

The PI System at the Heart of a Mining Integrated Operations Center

Presented by: Michel Plourde, Director Innovation & Technology



ArcelorMittal

Agenda

- About ArcelorMittal mining Canada
- Our data infrastructure
- Origins of our operations management system (OMS)
- Components and philosophy of the OMS
- Vision of an IROC, results and benefits



About Us

AMEM and AMIC

- ArcelorMittal Exploitation minière Canada s.e.n.c. (AMEM) and ArcelorMittal Infrastructure Canada s.e.n.c. (AMIC) are two complementary companies operating on the north shore of the province of Québec (Canada).
- AMEM produces concentrate and iron oxide pellets for the steel industry. AMIC provides rail and port infrastructure to transport and ship its products to four continents.
- Both are part of the ArcelorMittal mining segment, the world's largest steel producer and among the 5 largest iron-ore producers worldwide.
- AMEM is one of the premier canadian suppliers of iron-ore products destined for the national and world steel markets.



AMEM and AMIC ...

- AMEM produces some 26 million tons of concentrate per year while mining it's Mont-Wright and Fire Lake sites. The Mont-Wright site also includes the crushing, beneficiation and large maintenance facilities.
- The concentrate produced is transported by train to Port-Cartier where part of the production is transformed at AMEM's pellet plant. With it's annual production capacity exceeding 10 million tons, the plant produces different pellet types to satisfy customers requirements.
- AMIC operates rail and port infrastructures in order to transport, stockpile and ship iron-ore concentrate and pellets from AMEM.
- AMIC owns and operates a world class railway spanning 420 kilometers as well as a large rail fleet to transport the 26 million tons of concentrate from Mont-Wright to Port-Cartier

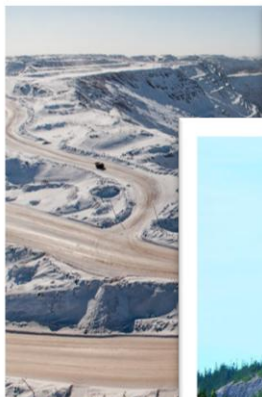


Our Value Chain



Mine

- Located in Northern Quebec
- 2 Mines – Mont Wren, Firmin (Northern Quebec)
- Over 10 years of experience
- Over 2+ Billion tonnes of Ore Reserve



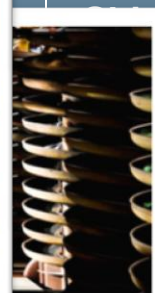
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Our PI Infrastructure

Our PI System

- 2 PI Servers, 140K PI Points
- PI AF, PI Analytics, PI Event Frames, PI Notifications
- PI ProcessBook, PI DataLink, PI Activeview, PI Vision, PI Manual Logger
- 7 Interface Types, 50+ instances
- PI OLEDEB Enterprise, PI OLEDB Provider
- Internal Applications

