



# Digital Transformation Changing the Future of Mining

**May 30, 2018**

Confidential. Not to be copied, distributed, or reproduced without prior approval.

# What Mining Companies have told us...

**More and more data is being generated.  
Need faster networks, faster computing.**

**“We are at best looking at 2% of our data.”**

**“We want to bring our data onto one  
platform.”**

**Higher equipment availability is needed.**

**“We are worried about data and system  
security.”**

**Too many islands of disparate data.**

**“We stopped replacing instrumentation until  
someone noticed.”**

**Fewer resources to manage the data  
infrastructure and costs are rising.**

**End to end optimization is increasingly  
gaining importance.**

**“We understand that to have double digit  
improvements in productivity and to truly  
transform ourselves we need to do more  
from the cloud.”**

# Digital Transformation in Mining is happening

## South32, GE sign three-year digital transformation deal

South32 said in a statement on Monday that it will use GE's Predix platform, designed to connect industrial equipment, data analysis and instant insights, to enable the company to make fast, informed decisions, and to provide the opportunity to optimise entire operations rather than individual assets and equipment.

## New South African zinc mine going digital



**Z**inc miner Vedanta Zinc International (VZI) is collaborating with digital industrial company GE South Africa to implement a Smart Ore Movement system at its flagship Gamsberg project, in the Northern Cape, to ensure that best practices are in place when the mine goes into production next year.



## Gerdaus digital transformation: more than just automation

*This week, Gerdau and GE Digital, the tech arm of General Electric, announced the expansion of their partnership. As a result, GE's predictive analytics solution SmartSignal will go from small-scale deployment to a large project connecting 600 assets in 11 Gerdau plants across Brazil.*

# Mining companies face a multitude of head winds....

## Challenges

## Key reasons / barriers

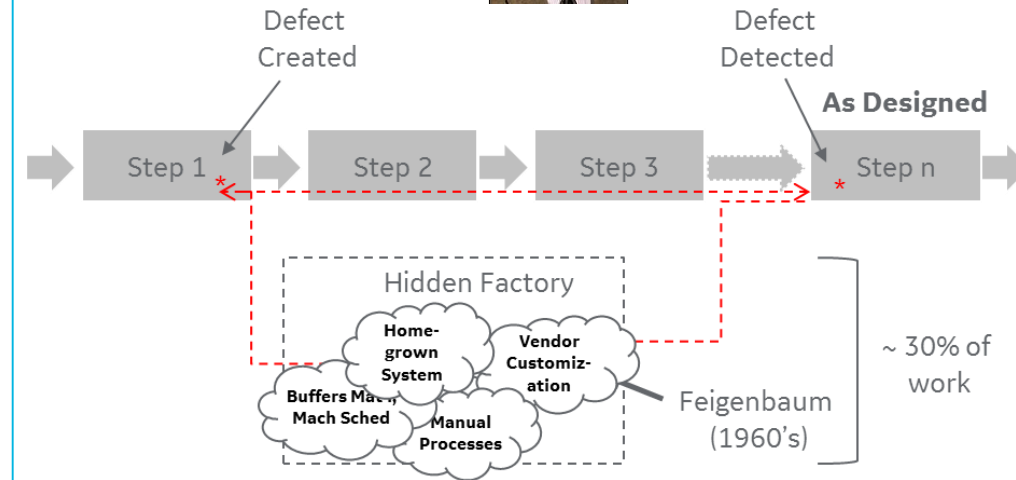
- |          |                                 |  |
|----------|---------------------------------|--|
| <b>1</b> | Ore body complexity             | <ul style="list-style-type: none"><li>▪ Lower quality (grades, impurities, homogeneity)</li><li>▪ Inadequate definition</li><li>▪ “Eroding” reserves</li></ul>                                     |
| <b>2</b> | Falling productivity            | <ul style="list-style-type: none"><li>▪ Equipment availability / reliability</li><li>▪ Knowledge transfer</li><li>▪ Siloed data, systems and organizations</li></ul>                               |
| <b>3</b> | Increasing costs                | <ul style="list-style-type: none"><li>▪ Escalating energy, consumables, labor costs</li><li>▪ Slower escalation of commodity prices</li><li>▪ Negative pressures on ore reserves</li></ul>         |
| <b>4</b> | Lack of agility                 | <ul style="list-style-type: none"><li>▪ Non-optimized response to upsets</li><li>▪ Non-adapting short term plans (vs daily plan)</li><li>▪ Slow reaction to commodity prices / mkt needs</li></ul> |
| <b>5</b> | Growing safety & security risks | <ul style="list-style-type: none"><li>▪ Unable to identify early deviations from expected operating conditions</li><li>▪ External cybersecurity threats increasing</li></ul>                       |

