

AVEVA PI WORLD

Merian Production Reporting

Metals Accounting Upgrade

Presented By: Daniel Qiao (MIPAC) and Yuanbin Qin (Newmont)

AVEVA



MIPAC & Newmont

- Newmont Merian
 - Newmont is the world's #1 gold producer with ~8M GEOs per year through 2030
 - Newmont Suriname is the managing partner of Merian mine owning a 75 percent interest
 - Open pit gold mine with 14 years estimated mine life and 448 Koz annual production
 - Closely partnering with the Surinamese government and adjacent communities to create value and improve lives through sustainable and responsible mining
- MIPAC
 - A global leader in operational technology, control systems and engineering services.
 - 100 Clients globally
 - 300 Projects Delivered
 - Aveva and OSISoft Partner with PI Accredited Engineers

Production Reporting

What's involved in production reporting for Newmont Merian?

- Plant production, KPIs and asset performance
 - Throughput
 - Availability
 - Grade
 - Recovery
 - Gold Production
- Comparison of actual results against budget and forecast
- Inventory of gold in the plant
- Shipment of product



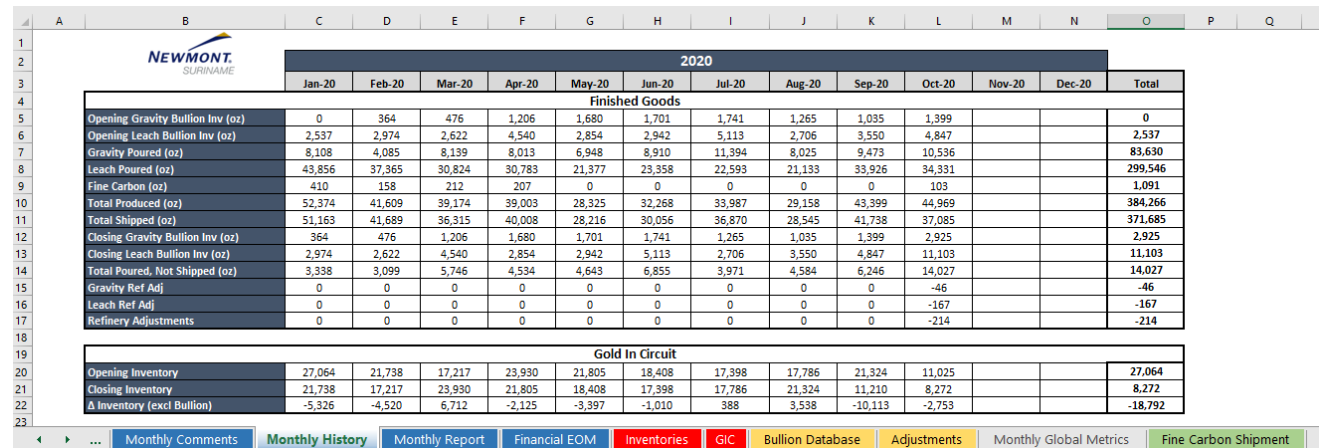
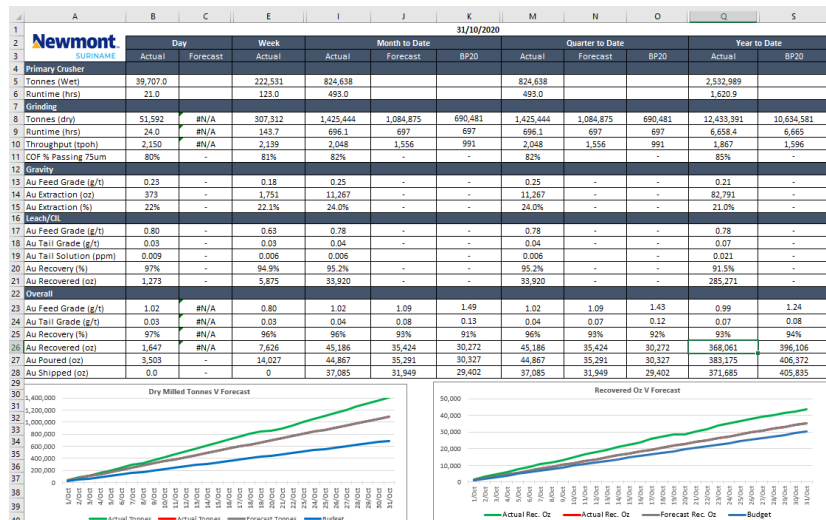
Business Case

Challenge

Business need

Production data, trends and metal accounting reports are manually created using manual data entry in excel. Combined with no real time production parameter trending or visualization for timely and informed decision making.

- Access to real time process data and trends is limited to control room operators
- Large amount of manual data entry and manual transfer of data between different systems to produce reports
- Limitations of Microsoft Excel, limited security options on sensitive data



Solution

Objectives

Migrate from Excel reporting to a modern web-based platform leveraging PI AF. Support the calculation and visualization of data over a user selectable time period.

- Facilitate visualization of Production KPIs to stakeholders (not limited to the control room)
- Automate Metals Accounting
- Automate Shift and Process reports
- Digitalize manual logsheets
- Integrate and consolidate data sources into a single repository



Elution Batch

01/01/2021 05:00:00 - 02/01/2021 05:00:00

GIC	Batch Number	Apparent Density	Level (%)
Acid Wash Column 1	12137	0.63	
Acid Wash Column 2	22221	0.63	
Elution Column 1	12136	0.61	
Elution Column 2	22220	0.61	
Kiln Hopper	22169	0.61	6.128717

csv

Comments

01/01/2021 05:00:00 - 02/01/2021 05:00:00

Value

Supervisor: Jason Kall

Operator: Shaylesh Herman

Comments

csv

Benefits

Data visualization



User selectable time period of plant and asset performance data readily available