The PI System as a Single Information Source

Data — — — — —> Context — — — — —> Information

Operations

- DCS & PLC
- Mining systems & equipment
- Rail systems & equipment

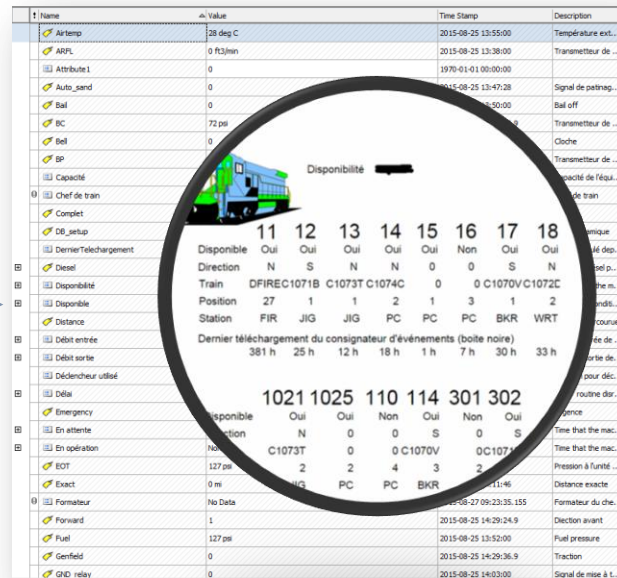
Maintenance

- State and status
- Statistics & KPIs

Finance & management

- Targets & forecasts
- Health & Safety

PI Server PI AF

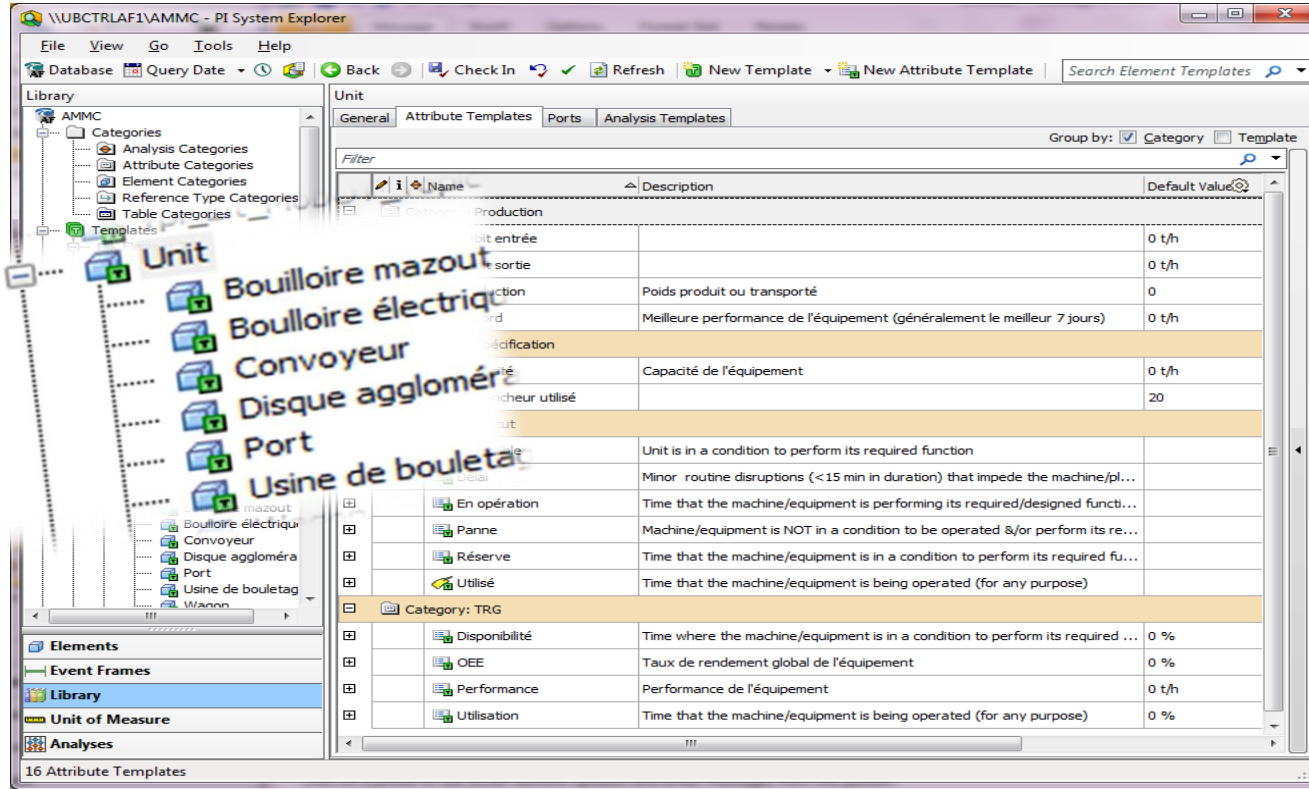


Name	Value	Time Stamp	Description
Airtemp	28 deg C	2015-08-25 13:55:00	Température ext...
ARPL	0 ft3/min	2015-08-25 13:38:00	Transmetteur de ...
Attribut1	0	1970-01-01 00:00:00	
Auto_land	0	2015-08-25 13:47:28	Signal de patnag...
Bal	0	2015-08-25 13:50:00	Bal off
BC	72 psi		Transmetteur de ...
Bel	0		Cloche
BP			Transmetteur de ...
Capacité			Capacité de l'équ...
Chief de train			Chef de train
Comple			
DB_setup			
DernierTéléchargement			
Diesel			
Disponibilité			
Distance			
Debit entrée			
Debit sortie			
Déclencheur utilis			
Delai			
Emergency			
En attente			
En opération			
EOT			
Exact			
Formateur			
Forward			
Fuel			
Genfield			
GND relay			

	11	12	13	14	15	16	17	18
Disponible	Oui	Oui	Oui	Oui	Oui	Non	Oui	Oui
Direction	N	S	N	N	0	0	S	N
Train	DFIREC1071B	C1073T	C1074C	0	0	C1070V	C1072C	
Position	27	1	1	2	1	3	1	2
Station	FIR	JIG	JIG	PC	PC	PC	BKR	WRT
Dernier téléchargement du consignateur d'événements (boîte noire)	381 h	25 h	12 h	18 h	1 h	7 h	30 h	33 h

	1021	1025	110	114	301	302
Disponible	Oui	Oui	Non	Oui	Non	Oui
Direction	N	0	0	S	0	S
Train	C1073T	0	0	C1070V	0	C1074C
Position	2	2	4	3	2	
Station	JIG	PC	PC	BKR		

PI Asset Framework Supplies the Context

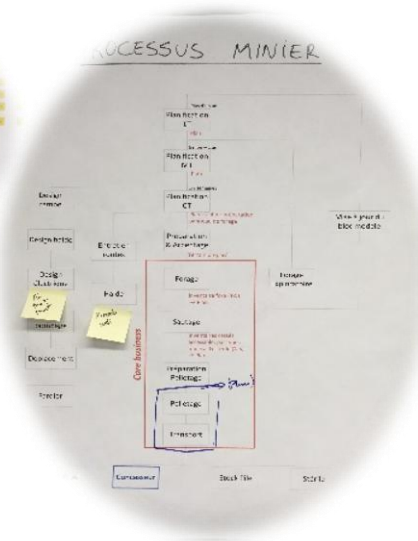
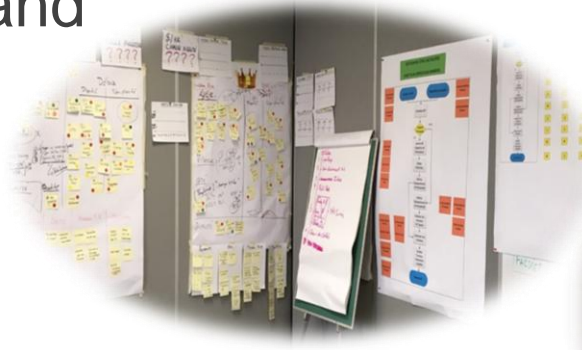