## Unlocking the Hidden Factory

Enabling the data supply chain



John DC Little  
Institute Professor  
MIT Sloan School



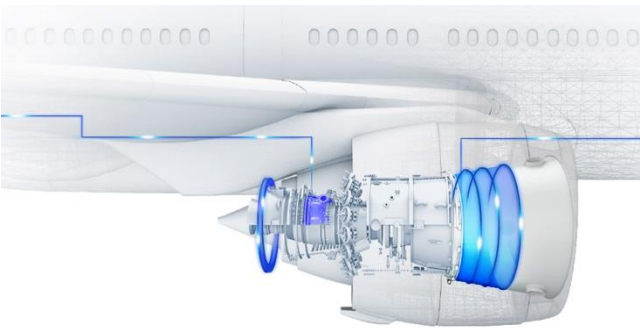
Gartner finds that “...slightly more than two-thirds [deploying] said they achieved **less than 75%** of the intended business results, and 31% achieved **less than half...**”

The secret to MES success  
Darren Riley - July 26, 2016

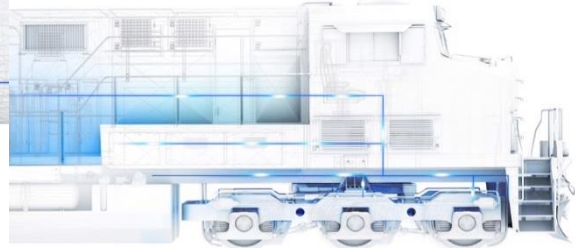


# GE is learning from its own Digital Transformation Journey

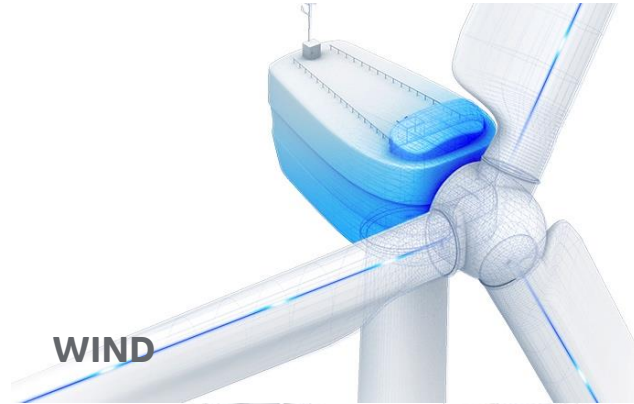
Designing, Manufacturing, and Servicing Equipment – “Heaps” of Industrial Data