A single source of truth derived from real time plant data for decision making



Plant and asset performance data readily available to view and share

Reporting



Streamlined daily, weekly and monthly metals reporting requirements



No manual transfer of data between systems required



Significant reduction in manual entry

Data security



Improved security and report access

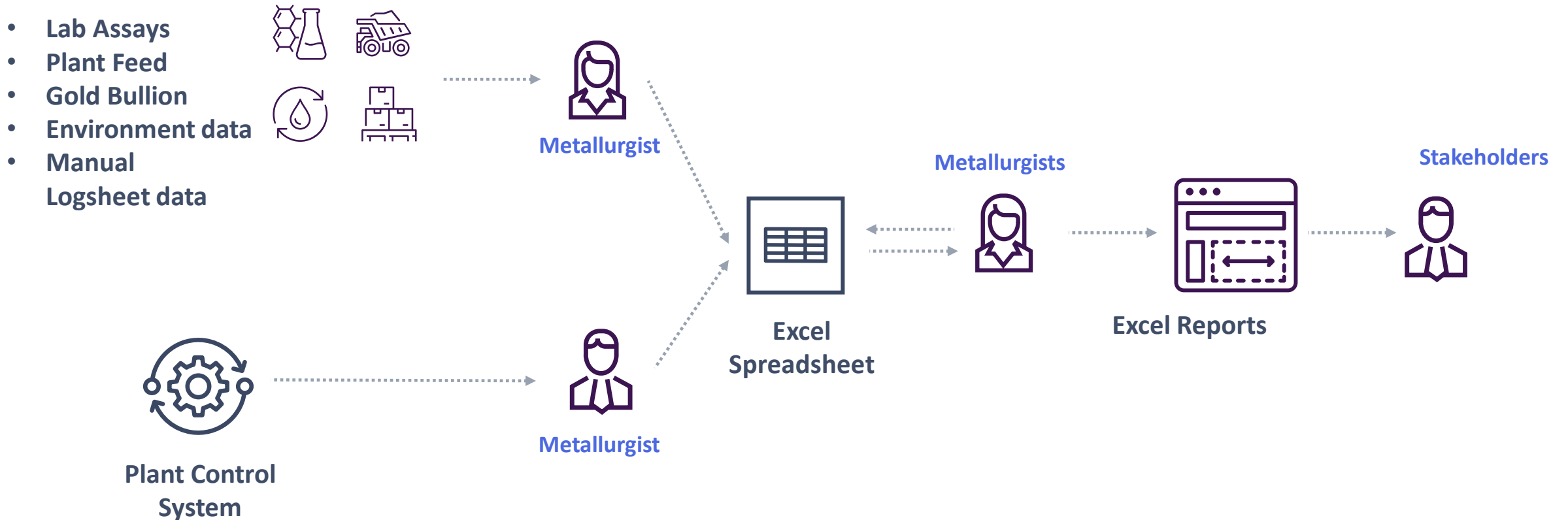


Architecture

AVEVA

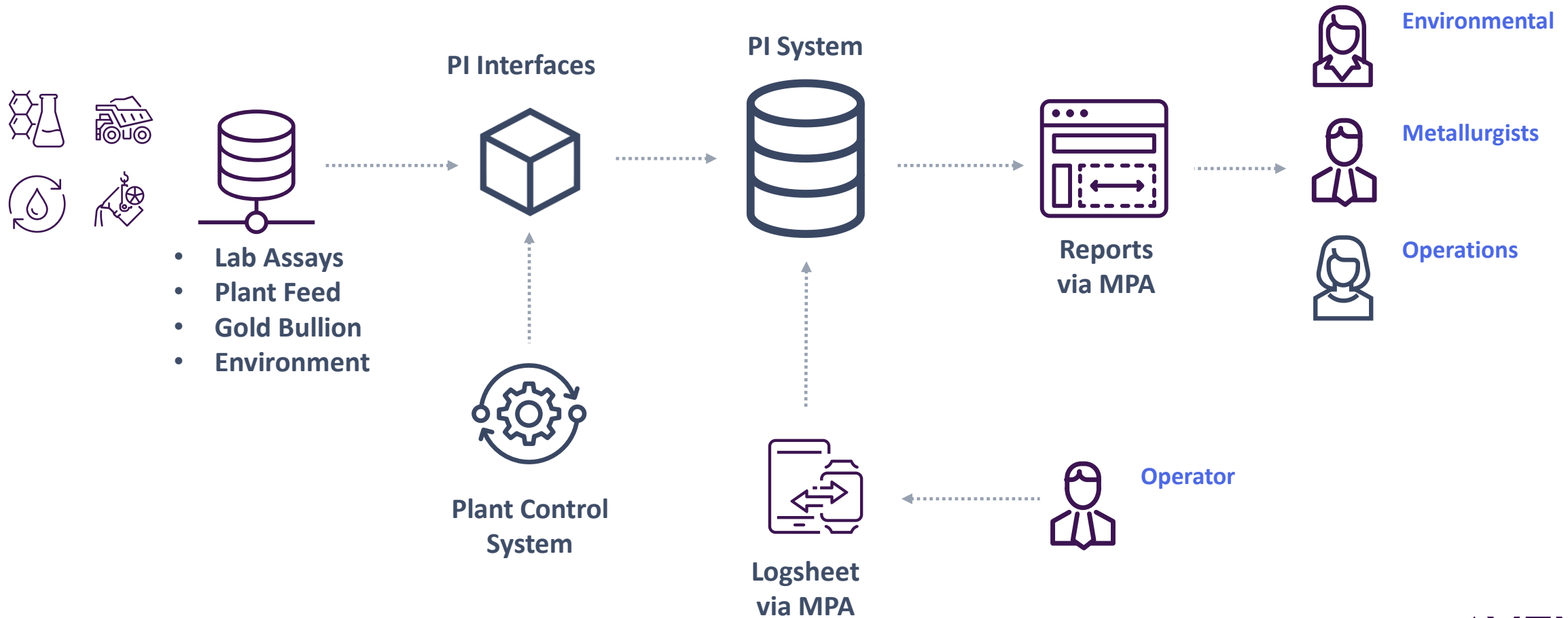
Manual Production Reporting using Excel (Before)

Data from various sources is entered into excel, calculations manually updated to issue plant reports



Automated Production Reporting using the PI System (After)

Data from various sources is consolidated in the PI system and visualized via MPA



Solution and Implementation

MIPAC Process Advantage (MPA)

AVEVA

Visualization of PI System data using MPA

Built using PIAFSDK, PI AF data retrieval and entry (attribute values, linked-tables, event frames)

