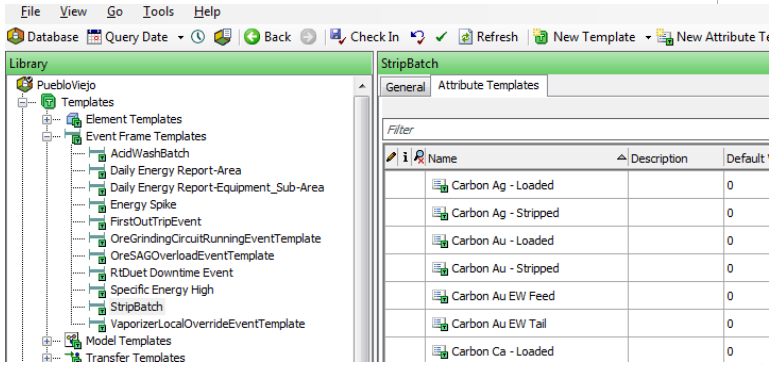




Smart Structure – Asset Framework (AF) - Create attributes

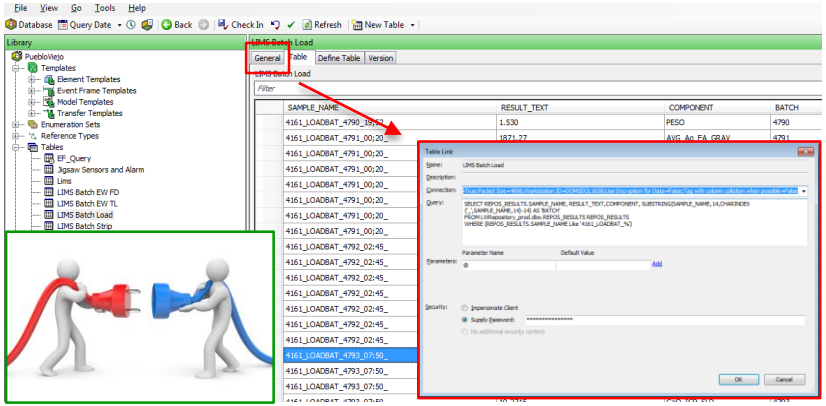
Advantages:

- **Scalability**
- No **Big Data** on the excel spreadsheet
- More **Reliability**
- More **Security**- Information on the **PI Server**

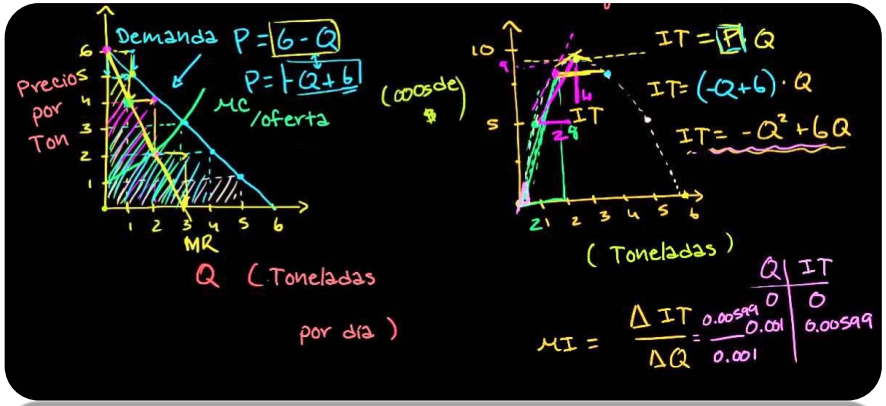


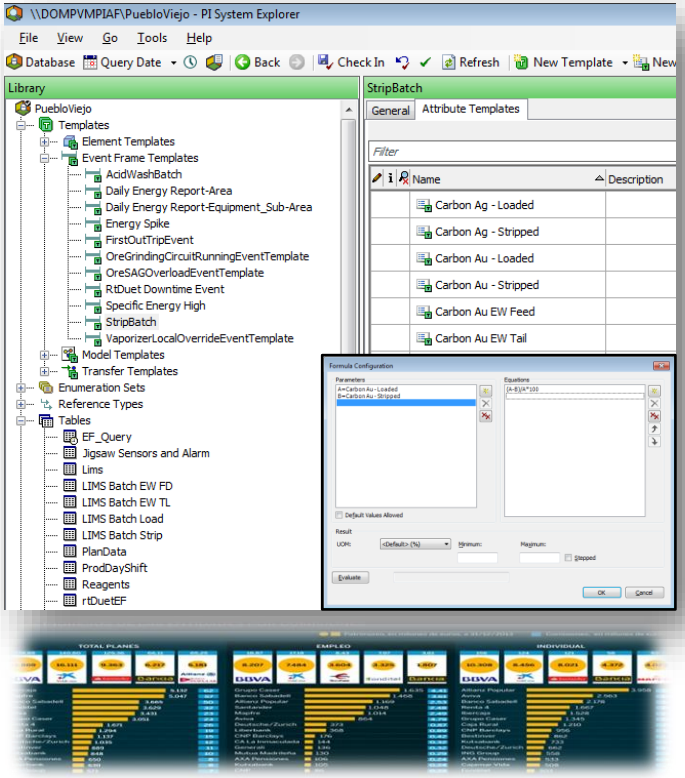
Easy Connection to LIMS (Laboratory Information Management System)