- Unit
 - Equipment
 - Process
 - Plant
 - Company unit
- Transforms DATA and EVENTS into information
- A unique template for all historical events for all units.
- Context leads to actionable information

Origins of an OMS

An Optimisation Blitz for Our Mine Operations

- A 90 day sprint to identify our improvement opportunities and optimise mine operations.
- A multidisciplinary team:
 - Maintenance
 - Operations
 - Technology
 - Continuous improvement



The Technology Team's Mandate

Design and implement a digital platform to assist mine

o
b

D
a
supply a



Assemble Information Sources

Data Sources

- Wenco FMS
- PI Data Archive
- Minesight
- CAT Terrain



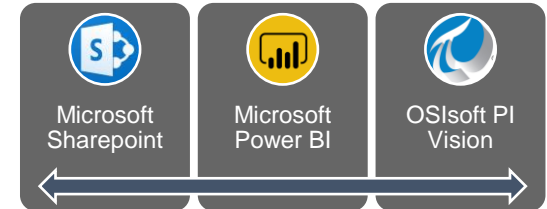
Data models

- PI AF
- SQL Server Analysis Service Tabular



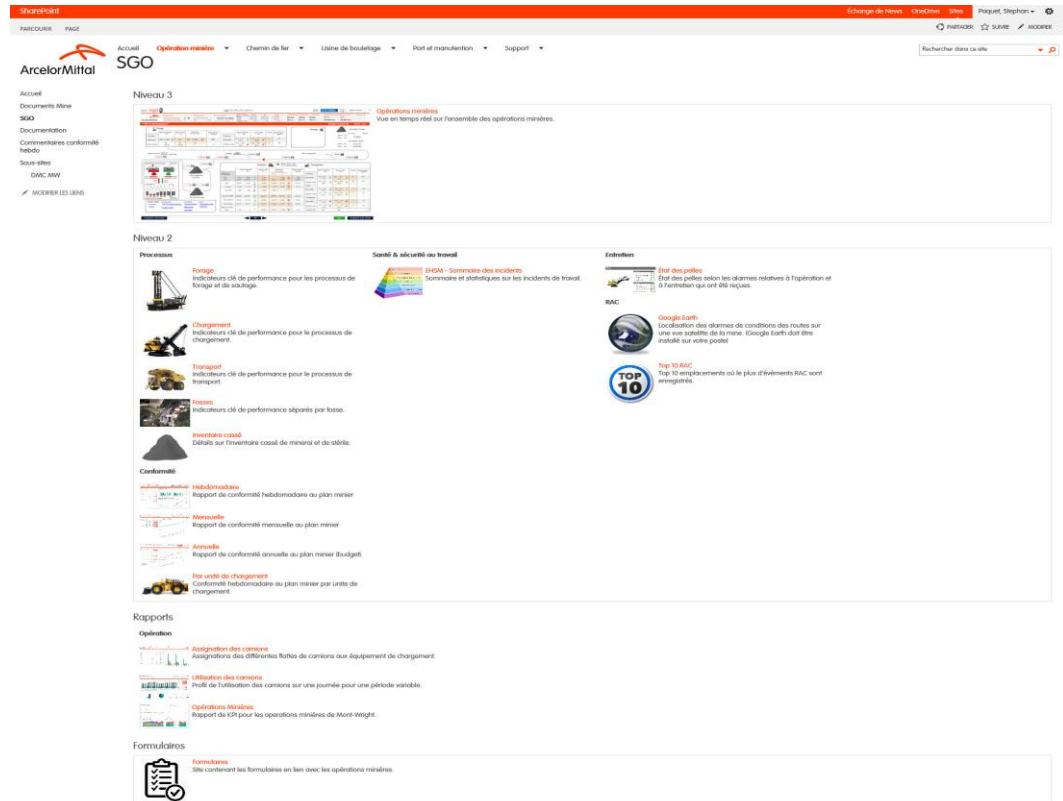
Visualisation

- PI Vision
- Power BI
- Sharepoint



Offer Users a Single Portal and Source of Truth

- Sharepoint Portal: Integrates access to multiple systems.
- PI Vision for dashboarding and monitoring and analysis in real-time.
- Power BI for reporting and analysis



Components & Philosophy of the OMS

Structure

3 levels, 3 audiences:

- Level 3 – Overall view of mine operations



management, supervisors

- Level 2 – Value driver tree per process (drilling, loading, hauling).
Reports and specialized dashboards.