\\MERIAN-AF\Merian (Time Context: 8/1/2021 5:00:00 AM) - PI System Explorer

File Search View Go Tools Help

Database Query Date Back Refresh New Element New Attribute

Elements

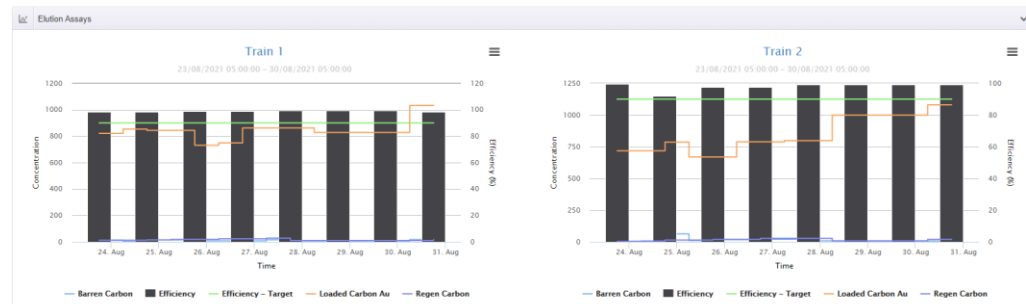
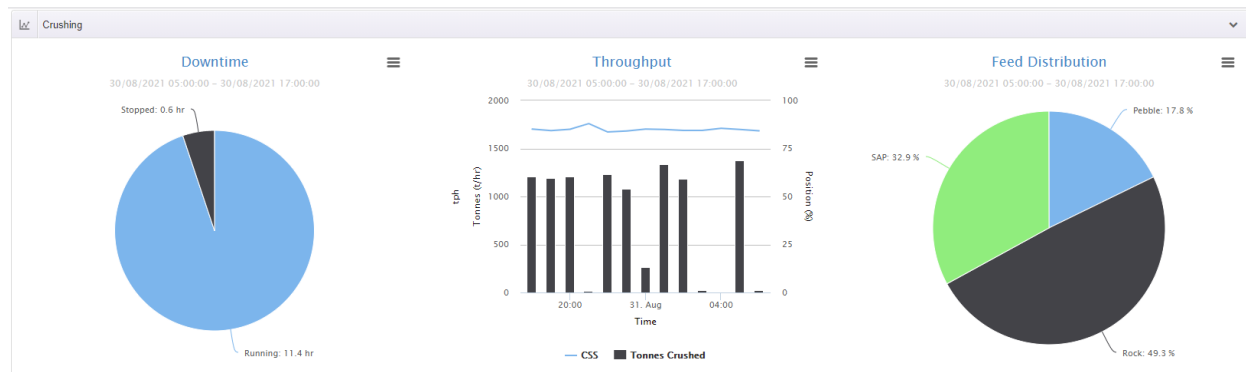
- Analytics
 - APC Competency Framework
 - CRO Training
- Merian
 - 000 - Logsheets
 - 000 - Met Logsheets
 - 000 - Operator Logsheets
 - 100 - Reports
 - 100.Asset Hours and Tonnes
 - 100.Bullion
 - 100.Carbon Bags
 - 100.Carbon Mngt
 - 100.Daily Report
 - 01 Primary Crusher - Tonnes (Wet)
 - 02 Primary Crusher - Throughput (tpoh)
 - 03 Primary Crusher - Runtime (hrs)
 - 11 Grinding - Tonnes
 - 12 Grinding - Runtime (hrs)
 - 13 Grinding - Throughput (tpoh)
 - 14 Grinding - COF Percent Passing 75um
 - 21 Gravity - Au Feed Grade (gpt)
 - 22 Gravity - Au Extraction (oz)
 - 23 Gravity - Au Extraction (pct)
 - 31 Leach CIL - Au Feed Grade (gpt)
 - 32 Leach CIL - Au Tail Grade (gpt)
 - 33 Leach CIL - Au Tail Solution (ppm)
 - 34 Leach CIL - Au Recovery (pct)
 - 35 Leach CIL - Au Recovered (oz)
 - 42 Overall - Au Tail Grade (gpt)
 - 43 Overall - Au Recovery (pct)
 - 44 Overall - Au Recovered (oz)
 - 45 Overall - Au Poured (oz)
 - 46 Overall - Au Shipped (oz)
 - 99 Forecast Vs Actuals
 - Calc. Grade and Recovery
 - 100.ETP
 - 100.GIC
 - 100.GIC Profile
 - 100.Met Accounting Change Log
 - 100.Metallurgical Account Discrepancy
 - 100.MINESTAR
 - 100.Monthly Report
 - 100.Power Consumption
 - 100.Production Report (KPI Report)

03 Primary Crusher - Runtime (hrs)

General Child Elements Attributes Ports Analyses Notification Rules Version

Filter

Name	Value
Category: <None>	
Category: 000 Information	
Description	Runtime (hrs)
Group	01 Primary Crusher
Order	3
Category: 100 Inputs	
Budget	0
Forecast	0
Shift	7.0667 h
Category: 300 Calculations - Analysis	
Validated Value	16.017
Category: 800 Report - Daily Report	
Day Actual	7.5667
Day Forecast	Excluded
Month to Date Actual	284.45
Month to Date Budget	Excluded
Month to Date Forecast	Excluded
Quarter to Date Actual	284.45
Quarter to Date Budget	Excluded
Quarter to Date Forecast	Excluded
Week Actual	86.117
Year to Date Actual	2470.7
Year to Date Budget	Excluded



Train 1 Elution Strips

23/08/2021 05:00:00 - 30/08/2021 05:00:00

Batch	Assay Loaded	Assay Barren	Assay Regen	Elution Gold (g)	Efficiency Elution (%)	Assay EW Heads	Assay EW Tails	Volume EW (m3)	EW Gold (g)	Efficiency EW (%)	SEQ Level Increase in Kiln Feed Hopper	SEQ Step 01 LC to AW	SEQ Step 02 Acid Wash	SEQ Step 03 LC to Elution	SEQ Step 04 Elution Strip	SEQ Step 05 Prep to EW	SEQ Step 06 Transfer to Kiln	SEQ Step 07 EW to Barren
[12402]	821.2	2.4	14.7	8703.9	99.70	80.1	4.0	107.6	6033.5	93.3	82.6	23/08/2021 19:30:35	23/08/2021 12:11:26	23/08/2021 15:20:41	23/08/2021 16:20:27	23/08/2021 21:03:59	24/08/2021 00:23:00	24/08/2021 05:02:30
[12403]	853.2	14.2	18.6	8917.9	98.33	79.1	9.2	107.6	7524.1	88.4	83.8	23/08/2021 19:22:29	23/08/2021 22:49:47	24/08/2021 04:07:21	24/08/2021 05:34:28	24/08/2021 10:11:01	24/08/2021 13:07:37	24/08/2021 14:15:00