- **Flexibility** to source information from different sources making a more robust infrastructure **(Connectivity)**



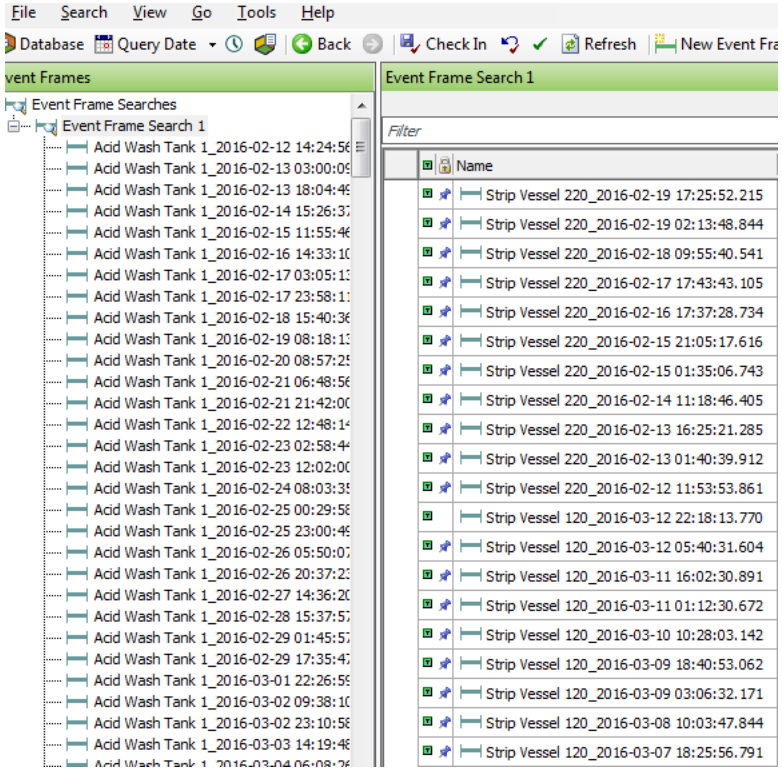
Smart Structure – Asset Framework - Calculating Efficiencies





- All **Calculations** are now performed on the **PI Server,** not on your personal computer