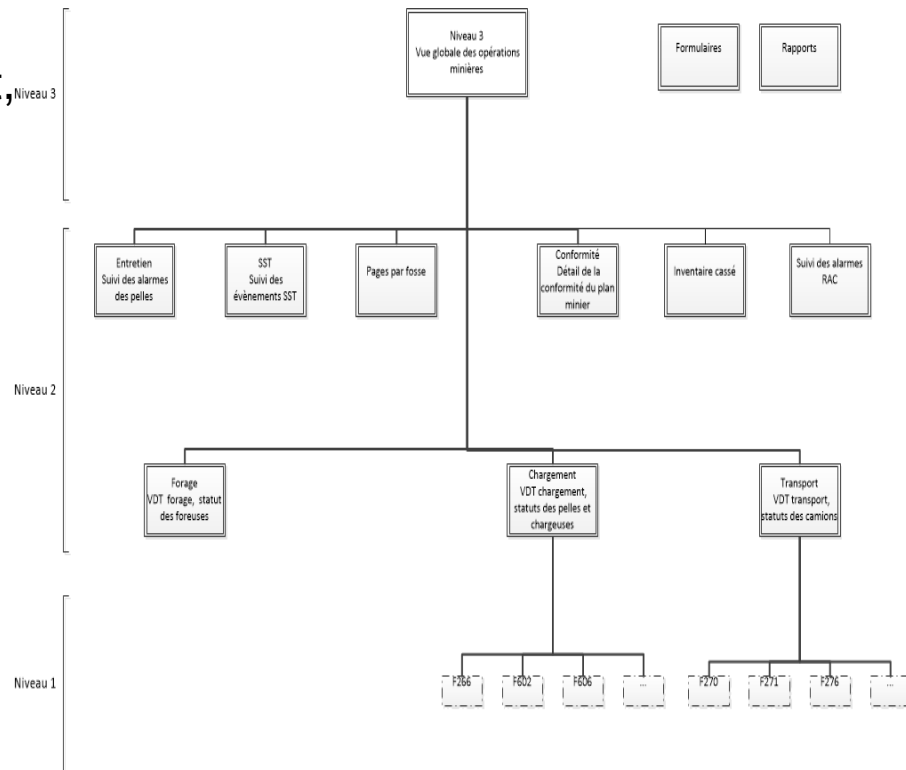


foremen, analysts

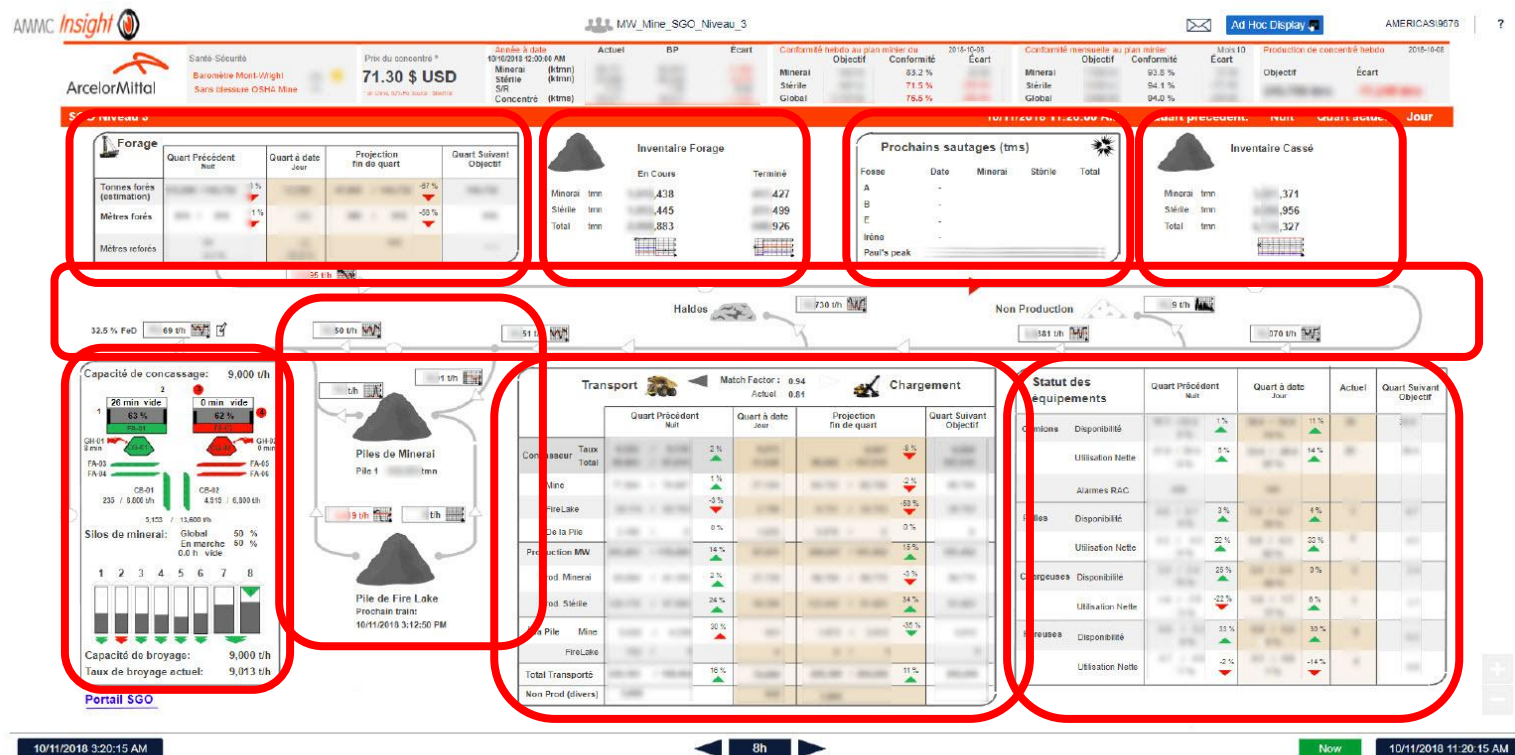
- Level 1 – Equipment level dashboards



operators

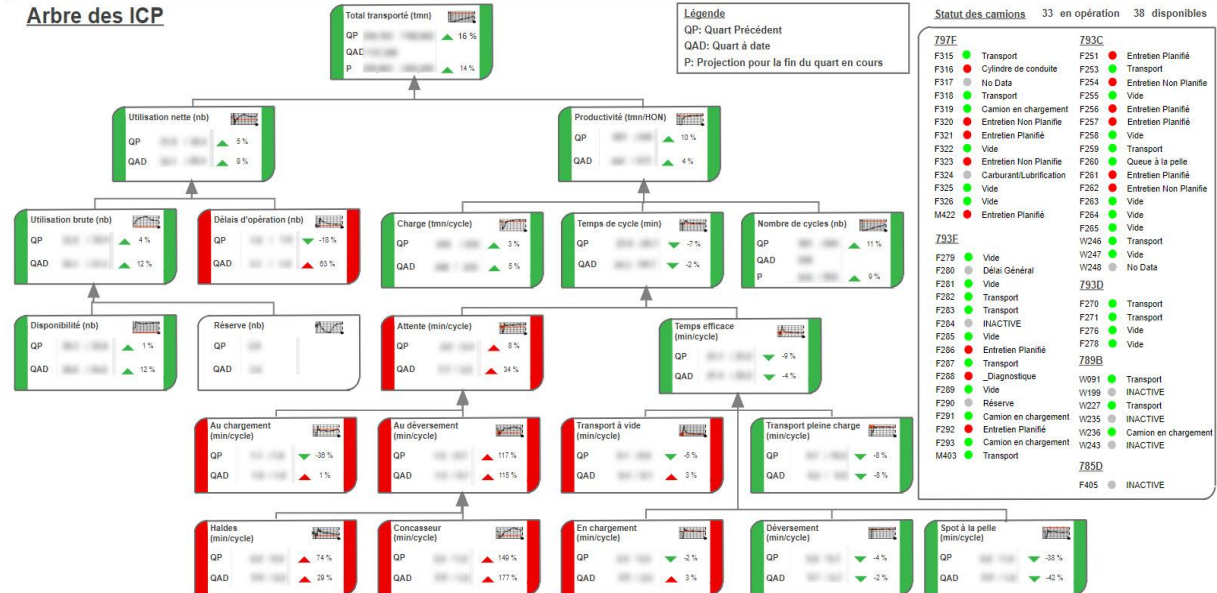


SGO niveau 3 – Mining Operations



OMS level 2 – Value Driver Tree & KPIs

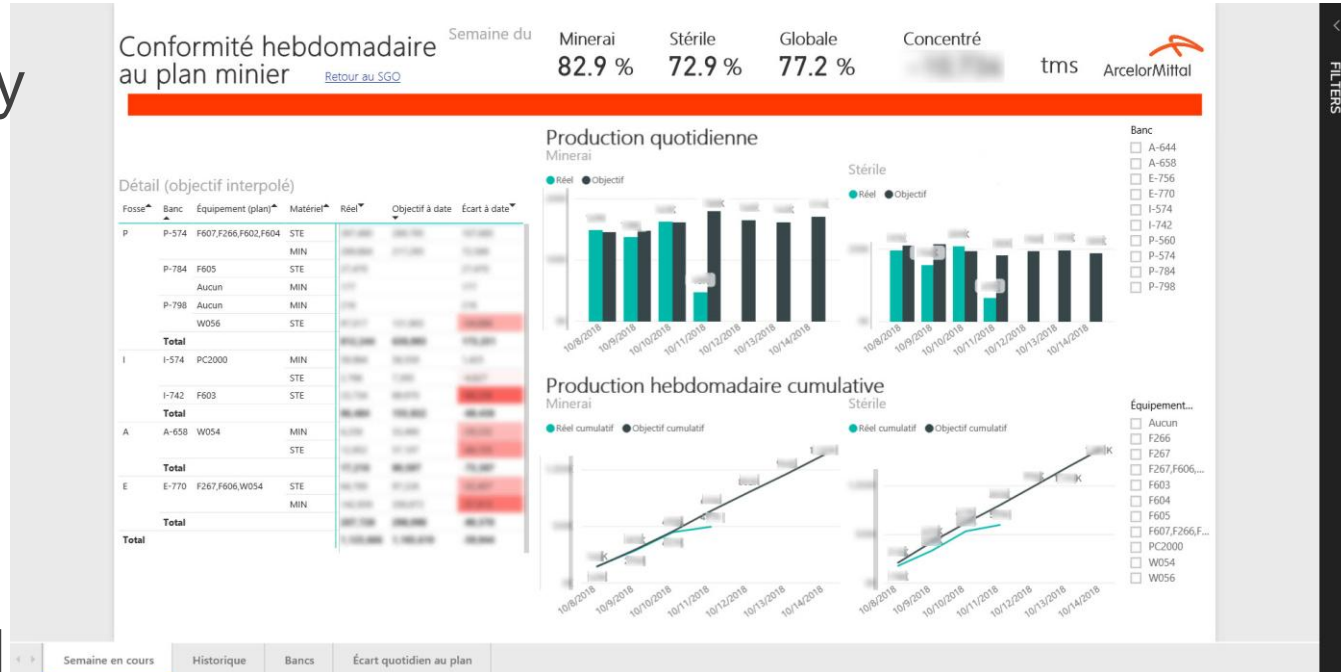
Arbre des ICP



OMS level 2 – Mine Plan Conformity

Track IT!