Data entry into the PI System using MPA

Built using PIAFSDK, PI AF data retrieval and entry (attribute values, linked-tables, event frames)

Event Frames

- Elution Strip T1
 - Elution - 12413 - 2021-09-05 10:21
 - Elution - 12412 - 2021-09-04 18:03
 - Elution - 12411 - 2021-09-04 03:25
 - Elution - 12410 - 2021-09-03 13:46
 - Elution - 12409 - 2021-09-02 22:38
 - Elution - 12408 - 2021-08-30 04:13
 - Elution - 12407 - 2021-08-27 22:48
 - Elution - 12406 - 2021-08-26 15:28
 - Elution - 12405 - 2021-08-25 18:10
 - Elution - 12404 - 2021-08-25 03:46
 - Elution - 12403 - 2021-08-24 05:34
 - Elution - 12402 - 2021-08-23 16:20
 - Elution - 12401 - 2021-08-22 23:33
 - Elution - 12400 - 2021-08-22 10:04
 - Elution - 12399 - 2021-08-21 18:26
 - Elution - 12398 - 2021-08-20 19:29
 - Elution - 12397 - 2021-08-20 03:21
 - Elution - 12396 - 2021-08-19 06:55
 - Elution - 12395 - 2021-08-18 15:34
 - Elution - 12394 - 2021-08-17 23:57
 - Elution - 12393 - 2021-08-17 00:56
 - Elution - 12392 - 2021-08-16 08:48
 - Elution - 12391 - 2021-08-15 19:18
 - Elution - 12390 - 2021-08-15 03:16
 - Elution - 12389 - 2021-08-14 13:08
 - Elution - 12388 - 2021-08-13 22:45
 - Elution - 12387 - 2021-08-13 09:33
 - Elution - 12386 - 2021-08-12 17:53
 - Elution - 12385 - 2021-08-12 00:36
 - Elution - 12384 - 2021-08-11 08:30
 - Elution - 12383 - 2021-08-10 19:06
 - Elution - 12382 - 2021-08-10 01:47
 - Elution - 12381 - 2021-08-09 12:17
 - Elution - 12380 - 2021-08-07 23:24
 - Elution - 12379 - 2021-08-07 12:23
 - Elution - 12378 - 2021-08-07 09:54
 - Elution - 12377 - 2021-08-05 21:33
 - Elution - 12376 - 2021-08-05 03:26
 - Elution - 12375 - 2021-08-04 13:37
 - Elution - 12374 - 2021-08-03 22:51
 - Elution - 12373 - 2021-08-03 07:11
 - Elution - 12372 - 2021-08-02 17:20
 - Elution - 12371 - 2021-08-02 02:42
 - Elution - 12370 - 2021-08-01 13:17
 - Elution - 12369 - 2021-08-01 00:52
 - Elution - 12368 - 2021-07-31 09:41
 - Elution - 12367 - 2021-07-30 19:49

Elution - 12412 - 2021-09-04 18:03

General | Child Event Frames | Referenced Elements | Attributes

Filter

Name	Value
Category: <None>	
Add Wash Valve	CLOSED
Duration Acid Wash	13.65 h
Duration Elution	10.68 h
Elution Valve	CLOSED
EndTime	8/1/2021 5:00:00 AM
EW Cell	0
EW Cells Online	0
Kiln Feed Hopper Level	67.709
newCaptureTime	
Pregnant Solution Tank Level	31.551 %
Regen Valve	CLOSED
SEQ PCS AW	IDLE
SEQ PCS Elution	Error
Source	Elution
Category: 000 Information	
Assay Barren	15.247
Assay Barren - Estimated	False
Assay EW Heads	109.65
Assay EW Heads - Estimated	False
Assay EW Tails	1.38
Assay EW Tails - Estimated	False
Assay Loaded	1045.3
Assay Loaded - Estimated	False
Assay Regen	17.227
Assay Regen - Estimated	False

Newmont SURINAME 000 Budget Forecast

MPA | Merian | 000 - Logheets | 000 - Met Logheets | 000 Budget Forecast

Budget | Forecast | Budget - Data Entry | Forecast - Data Entry | TSF and ETP | Budget Reagents

Budget - Data Entry

01/01/2019 05:00:00 - 01/01/2020 05:00:00

Description	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19
01 Milled Tones		10543.14	1028300	1109401	1033243.75	1155990		1118700
02 Days		31.00	28.00	31.00	30.00	31.00		30.00
03 Unplanned Downtime								
04 Planned Downtime								
05 Total Downtime								
09 Availability		87	94.16666412353516	91.76187133789082	86.97338104248947	94.16666412353516		94.16666412353516
07 Utilisation		87	94	92	87	94		94
08 Run Hours		847.28	832.80	882.71	828.21	700.80		878.00
09 Tonnes per Day		34510.13	38725.00	38787.13	34441.48	37280.00		37280.00
10 Tonnes per Hour		1628.84	1625.00	1625.00	1450.00	1550.00		1550.00
11 Feed Grade		1.5822009944815771	1.6971139907836814	1.6788040399551392	1.152114987373352	1.2543020248413086		1.244757058236267
12 Recovery		93.65609741210938	92.99947357177734	93.57937622070312	94.02820687021484	93.38157989501953		93.56558227539062

Weekly OIC Logsheet (Carbon)

CIL Circuit

01/01/2019 05:00:00 - 01/01/2020 05:00:00

Description	Carbon Sample Volume (L)	Dry Carbon Weight (g)	Carbon g/L	A.D. Carbon Sample Volume (mL)	Carbon A.D. (g)	Carbon AD g per mL
CIL Tank 1						
CIL Tank 2						
CIL Tank 3						
CIL Tank 4						
CIL Tank 5						
CIL Tank 6						
CIL Tank 7						
Total						0