AVIATION



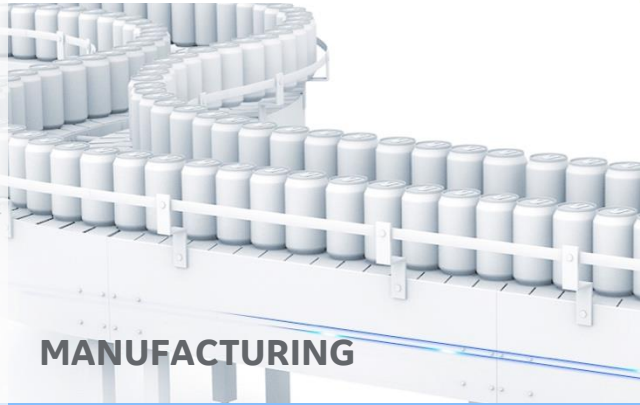
TRANSPORTATION



WIND



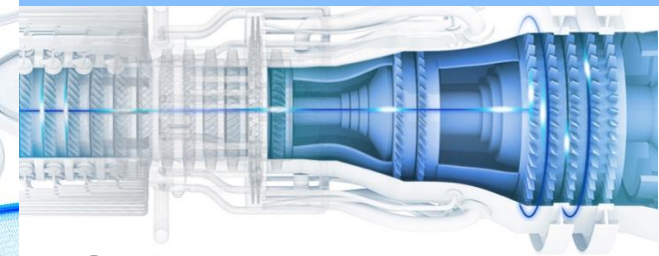
HEALTHCARE



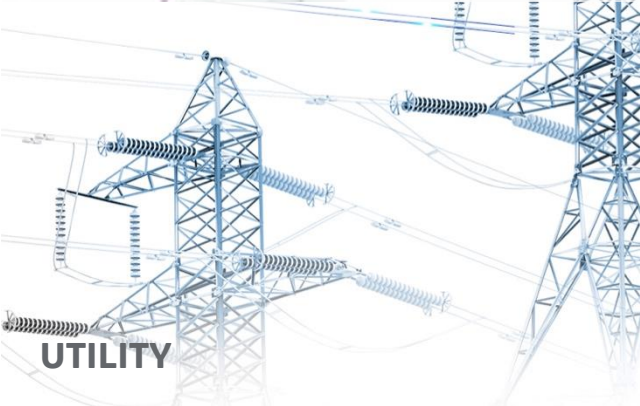
MANUFACTURING



WATER



POWER



UTILITY

40+

RM&D Centers worldwide

500+

Factories worldwide



MINING



OIL & GAS

\$1 Trillion

Assets under management  
(not just GE)

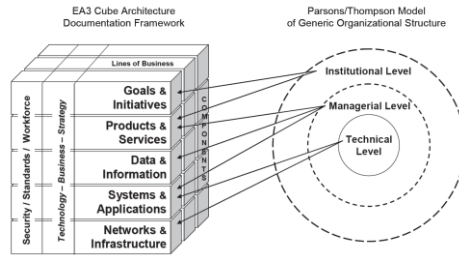
\$730 M

Manufacturing productivity  
gains @ GE

# Our Evolution and Insights

1

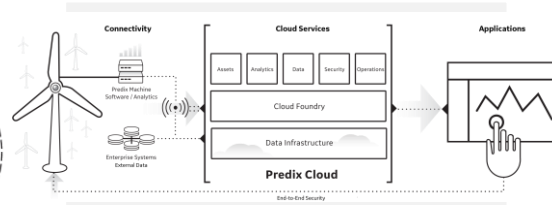
## Operating Model and Capabilities



Organizations need to understand how to configure their operations for transformation – determining what capabilities, roles, leaders and teams are needed.

2

## Data and Connected Infrastructure



Companies that leverage data and the power of the app economy will set themselves up for long term success.

3

## Partner Ecosystem

Program Blue/Red	Control	Setup	Produce	Global Strategy
<b>General</b>				
Access to the Partner Portal	x	x	x	x
Access to App Store	x	x	x	x
Partner Management	x	x	x	x
Partner Advisory Council				x
<b>Technical</b>				
Free Developer Access	x	x	x	x
Free On-line Tooling	x	x	x	x
Cart/Marketplace		x	x	x
Partner Benefits			x	x
Regional Training Workshops			x	x
<b>Marketing</b>				
General Marketing Support			x	x
General-Salesperson Tools	x	x	x	x
Market Development Funds		x	x	x
PA Resources			x	x
Joint Marketing Planning			x	x
<b>Sales</b>				
Outsourcing Resources	x	x	x	x
Joint Solution Offering Planning			x	x
Joint Go to Market Planning			x	x
Joint Opportunities Ident. Tool on Running				x

You can't transform on your own. We pair the capabilities of the app economy with a growing partner ecosystem that provide ready-made digital solutions.