- Short term weekly plans
- Monthly mine plans
- Conformity per material type and shovel face



Niveau 2 – production par fosse en temps réel

Tracking mine plan conformity per pit:

- Production: Drill, Load
- Haul cycle time per material type
- Inventories
- RAC Alarms



MW_Mine_SGO_Niveau_2_Fosses



Ad Hoc Display



AMERICAS/9676



Recher

SGO Niveau 2 - Fosses

Quart: Nuit 9/19/2018 12:00:00 AM

Fosse A



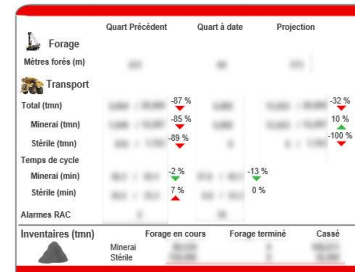
Fosse E



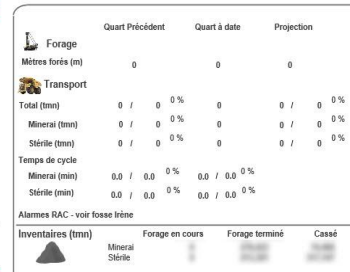
Paul's Peak



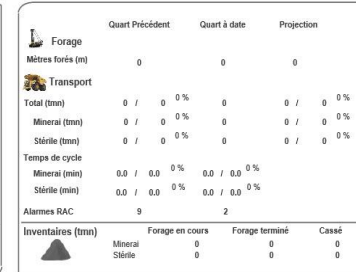
Irène



Webb



Fosse B



9/18/2018 4:00:00 PM

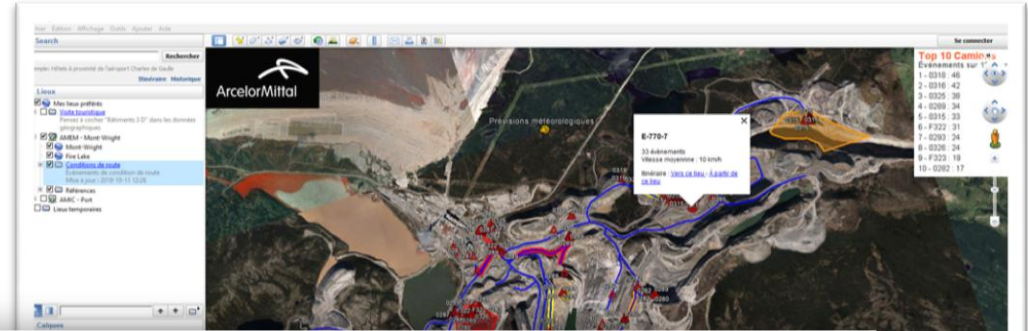
8h

Now

9/19/2018 12:00:00 AM

Improvements in mine road conditions

Road Analysis Control (RAC)



