The Digital Transformation Journey in BP Upstream

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Global Operations in BP

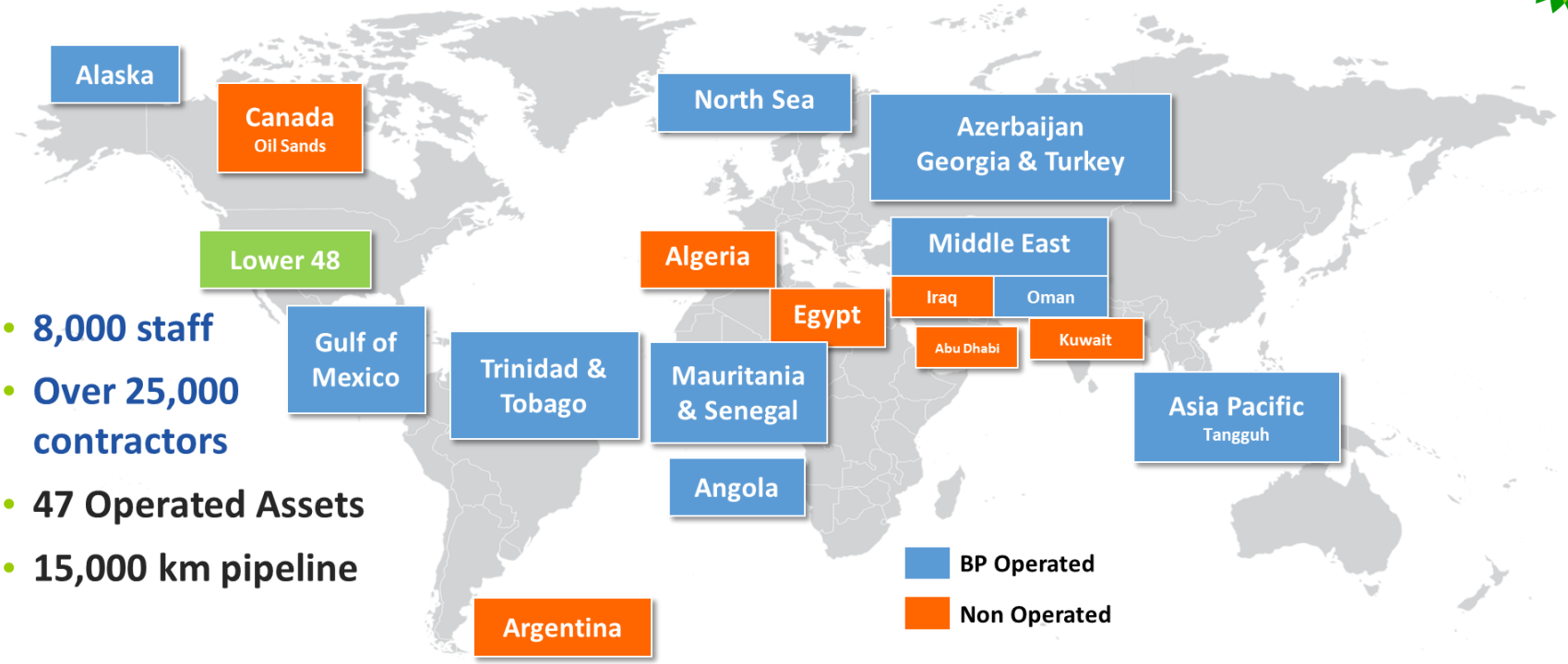
- **Responsible for safe, compliant, reliable, and efficient operations**
- **We operate upstream production assets (onshore and offshore) and midstream transportation and processing activities around the globe**