4

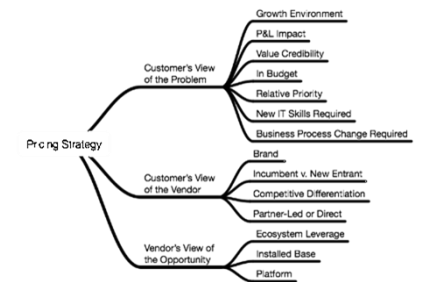
## Culture Change



Transformation doesn't matter unless you've got a culture that's willing and able to embrace it - Fastworks (Iterative Innovation, Space to Experiment, Fail-fast Mentality)

5

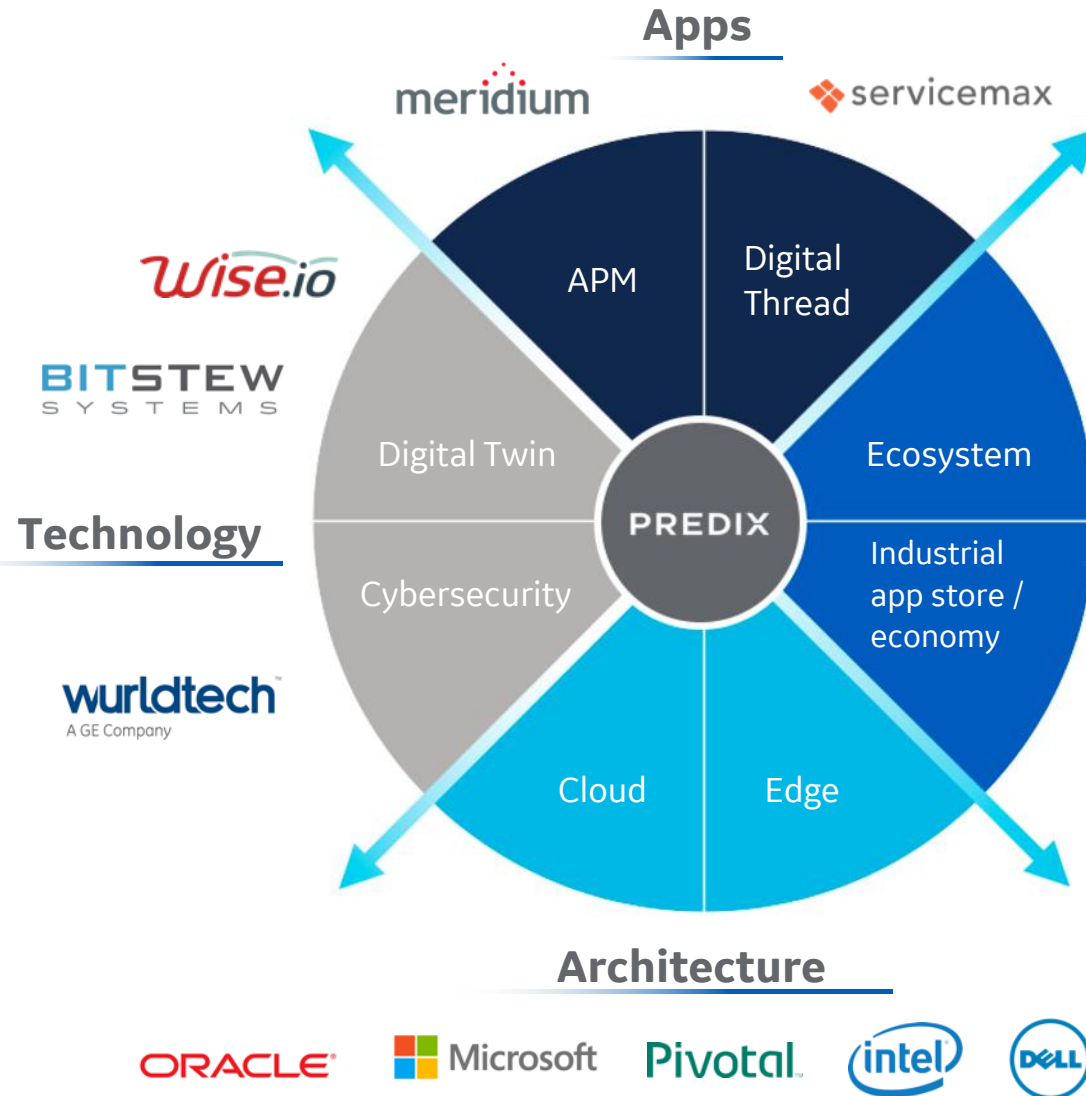
## Revenue Model Innovation



“Open app ecosystem” - ability for customers and ecosystem partners to put their own applications, analytics, or microservices on Predix – from IT cost centers to a profit centers