AMEM - (TOP 10) Rac

Ad Hoc Display

AMERICAS/9676

Par segments		Events - Proximite segments		Total Events	
Date	Eqpt	Events	Proximite segments		
10/11/2018 12:01:46 PM	ALL	(237) Events	from [Banc P656] to [beacon P2_3] - Speed: 10 Km		31
10/11/2018 11:12:58 AM	ALL	(64) Events	from [H02Access1] to [H02] - Speed: 15 Km		47
10/11/2018 11:24:21 AM	ALL	(56) Events	from [Intersection crusher] to [CONCASSEUR] - Speed: 9 Km		29
10/11/2018 11:18:30 AM	ALL	(43) Events	from [P-574-121-2] to [Banc P656] - Speed: 16 Km		28
10/11/2018 11:35:28 AM	ALL	(41) Events	from [E-770-7] to [PHE Acces] - Speed: 20 Km		28
10/11/2018 12:05:12 PM	ALL	(31) Events	from [P1Access1] to [Beacon P1-P2-P3] - Speed: 12 Km		28
10/11/2018 9:39:21 AM	ALL	(22) Events	from [Cuisine3] to [Intersection crusher] - Speed: 13 Km		18
10/11/2018 11:26:23 AM	ALL	(22) Events	from [Acces Halde Hesse] to [Irene v2] - Speed: 8 Km		15
10/11/2018 10:49:23 AM	ALL	(21) Events	from [Intersection crusher] to [HalSteMarie] - Speed: 16 Km		15
10/11/2018 6:14:50 AM	ALL	(14) Events	from [CPrimeAccess] to [H60.5] - Speed: 15 Km		14
Par équipements					
10/11/2018 5:57:03 AM	F323	(31) Events	from [Banc P656] to [beacon P2_3] - Speed: 10 Km		31
10/11/2018 10:01:06 AM	0326	(30) Events	from [Banc P656] to [beacon P2_3] - Speed: 17 Km		47
10/11/2018 11:59:48 AM	F322	(29) Events	from [Banc P656] to [beacon P2_3] - Speed: 18 Km		29
10/11/2018 11:52:10 AM	0318	(28) Events	from [Banc P656] to [beacon P2_3] - Speed: 21 Km		28
10/11/2018 12:01:46 PM	0325	(28) Events	from [Banc P656] to [beacon P2_3] - Speed: 17 Km		28
10/11/2018 6:26:06 AM	0317	(18) Events	from [Banc P656] to [beacon P2_3] - Speed: 18 Km		18
10/11/2018 4:07:21 AM	0326	(17) Events	from [Intersection crusher] to [CONCASSEUR] - Speed: 10 Km		47
10/11/2018 10:01:44 AM	0293	(15) Events	from [Acces Halde Hesse] to [Irene v2] - Speed: 8 Km		15
10/11/2018 10:12:33 AM	0315	(15) Events	from [E-770-7] to [PHE Acces] - Speed: 20 Km		15
10/11/2018 4:28:57 AM	0316	(14) Events	from [Banc P656] to [beacon P2_3] - Speed: 18 Km		14

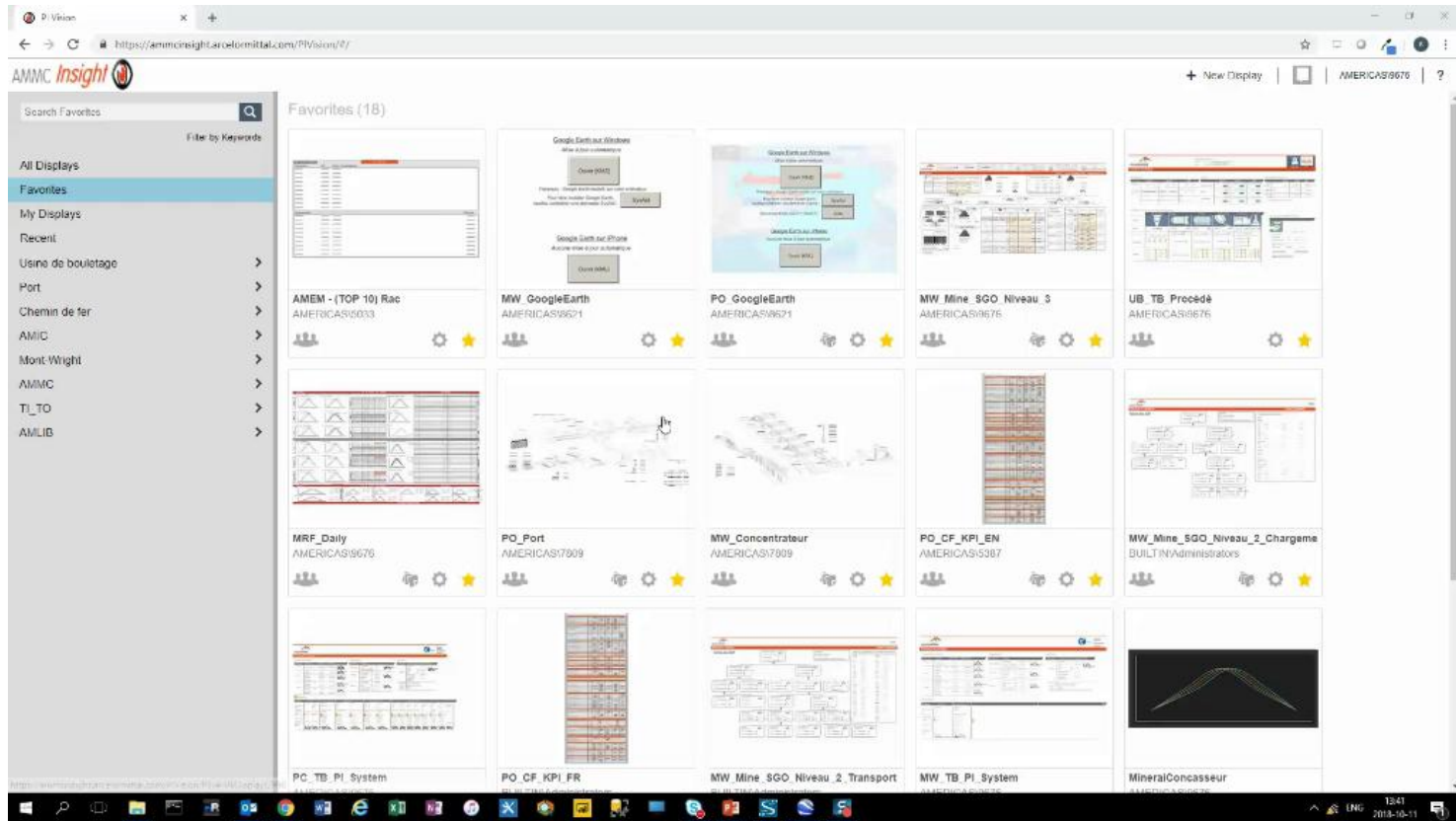
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8h