CSV

Solution and Implementation

Calculations and configuration for Daily Production
Report using PI AF



Daily Production Report

Calculated Shift Averages and Totals using PI analysis

- Displays daily production data used by Metallurgists
- Using value retrieval methods and a dynamic user selectable time range, the report user can compare time periods easily between different days

Calc.Grade and Recovery

General Child Elements Attributes Ports Analyses Notification Rules Version

Name: Shift Calc
Description:
Categories: Recalculation/Shift
Analysis Type: Expression Rollup Event Frame Generation SQC

Name	Expression	Output Attribute
GravRatio	//Use reconciled gravity ratio if exists otherwise use the gravity ratio if BadVal(TagVal('Reconciled Gravity Ratio','*-12h')) then TagVal('Gravity Ratio','*-12h') else TagVal('Reconciled Gravity Ratio','*-12h')	Map
GravityHeadGradeAu	//Gravity Head Grade Au (g/t) //MerMet - Metal Accounting Q:Q LeachFeedAuTotal * GravRatio	Gravity Head Grade Au (g/t)
GravityAuExtraction	//for Daily Report Gravity Au Feed Grade (g/t) and Gravity Au Extraction (oz) GravityHeadGradeAu * TagVal('Leach Feed Tonnes','*-12h')	Gravity Au Extraction
MillFeedCalcAu	//for Daily Report Gravity Au Extraction (%) //MerMet - Metal Accounting V:V *1000 (GravityHeadGradeAu + LeachFeedAuTotal) * TagVal('Leach Feed Tonnes','*-12h')	Mill Feed Calculated Au
LeachFeedGrade	//for Daily Report Leach Au Feed Grade (g/t) LeachFeedAuTotal * TagVal('Leach Feed Tonnes','*-12h')	Leach Feed Au
FinalTailAuTot	//Final Tails Au Total (g/t) //MerMet - Metal Accounting AT:AT if FinalTail > 0 then (FinalTail * TagVal('Final Tails Au (g/t)','*-12h') + FinalTailSolution * TagVal('Final Tails Au (g/t)','*-12h')) else 0	Final Tails Au Total (g/t)
CILTailAu	//for Daily Report Leach Au Tail Solution (ppm) TagVal('Final Tails Au (ppm)','*-12h') * TagVal('Leach Feed Tonnes','*-12h')	CIL Tail Au

Scheduling: Event-Triggered Periodic
Period: 12h 00m 00s, Offset: 05h 00m 00s
Advanced...
Output time stamp override: *-12h
Connected to the PI Analysis Service.

Day 01/01/2020 05:00 02/01/2020 05:00

Newmont - Merian
01/01/2019 05:00:00 - 02/01/2019 05:00:00

Description	Day Actual	Day Forecast	Week Actual	Month to Date Actual	Month to Date Forecast	Month to Date Budget	Quarter to Date Actual	Quarter to Date Forecast	Quarter to Date Budget	Year to Date Actual	Year to Date Budget
01 Primary Crusher											
Tonnes (Wet)		0.00									
Throughput (t/h)	0.000			0.00			0.00			0.00	
Runtime (hrs)	0.000		0.000	0.00			0.00			0.00	
10 Grinding											
Tonnes	43778.590		88810.920	43778.59		34010.13	43778.59	0.00	34010.13	43778.59	34010.13
Runtime (hrs)						20.88		0.00	20.88		20.88
Throughput (tph)	0.000			0.00		1628.84	0.00	0.00	1628.84	0.00	1628.84
COF % Passing 75um	0.000			0.00			0.00			0.00	
20 Gravity											
Au Feed Grade (g/t)	0.000			0.00			0.00			0.00	
Au Extraction (oz)											
Au Extraction (%)	0.000		4.707	0.00			0.00			0.00	
30 Leach CIL											
Au Feed Grade (g/t)	0.000			0.00			0.00			0.00	
Au Tail Grade (g/t)	0.000			0.00			0.00			0.00	
Au Tail Solution (ppm)	0.000			0.00			0.00			0.00	
Au Recovery (%)			90.712								
Au Recovered (oz)											
40 Overall											
Au Feed Grade (g/t)	0.000		0.000	0.00		1.59	0.00		1.59	0.00	1.59
Au Tail Grade (g/t)	0.000			0.00		0.10	0.00		0.10	0.00	0.10
Au Recovery (%)			91.149			93.86			93.86		93.86
Au Recovered (oz)			1830.55			1830.55	0.00		1830.55		1830.55
Au Poured (oz)	4517.854		4517.854	4517.85		1718.93	4517.85	0.00	1718.93	4517.85	1718.93
Au Shipped (oz)						1948.81	0.00		1948.81		1948.81

CSV

Daily Production Report

Using PI AF configuration and MPA to shape and transform data

Category: 000 Information	
Description	Tonnes
Group	10 Grinding
Order	1

Category: 100 Inputs	
Budget	1.197E+06
Forecast	1.2398E+06
Shift	23312 t

Category: 300 Calculations - Analysis	
Validated Value	45304

Category: 800 Report - Daily Report	
Day Actual	41824
Day Forecast	39993
Month to Date Actual	1.1767E+06
Month to Date Budget	1.197E+06
Month to Date Forecast	1.2398E+06
Quarter to Date Actual	1.1767E+06
Quarter to Date Budget	1.197E+06
Quarter to Date Forecast	1.2398E+06
Week Actual	2.5815E+05
Year to Date Actual	9.1129E+06
Year to Date Budget	7.4133E+06

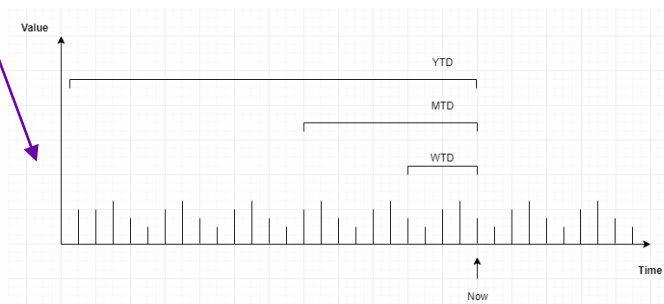
Newmont - Merian
02/11/2020 05:00:00 - 03/11/2020 05:00:00