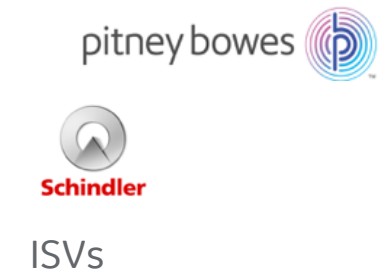
# The Predix powered world

- Industry leading applications for asset management & digital field services
- Comprehensive ecosystem to deliver to market
- Agnostic platform; flexibility in architecture & deployment needs
- Technology investments speed time to value



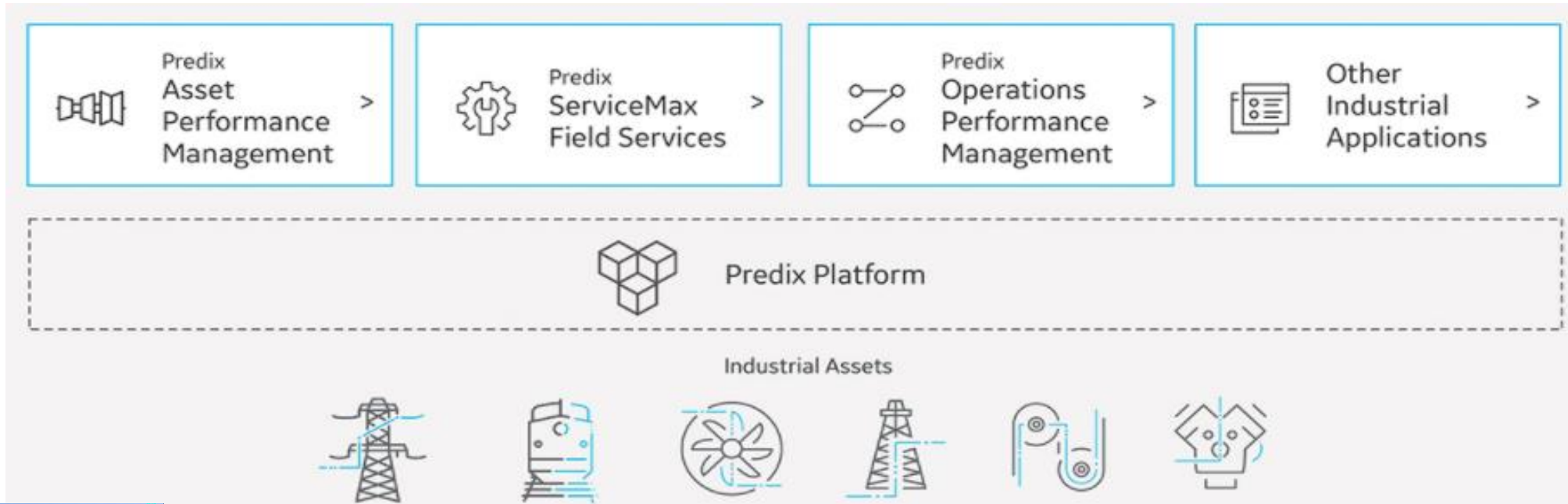
- Independent software vendors
- Industrial resellers
- System integrators
- Technology Partners

## Global Distribution





# Predix Apps – For Industrial Applications



*“A number of companies have asked us: help us innovate. The best ones have really thought about it and said, “Don’t try to understand mining better than we do, because you never will: Bring us the best that people are doing from other industries” M. Speaker, Microsoft, quoted in CMJ Feb, 2018.*



# Digital Twins & Data Science

## ANALYTICS

4,000+ Software Engineers  
**GE Digital**

## PHYSICS

15,000+ Applied Engineers  
**GE Businesses**

Data / Meta Data /  
Gold Data



Analytics / Physics /  
Modeling



Industrial Learning System  
AI & Machine Learning



### Digital Twins

- Wide range of complexity – assets, processes, entire plants
- Bridge between physical and digital worlds – sensors, states, histories, digital threads
- Adapting, learning to improve performance – self tuning, benchmarking
- Platform enables higher fidelity Digital Twins & integration



### Data Science

- Turn data into insights, and insights into actionable and tangible business outcomes
- Transform empirical knowledge into mathematical algorithms that can be operationalized through IIoT, Predix-based solutions