Event Frames, more than a Solution



Critical Component

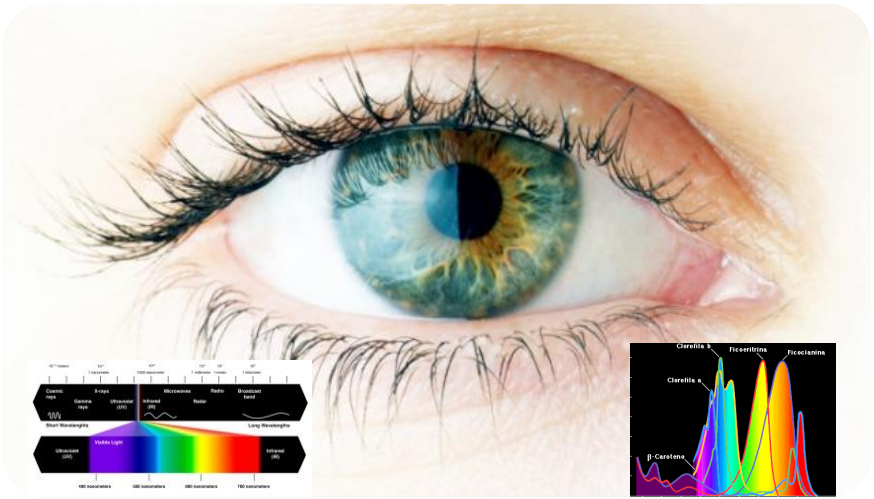
Problem

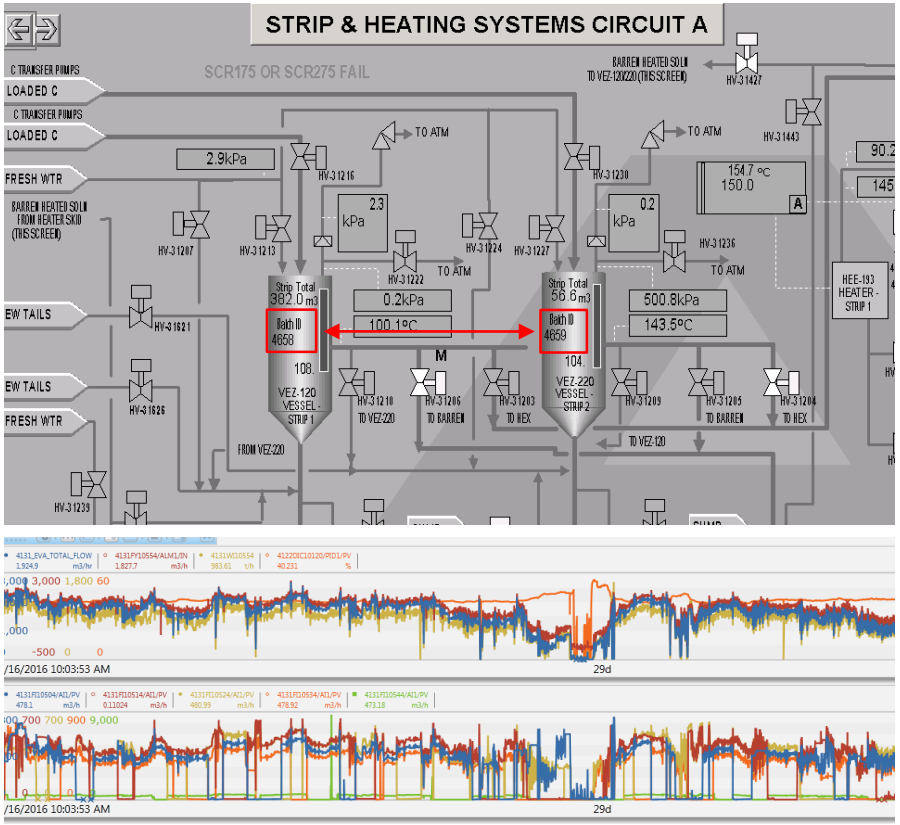
We had a problem getting the event frames to update with PI System data *after* the event frame was closed.

Solution

“OSIsoft worked with a Barrick engineer ”(**Aldo Vasquez**) to create a custom script to automatically update the event frame”

Visualize Batch ID in the DCS Screen-The advantage of seeing





Automate Contained Metal Inventory Logsheet

Automatically Generate Strip Report

- **Batch** Creations in AF
- **Attribute** Creations in AF
- Make **Connection** between the LIMS/PI System and AF database
- Calculating **Efficiencies** in AF
- Use **Event Frames**

BARRICK
PUEBLO VIEJO

CARBON STRIPPING REPORT

Date 24-Sep-15
By: Marte Abreu, Lucas

Send Report
Publish to Web

#Strips to Date: 134
Kiln by-pass count: 35
Operating Parameters: *Pi calculations:*
Batch#, Date, Duration: *Operator Sheets:*