Now

10/11/2018 1:29:28 PM

Improvements in mine road conditions - demo

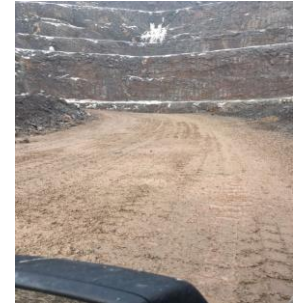


Improvements in mine road conditions

Before



After



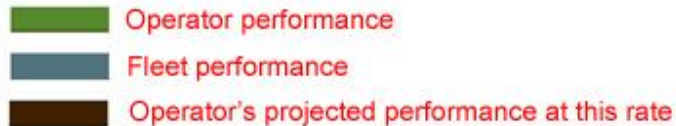
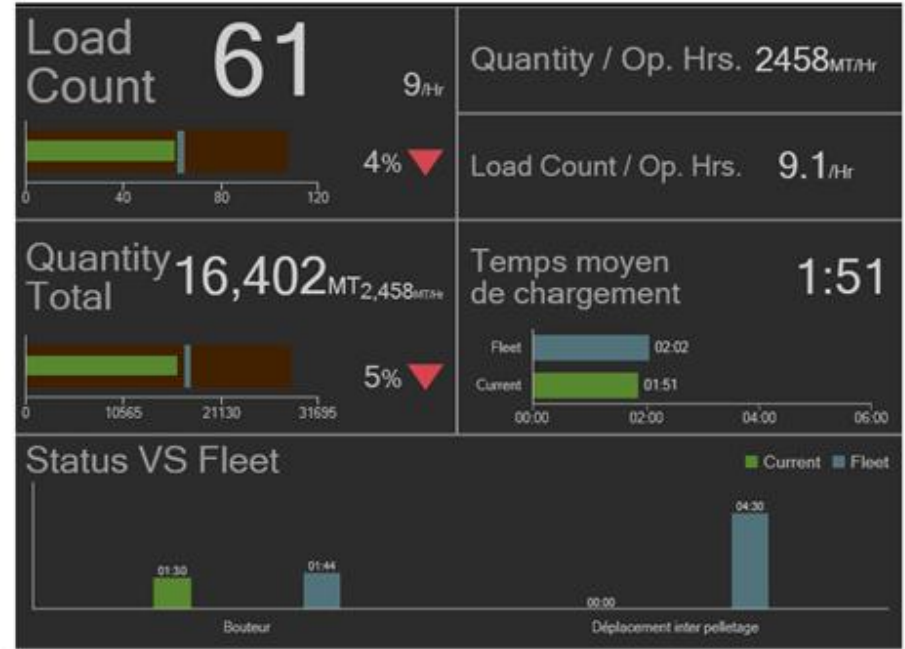
OMS level 1 – Performance for Truck Operators

- Real-time performance indicators for truck operators
- Comparison with the rest of the truck fleet



OMS level 1 – Performance for Shovel Operators

- Real-time performance indicators for shovel operators.
- Comparison with equivalent fleet.



IROC Vision, Results & Benefits

Integrated Operations



Results & Benefits of the OMS

- Higher conformity to mine plan!
An additional increase of 5%
- Bottleneck identification: Better utilisation of our mobile haul fleet (Match Factor).
- The best decision may be to park trucks!
- You can improve only what you measure!

Results & Benefits of the IROC

- 300% reduction in concentrator slowdowns caused by low feed at crushers.
- Efficiency increase of our loading equipment while lowering our dependance on costly front-end loaders
- Significant increase in daily hauled tonnage related to increased truck productivity.

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The PI System at the Heart of a Mining Integrated Operations Center



CHALLENGE

Increase productivity at our Mont-Wright mine site

Stabilize crusher feed

Plan the mine and mine the plan

Optimize logistics from Pit-to-Port

SOLUTION

- Develop a data-driven approach to assist IROC and mine operations become integrated and resilient.
- Allow the real-time identification of bottlenecks at the mine and within the value chain.

RESULTS

- The OMS provides the digital glue integrating systems to:
- Track to plan - conformity above **80%**
 - Achieve high predictability in results.
 - Identify bottlenecks in real-time
 - IROC becomes our digital 4.0 transformation vehicle.

Contact Information



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Questions?

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the **microphone**

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name & company



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