# Information Across the Mining Flowsheet Connected to Ore Management

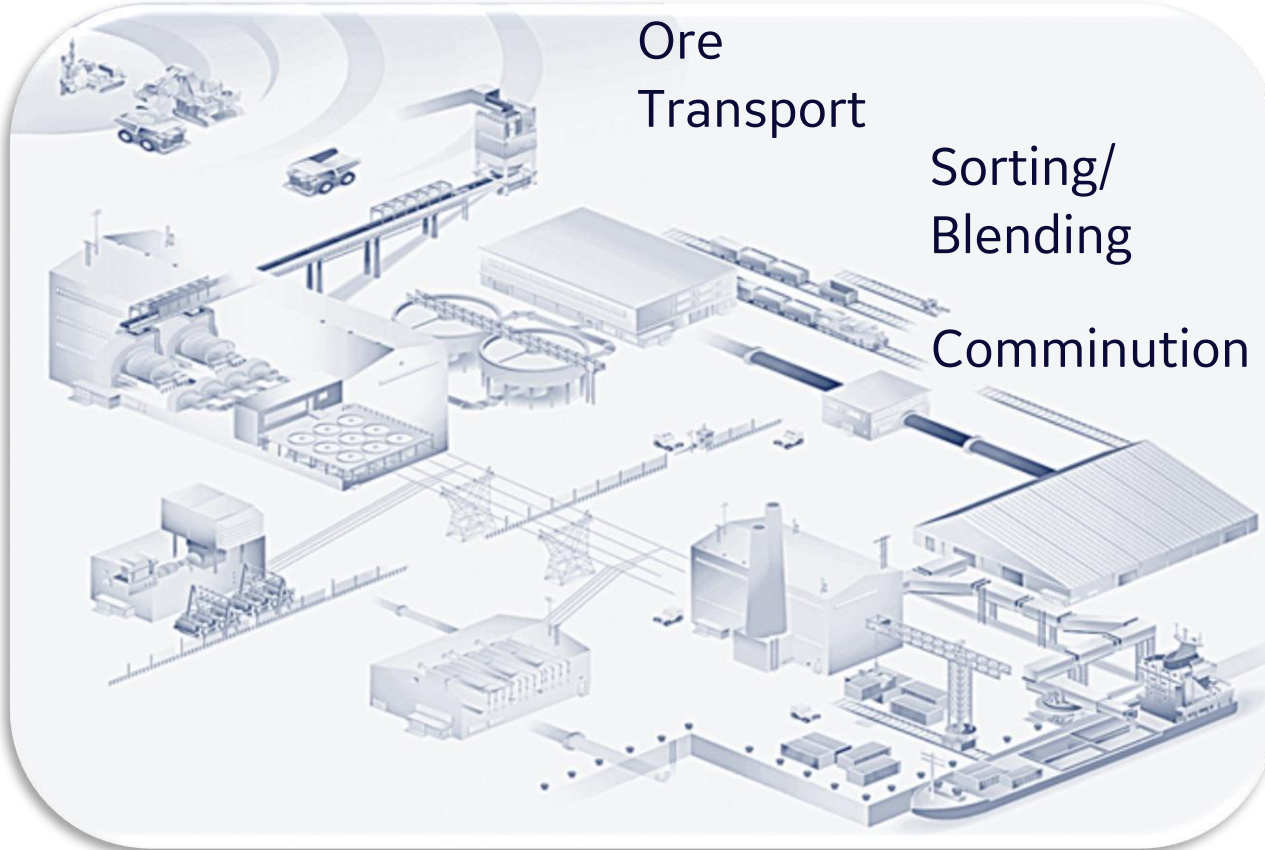
Planning

Drill/Blast

Ore  
Transport

Sorting/  
Blending

Comminution



Mineralogy (grades, impurities, hardness)

Fragmentation, material tracking, inventories

- Autogenous positioning
  - MWD data
  - Optimize blasting
- Fragmentation measurement
  - Blasting feedback

- Dispatch/scheduling
- OHV Asset performance
  - Fuel consumption
  - Collision avoidance

- Ore sorting
- Stockpile management – tonnes / grade / impurities
  - Blending Optimization
  - Mill feedforward control
- Optimal response to ore hardness & fragmentation
- Reconciliation / unaccounted losses / lag times / outages