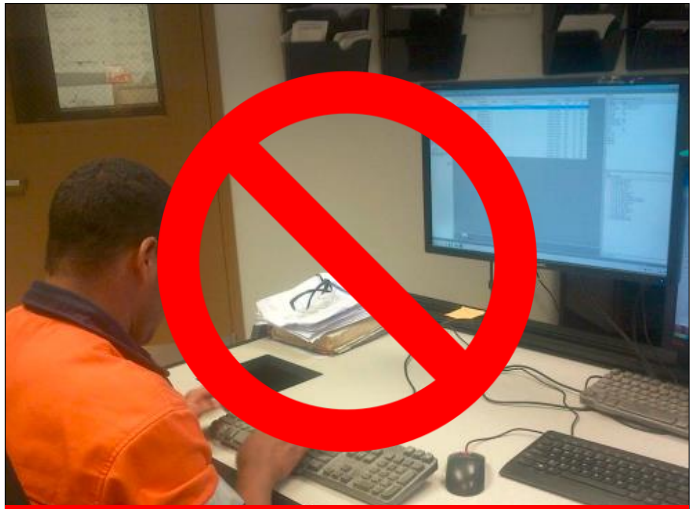
MONTH 9
YEAR 2015
Refresh Data

Day	Batch	Kiln By-Pass (Yes/N	Kiln Hopper	AW VESSEL	Acid Wash (Yes/N	AW Efficiency (%)	Au Efficiency (%)	LOAD C Au GRADE	Strip Carb Au (gpt)	Ag Efficiency (%)	Load Carb Ag (gpt)	Strip Carb Ag (gpt)	Duration (hrs)	Temp (°C)	FLOW (m3)	Flow (m3/h)	NaCN (ppm)	NaOH (%)	EW Cell Efficiency (%)
25	4791	Yes	-	1	Yes			890			1871		7.0	140	332	48	534	1.83	
	4792	No	1	3	Yes			957			2061		8.0	130	397	51	550	1.89	
24	4783	No	1	1	Yes		80.8%	1278	246	94.4%	2243	125	8.4	123	441	53	524	1.93	80%
	4784	Yes	-	3	Yes	18%	95.7%	1714	73	95.0%	1936	96	8.5	138	367	47	543	1.91	72%
	4785	No	1	4	Yes		86.7%	1356	181	94.2%	2121	123	6.9	131	349	52	491	2.08	85%
	4786	Yes	-	2	Yes				168			130	7.5	141	352	47	550	1.86	65%
	4787	Yes	2	1	Yes		73.8%	960	252	92.7%	2124	156	6.5	140	297	48	492	1.78	47%
	4788	No	1	3	Yes		70.4%	935	277	91.6%	1982	167	6.8	129	295	51	513	1.86	53%
	4789	Yes	-	4	Yes			907			1856		6.2	141	308	49	510	1.90	
	4790	No	1	2	Yes			891			1891		5.3	130	296	52	540	1.91	
23	4778	No	1	2	Yes	27%	86.7%	1249	166	94.1%	2151	127	7.3	128	274	37	525	2.05	88%
	4779	Yes	2	1	Yes	36%	92.0%	1312	105	95.6%	1935	85	6.5	140	281	48	600	1.98	70%
	4781	No	1	4	Yes		91.6%	1128	33	93.5%	2007	131	9.0	128	309	37	519	2.01	39%
	4782	Yes	2	2	Yes	17%	79.2%	1301	271	95.8%	2046	85	6.9	136	351	49	522	1.94	34%
22	4763	No	1	3	Yes	27%	86.4%	814	111	95.6%	1836	81	6.7	123	133	45	525	2.05	90%
	4771	Yes	-	2	Yes	45%	83.5%	928	153	94.6%	1977	106	7.0	138	262	46	600	1.98	88%
	4773	Yes	-	4	Yes		84.4%	836	140	90.3%	1785	173	5.2	138	257	49	600	1.98	70%
	4775	No	2	1	Yes	16%	49.3%	1050	532	89.8%	1901	194	5.7	137	292	49	600	1.98	88%
	4776	No	1	3	Yes	30%	85.3%	1103	155	91.8%	2016	165	8.5	128	313	41	525	2.05	84%
	4777	No	2	4	Yes		87.2%	1229	157	95.3%	2137	103	6.3	136	303	48	600	1.98	82%
	4780	No	1	3	Yes	43%	78.1%	1156	255	89.5%	2065	217	5.4	136	303	49	600	1.98	34%
21	4765	No	1	4	Yes		87.7%	887	109	96.3%	1948	73	6.6	125	241	43	525	2.05	90%
	4766	No	2	1	Yes		79.0%	995	209	89.6%	2202	230	6.3	127	266	47	600	1.98	83%
	4767	Yes	1	2	Yes	28%	89.9%	937	95	96.8%	2015	85	7.5	130	361	48	600	1.98	83%
	4768	No	-	3	Yes	37%	82.6%	877	328	93.0%	1870	131	6.4	119	241	48	525	2.05	75%
	4769	No	1	4	Yes		92.6%	848	63	97.3%	1793	48	7.0	125	293	46	525	2.05	
	4770	No	2	1	Yes	19%	64.4%	971	346	92.5%	1946	145	7.0	129	301	48	600	1.98	75%
	4772	No	2	3	Yes				54			45	7.8	125	299	47	525	2.05	93%
	4774	No	2	2	Yes	11%		967			2089		7.2	126	241	47	525	2.05	84%
20	4758	No	1	4	Yes		90.3%	1240	113	94.4%	2002	113	10.1	130	283	36	525	2.05	92%
	4760	No	1	3	Yes	32%	75.3%	1200	289	93.5%	2169	142	11.4	128	313	36	525	2.05	93%
	4761	No	2	4	Yes	13%	78.6%	892	191	95.6%	1864	82	7.3	129	262	48	600	1.98	30%
	4762	Yes	2	1	Yes	31%	67.4%	854	278	90.2%	1343	131	7.4	130	321	48	600	1.98	92%