Alaska

Azerbaijan

Gulf of Mexico

Large and Diverse



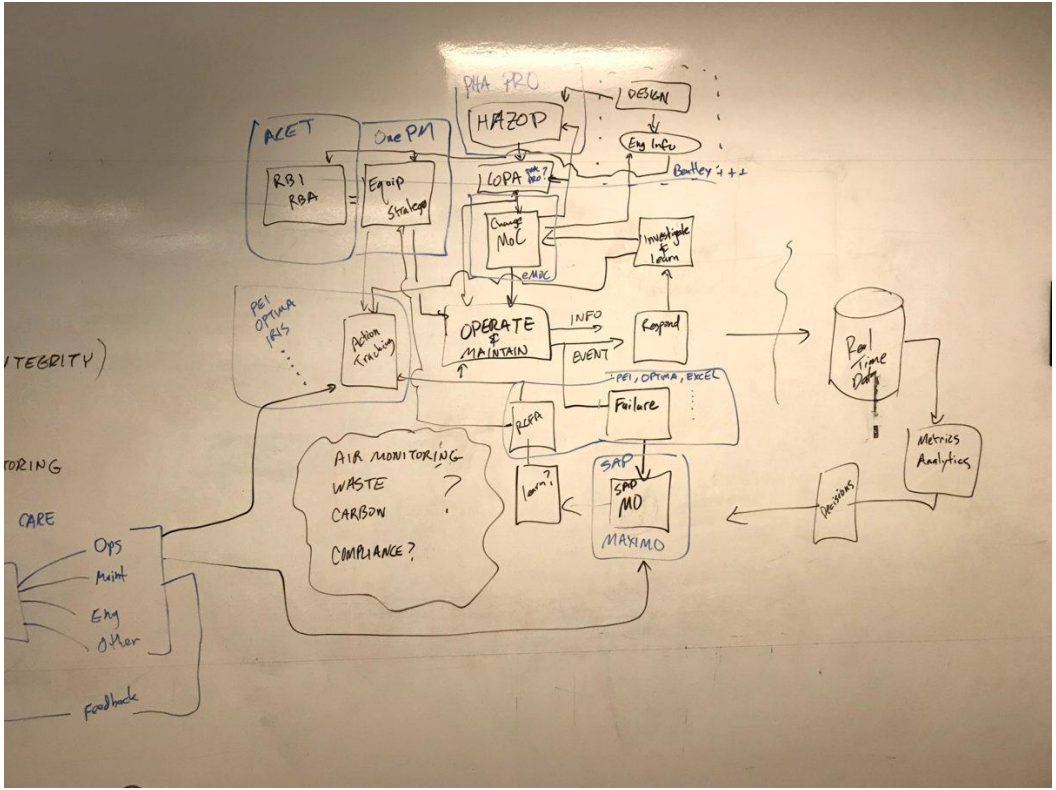
- 8,000 staff
- Over 25,000 contractors
- 47 Operated Assets
- 15,000 km pipeline

The Challenges That Started Us on This Journey

- Need for a step-change improvement in Process Safety
- Need to improve competitiveness
- Recognition by Executive Team that it was hard for people to access information and this was driving suboptimal decision making
  - Engineers spending 80% of their time finding information, 20% of time troubleshooting
  - No central repositories, single owners or commonality of tools
- Massive amounts of data, disconnected from other related data and disconnected from end users/consumers
- Compartmentalized organization resulting in compartmentalized information

A “Simplified View”
Everything is Related, Nothing is Connected

Many SME’s work in a Single Database focused on their expertise (Inspection, Maintenance etc.)



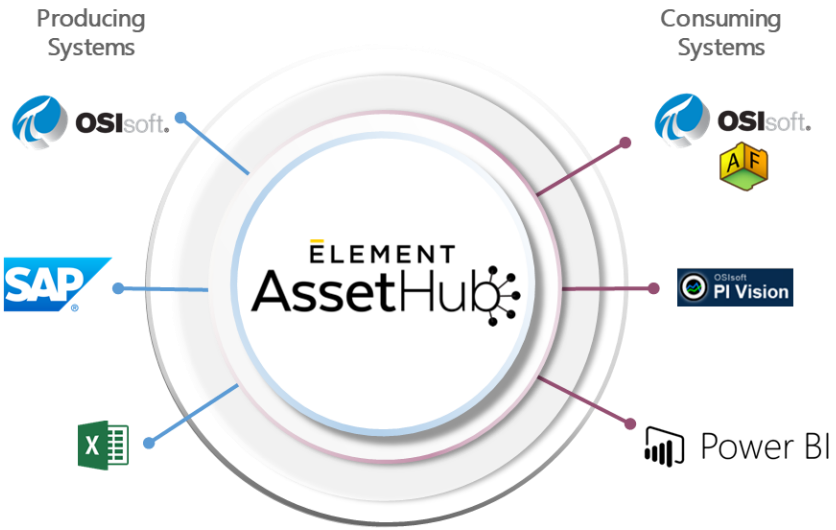
Much of the business value comes from relating the data to other data in different databases (equipment work orders to plant conditions)