Description	Day Actual	Day Forecast	Week Actual	Month to Date Actual	Month to Date Forecast	Month to Date Budget	Quarter to Date Actual	Quarter to Date Forecast	Quarter to Date Budget
01 Primary Crusher									
Tonnes (Wet)	34096.020	0.00	34096.020	63355.05			887992.60		
Throughput (t/h)	1899.366		1777.298	1682.79			1706.03		
Runtime (hrs)	17.951		17.951	37.65			520.50		
10 Grinding									
Tonnes	45844.000	34987.30	45844.000	96676.00	69974.59	49450.40	1522120.00	1154850.04	738931.69
Runtime (hrs)	22.581	21.96	22.581	46.58	43.92	44.16	742.67	741.05	743.52
Throughput (tpoh)	2030.163	1593.23	2088.221	2075.42	1593.23	1097.16	2049.52	1558.40	993.83
COF % Passing 75um	81.463		82.952	80.96			80.68		

100.Daily Report

- 01 Primary Crusher - Tonnes (Wet)
- 02 Primary Crusher - Throughput (tpoh)
- 03 Primary Crusher - Runtime (hrs)
- 11 Grinding - Tonnes
- 12 Grinding - Runtime (hrs)
- 13 Grinding - Throughput (tpoh)
- 14 Grinding - COF Percent Passing 75um
- 21 Gravity - Au Feed Grade (gpt)
- 22 Gravity - Au Extraction (oz)
- 23 Gravity - Au Extraction (pct)
- 31 Leach CIL - Au Feed Grade (gpt)
- 32 Leach CIL - Au Tail Grade (gpt)
- 33 Leach CIL - Au Tail Solution (ppm)
- 34 Leach CIL - Au Recovery (pct)
- 35 Leach CIL - Au Recovered (oz)
- 41 Overall - Au Feed Grade (gpt)
- 42 Overall - Au Tail Grade (gpt)
- 43 Overall - Au Recovery (pct)
- 44 Overall - Au Recovered (oz)
- 45 Overall - Au Poured (oz)
- 46 Overall - Au Shipped (oz)
- 99 Forecast Vs Actuals
- Calc. Grade and Recovery

- Templated AF elements map to rows
- AF attributes within the elements map to columns
- AF attribute values map to values in the report table



PI Point Data Reference

Data server: merian-pi

Tag name:

Attribute: Shift

Unit of Measure:

Source Units: <None>

Value retrieval methods:

By Time: Time Range Override

Relative time: %@Merian\100 - Reports\MTD

By Time Range: Total

Calculation basis: Event Weighted Exclude M

Min percent good: 0

Read only

OK Cancel

- PI analysis calculated a shift total
- Value retrieval methods with Time Range Override is used to totalize for month to date

Solution and Implementation

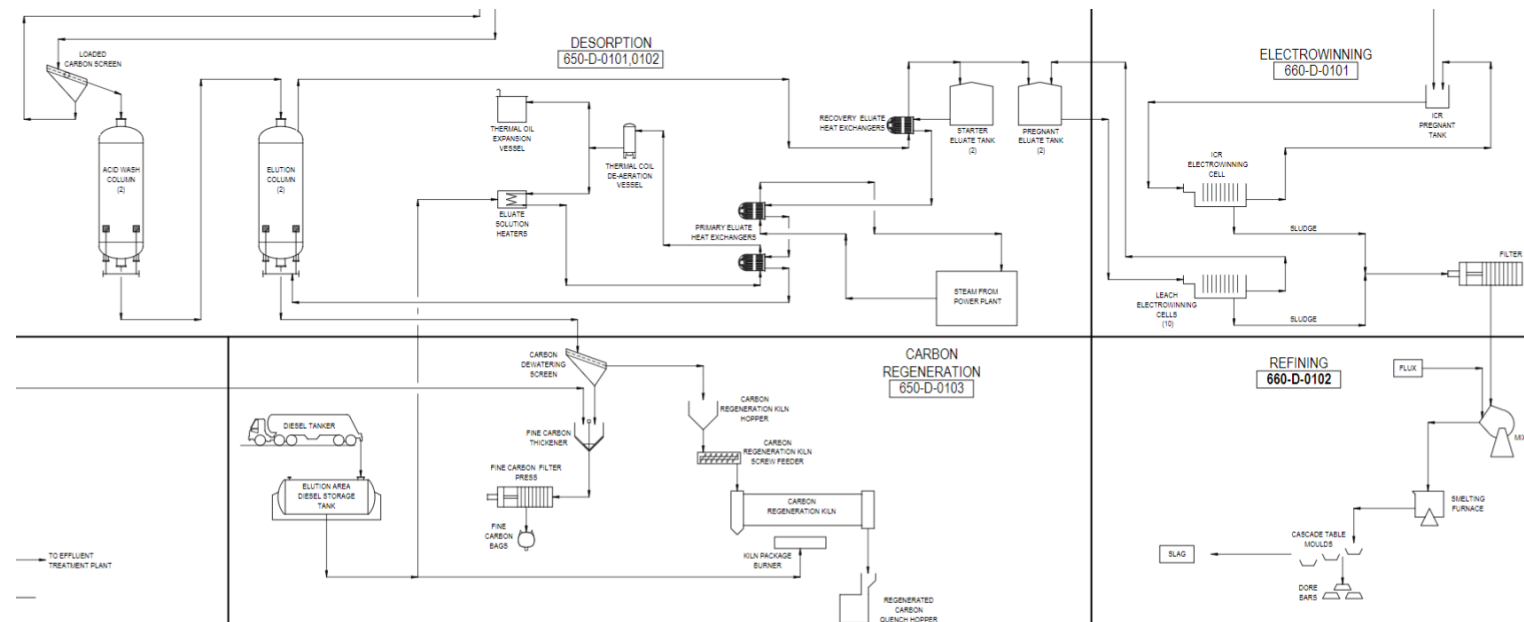
Calculations and configuration for Batch Processing using
PI AF