The PI System =

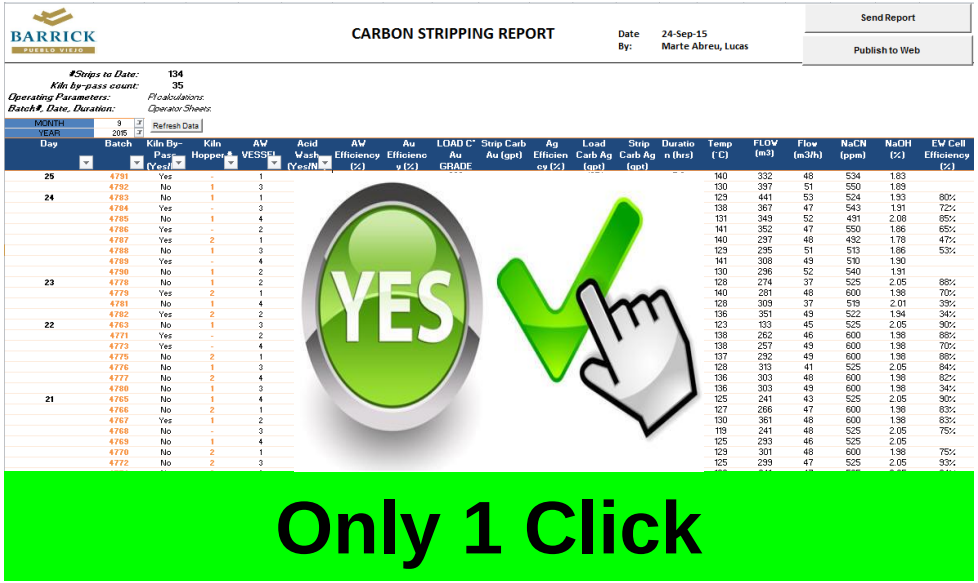
Automatically Generate Strip Report

Before



30 Minute entering manual values

After

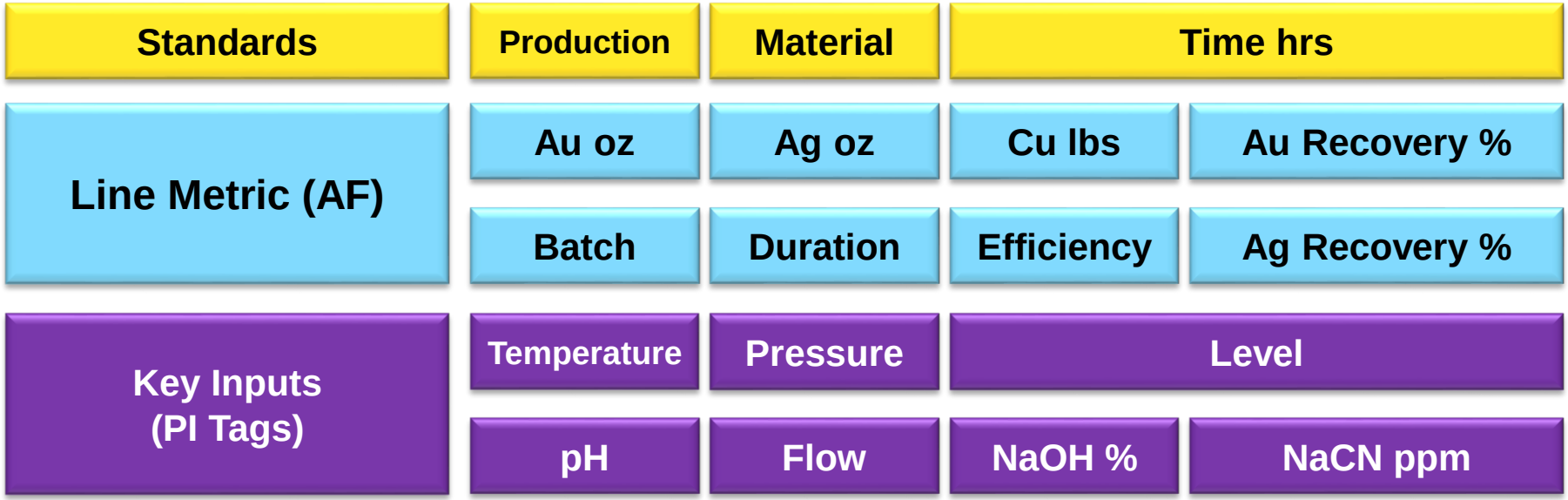


Only 1 Click

Create PI Coresight for Batch by Vessel, tank level, flows

- **PI ProcessBook and PI Coresight**
- **Visibility**
- **Data Integration**
- **Availability**

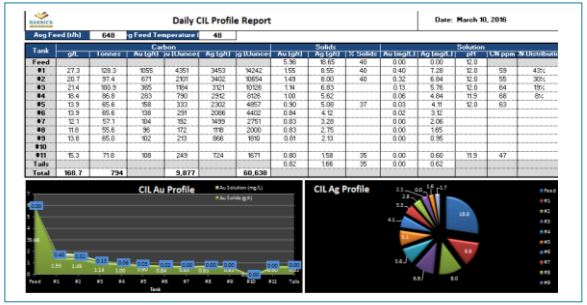
Key Performance Indicators- The PI System



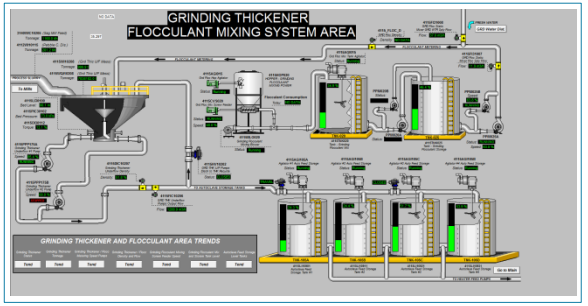
Barrick's Platform Intelligence - The PI System

PI Coresight

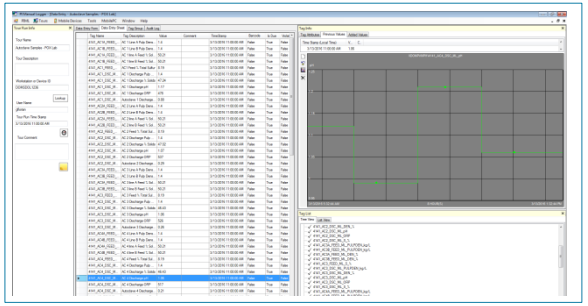
Now Real-Time information is available everywhere for everyone



PI DataLink



PI ProcessBook



Manual Logger

Benefits

- **Save 85%** of the time spent to update reports
  - Able to finished report in 4.5 minutes vs. 30 minutes
- **No more wrong data** due to manual entry
- Better decision based on **Real-time data**
- More control in the operations based on online **Data Visualization**
- Improved tracking for metal accounting **“Contained Metal Inventory”**

Future Plans

- Implement Training in **Asset Framework** for all member of team
- Implement **Asset Framework** in another areas
- Expand **Event Frames**
  - **Automate Metal Reconciliation**
- Involved Operation Team in a Global Project to increase **Business Impact**

Conclusion

- The less time we spend on repetitive tasks, the more time available to **Add Value**
- The PI System has been a powerful tool to achieve **Operational Excellence**

Operational Excellence with the PI System at Barrick Gold

COMPANY and GOAL

Barrick Pueblo Viejo, spends many hours a day to prepare manual reports, and wanted to **Reduce report preparation time, improve data quality and improve tracking of batch processes**

BARRICK
PUEBLO VIEJO

CHALLENGE

Recovery process is a batch process with various vessels in parallel. Required review of operator written records and PI System data collection manually.

- Manual data entry, increasing the probability of generating erroneous data.

SOLUTION

Used Asset Framework to create automatic batches, and build up a robust scalable platform which populates reports.

- 'Now we can see how with a single click, reports are updated and how PI System works for us. That is a beautiful thing'

RESULTS

Save 85% of the time spent to update reports and more accurate data.

Allow easy comparison of process information between different batches

- Prepare report in 4.5 minutes vs. 30 minutes.
- No more wrong data by manually entry.

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Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session

http://ddut.ch/osisoft

감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

“Desire triggers motivation, motivation ignites action and action makes what’s desired possible”. **Lucas Marte**

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