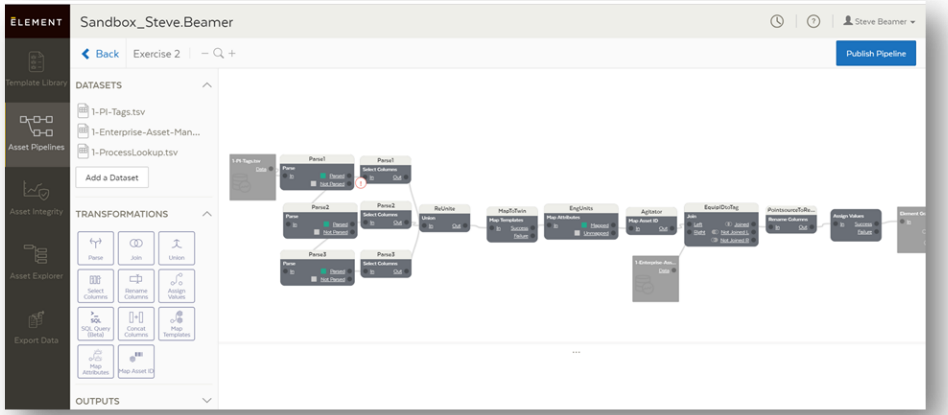
Our Journey

- 2014 – Began migration of data to data lake to facilitate “Big Data” projects
  - Worked with Palantir, a tech startup company across several parts of the business
    - Based on successes in other parts of business, CEO sponsored global adoption
    - Dedicated team with executive leadership eliminated barriers to speed deployment
  - This was seen as a step change in enabling multiple technology projects to succeed – Data access via historians is now considered to be “business critical” – no longer a nice to have.

- 2016 BHGE collaboration to build a “Plant Operations Advisor”. Problem – align Real Time (PI) tags to common hierarchy to feed to BP Data Lake to then feed to BHGE Data Lake.
  - Completed first asset ~17,000 tags, fed from our PI Historians took 6+ months to map and align with 5 FTE resources including documenting the process.
  - Realized their must be a better way to do this and asked for help from OSIsoft