AVEVA

Batch Process via PI AF configuration

Tracking Elution Batches through the process

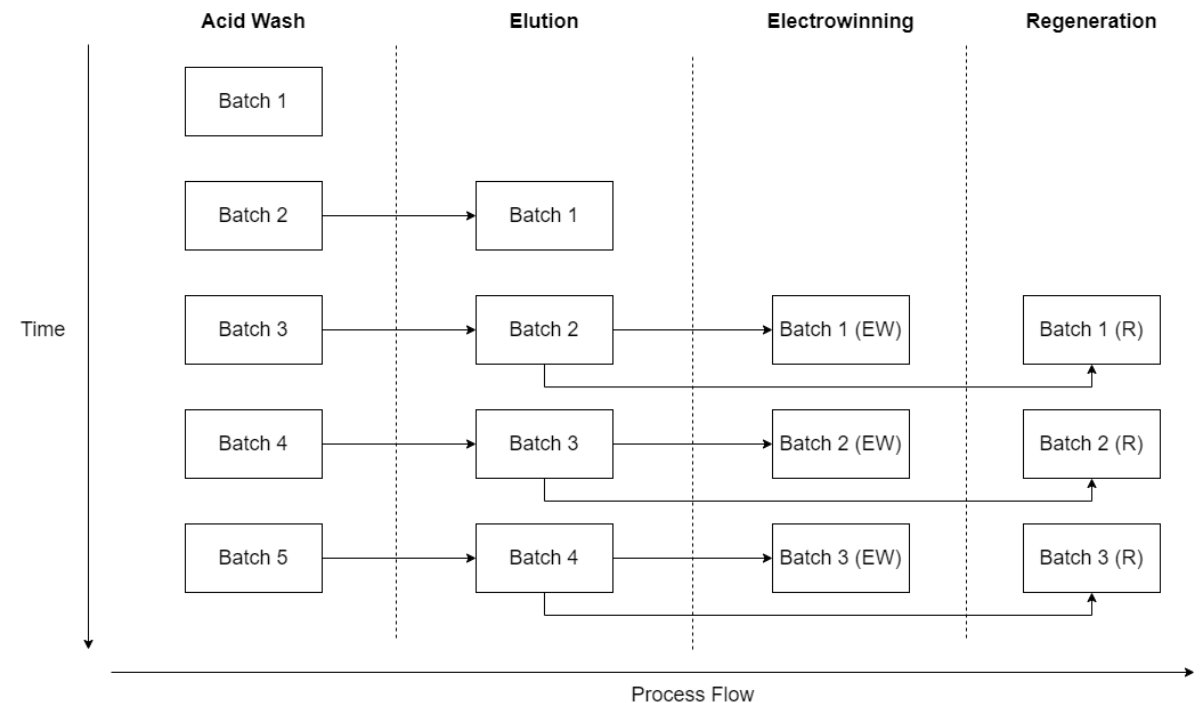
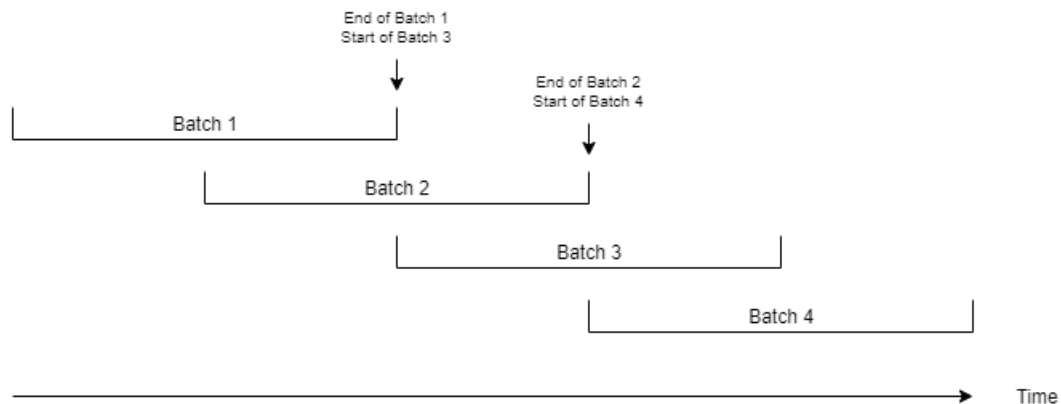
- Batch process in which gold is recovered from solution using Carbon
- Gold in the batch is calculated from
 - Assays values in the Laboratory Information Management System (SQL)
 - Volume of the batch from the Process Control System (OPC)



Batch Process via PI AF configuration

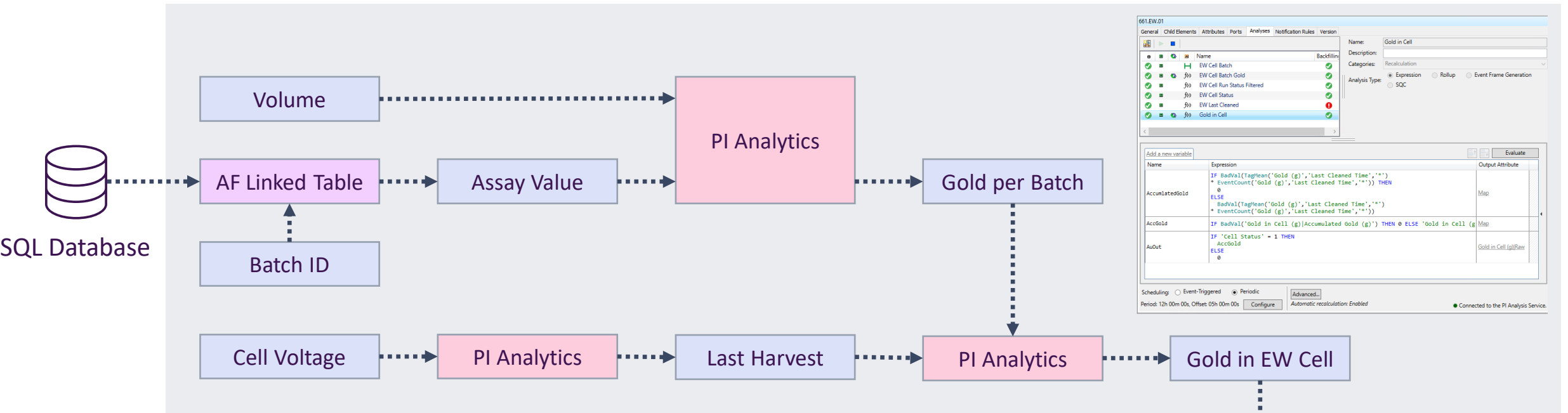
Batch processing using AF event frames

- Multiple batches can be in the system at any one time
- Many to many relationship between batches and gold dore bars