## Mining Ecosystem





# APM & Predictive Analytics

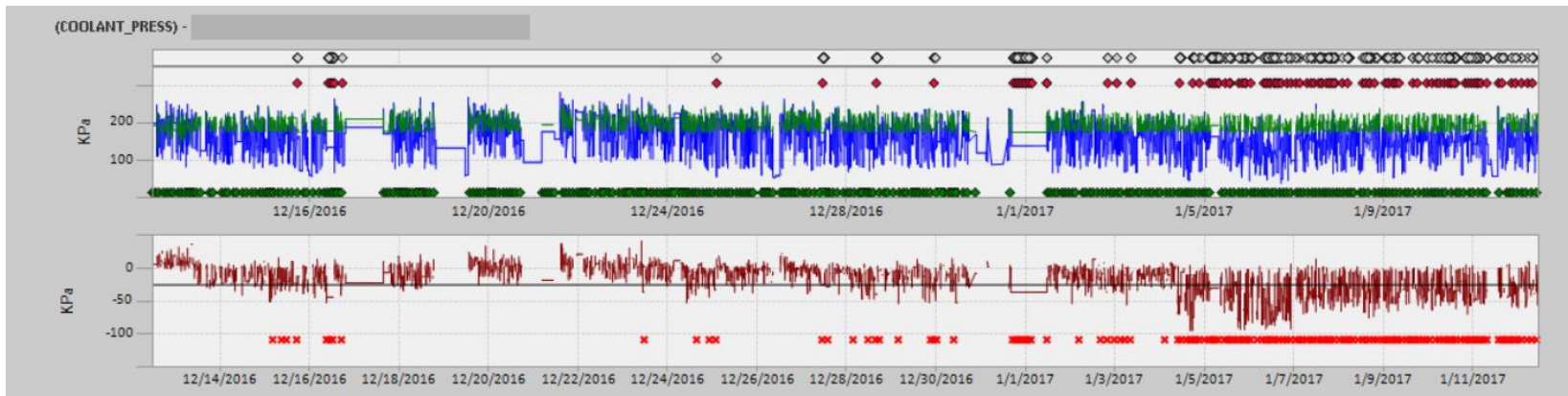
GE APM Reliability Management- used in Aviation, Power, etc.

## Catch:

**Coolant Loss:** Coolant Pressure had decreased from ~230 kPa down to ~180 kPa and appeared to be declining further.

## Cause:

Customer confirmed water leak as indicated by APM. No alerts from operator or OEM's condition monitoring