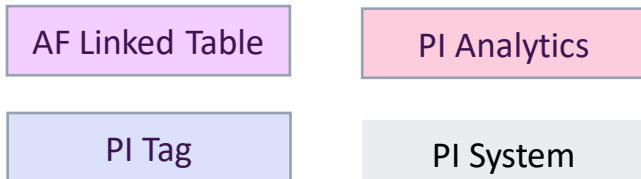


Batch Process via PI AF configuration

Automated cell inventory calculations, improved speed and consistency of calculations



Legend



Gravity Sludge Closing Inventory
01/11/2020 05:00:00 - 01/12/2020 05:00:00

Cell Type	Cell Number	Cell Status	Last Cleaned Time	First Batch	Last Batch	Gold in Cell (g)	Gold in Cell (oz)
Gravity	11	1	28/11/2020 13:56:58	1210	1214	32122.57	1032.76

CSV



Solution and Implementation

Calculations and configuration for Inventory using PI AF



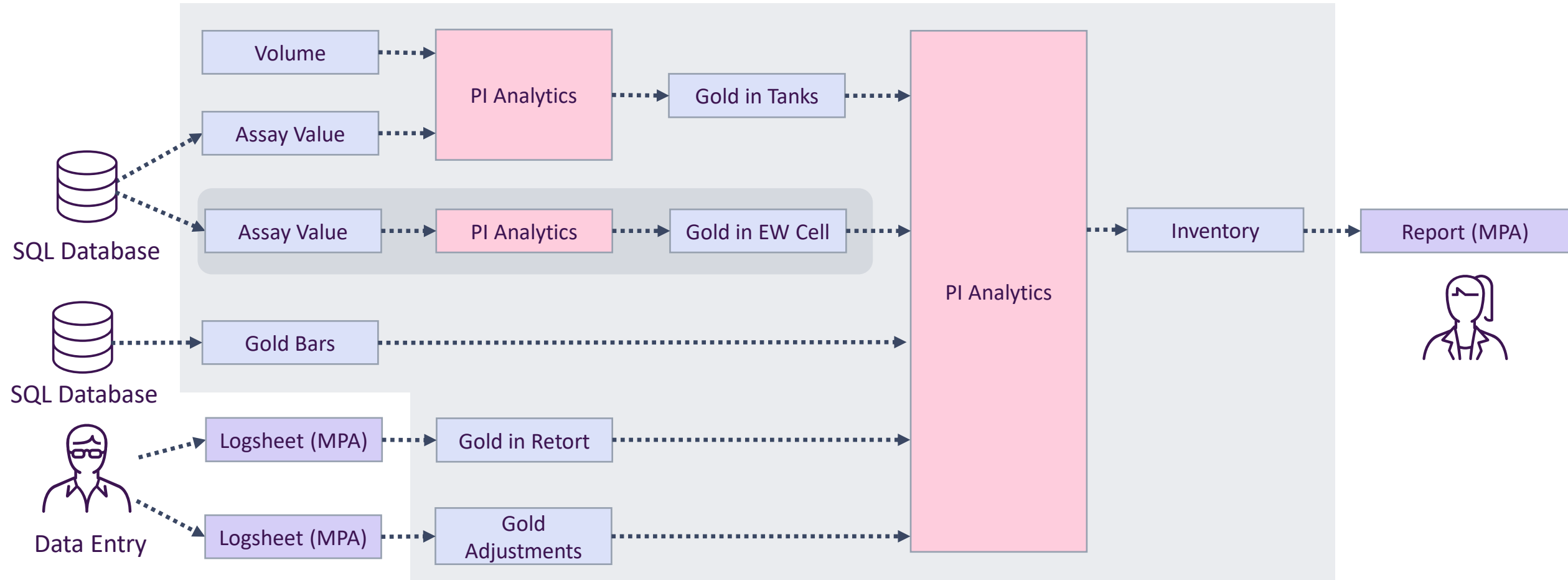
Inventory calculations

Assisting end of month reporting

- Automated calculation of inventory levels
 - Gold in tanks and vessels
 - Gold in electrowinning cells
 - Gold bars in safe
- Inventory levels calculated every shift and stored as a PI tag
 - Monthly Reporting
 - $\text{Production} = \text{Closing Inventory} - \text{Opening Inventory} + \text{Production} + \text{Adjustments}$
- Able to lock/validate calculated PI data
 - Uses event triggered PI analysis to copy values from one PI tag to another
 - Automatic Recalculation of PI analysis
 - Prevent data pipe from sending updates to only lock/validate once

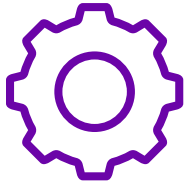
Inventory calculations

Reduction in the amount of manual entry, integrated data sources and automated calculations



Conclusion

Summary



Challenge

- Access to real time process data and trends limited to control room operators
- Resource intensive manual data entry including duplication of entries between systems
- Non-conformance to aspects of Newmont's Metals Accounting Standard



Solution

- Deployed the latest AVEVA PI System technology as an advanced foundation for Process Monitoring & Advanced Analytics
- Deployed MIPAC's MPA software to visualize PI and AF data for reporting



Benefits

- Reliability of data from reports
- Improved efficiency
- Integrated systems
- Improved data security



Daniel Qiao

Senior Systems Specialist (OSISoft Infrastructure Accredited)

- MIPAC (OSISoft by AVEVA - PI Systems Integrator)
- Daniel.Qiao@MIPAC.com.au
- sales@mipac.com.au
- + 61 7 3212 5600



Yuanbin Qin

Senior Metallurgist

- Newmont
- Yuanbin.Qin@newmont.com
- +597 8564518

THANK YOU

謝謝

DZIĘKUJĘ CI

NGIYABONGA

TEŞEKKÜR EDERİM

DANKIE

TERIMA KASIH

GRACIES

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МЕРЦИ

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MERCI

GRAZZI

ПАККА ПЕР

ありがとうございました

DI OU MÈSI

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HATUR NUHUN

PAXMAT CAĜA

SIPAS JI WERE

TERIMA KASIH

CẢM ƠN BẠN

UA TSAUG RAU KOJ

ТИ БЛАГОДАРАМ


СИПОС


WAZVIITA

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