# Smart Ore Movement



## SMART ORE MOVEMENT

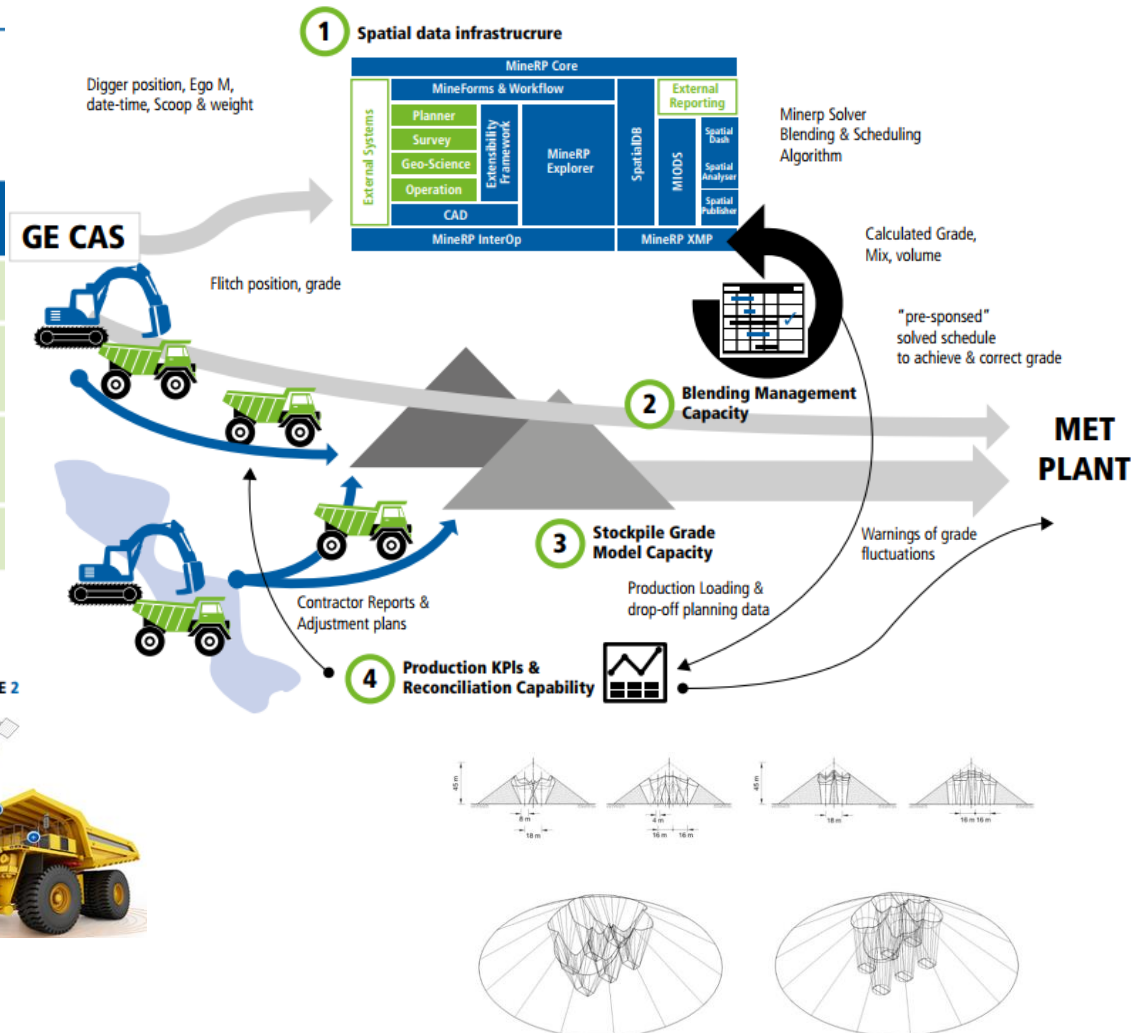
Business Information will be derived from spatial data which has its source in disparate- and stand-alone systems

Ability to blend near real time & manage adherence to the strategy

Effective Grade Control due to the ability to adjust blending strategy

Ability to continuously spatially reconcile the actual production against the planned schedule

Enterprise Spatial Data Infrastructure	Blending Management Capability	Stockpile Grade Model Capability	Production KPI's and Reconciliation Capability
Spatial data can be treated as an enterprise asset	Predictable grade to plant	Measuring of mining efficiency	Effective Contractor Management
One single set of spatial and transactional data	Production schedules to contractor fleet for optimal blending	Reconciling of grades	Ability to react in time to enforce planned production targets
No 'point-to-point' integration between information domains and application data	Optimized plant operation	Provide information to SAP regarding ore movement	Operational discipline and excellence
Data, people & systems utilised by reporting programs	Grade in stockpile and concentrator	Manage the orebody as stock transactions in the ERP	



It takes strong leadership and vision  
*"paper and spreadsheet free"*



# Bauxite Operations

## Agile Planning and Scheduling

- Weekly plans regularly become out of date - Production Coordinator real-time decisions
- Desire real-time integration of any changes back into a “live” weekly plan
- Full reconciliation with ore movement solutions
  - CAS, LIDAR, mobile view of active faces for PC
- Enable “minute-by-minute” production management
- Platform integration – mobile solutions & visibility for downstream refinery (digestors)



# Manganese Ore Operations

- Different products produced by concentrator (lump, fines, etc.)
- Digitally track product movements from mill to port – paper-free, in-process blending, identify/avoid misplacements, and inventory reconciliation
- Development of digital twins: correlate ore bodies to product mix (data science), concentrator and blending optimization to market
- Give Marketing better line of site to production through KPIs and forecasting



# Final comments...

- Digital transformation in mining is happening – including ore movements, asset performance and blending
  - Great potential when unifying with solutions such as CAS
- Tremendous value in integrating disparate solutions onto a common platform
  - Going beyond data and visualization – Digital Twins
- Tonnes + Quality
- Ecosystems are critical for success





imagination at work