The Accelerator
Element AssetHub: Connect, Manage, and Share Asset Data

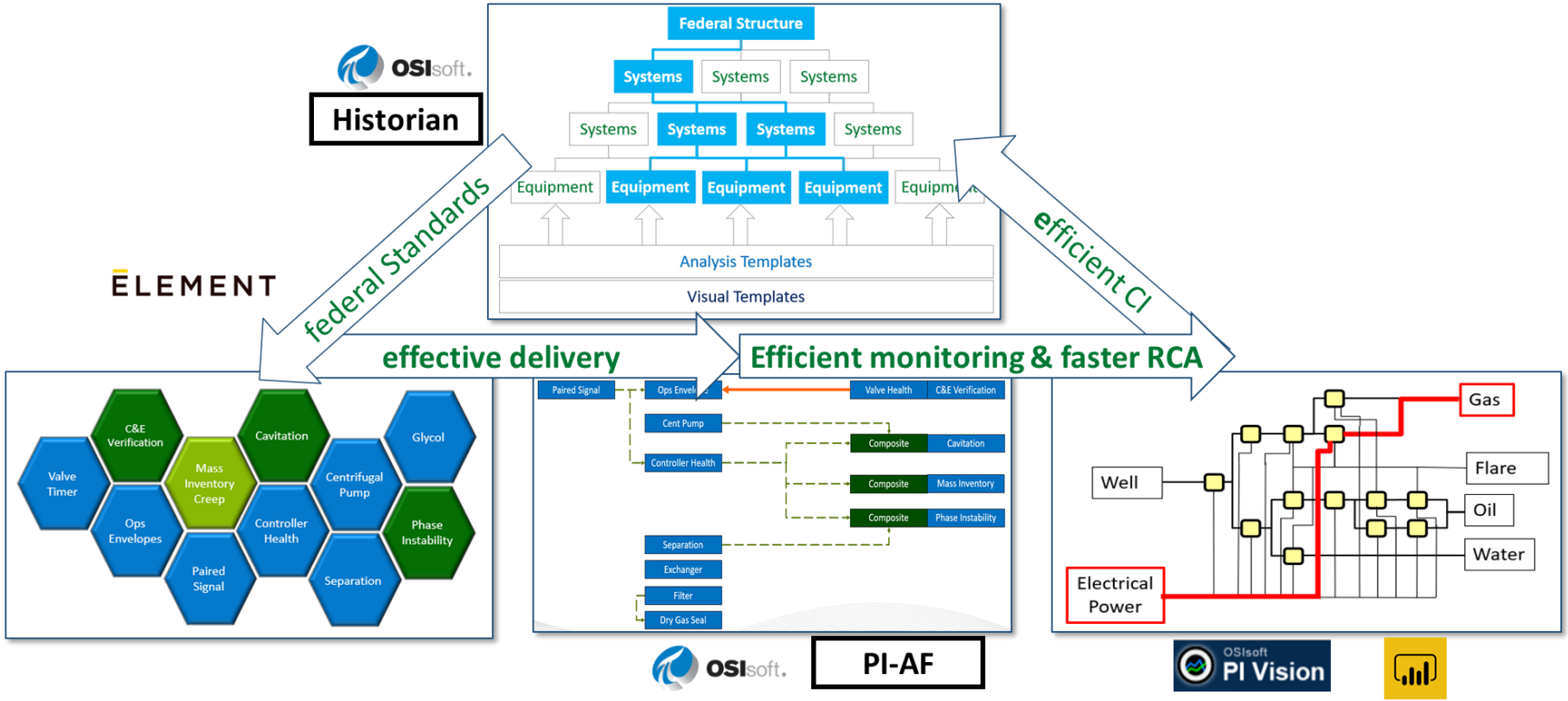




Where We Are Today – 18 months later

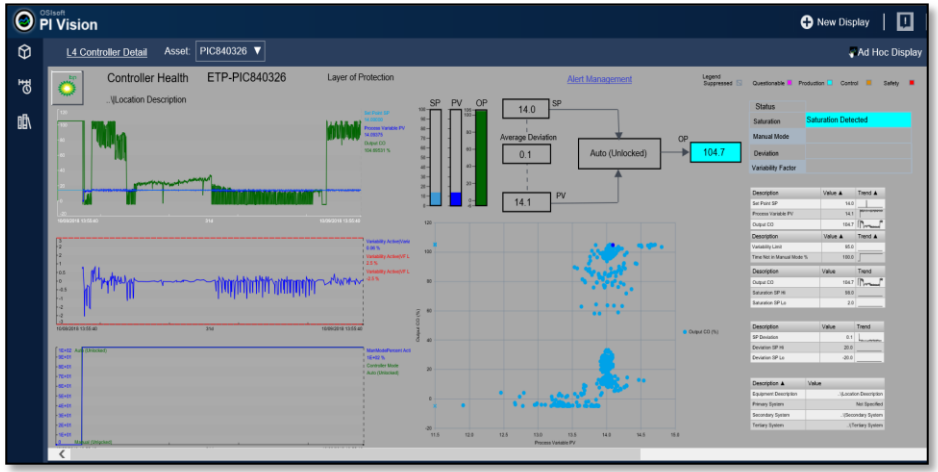
- Total Assets: 33 ~ 70% complete – taking 4 – 6 weeks per asset with 1 FTE
- Time series tags: 1m+. Data connections built 30m+.
- Other data sources: 6000+ (i.e. SAP, Hazops, Spreadsheets, limits etc.). For example, we are now automatically storing a history of HAZOP demands which will support better analysis in the future
- Annual data points made accessible via "digital twin" models: 100B+ (mostly time series data)
- Alignment of internal data sources across multiple systems in the Data Lake vs attempting to do so in the Core Systems. Availability of data, combined with live analysis to assist decision making is now tangible.

Setting the Foundations for Scaling



What Enterprise Framework Enabled (PI-Vision on AF)

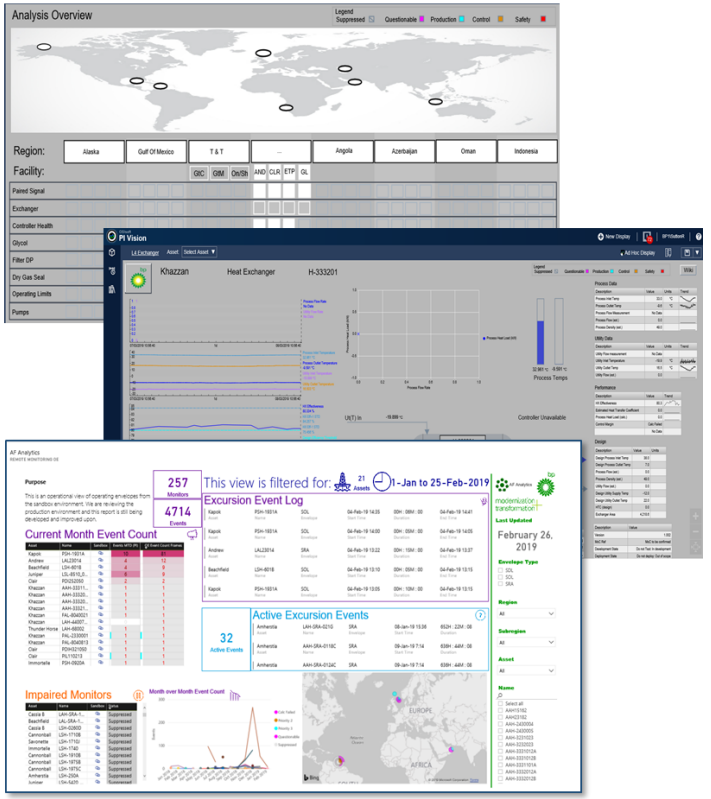
- Common data view (digital twin) allowed us quickly build and deploy AF's
- Standardized process analysis template for global adoption
- One global workstream instead of multiple assets/regions "reinventing the wheel"



Global Templates for Analytics

Requested Analytic	Hopper	Backlog/Dev	Deployed
Paired Signal			X
Heat Exchanger			X
Controller Health			X
Glycol System Performance			X
Filter DP			X
Dry Gas Seal			X
Operating Envelopes			X
Pump Performance Monitoring			X
Progressive Cavity Pump Monitoring			X
Compressor Performance	X		
Controller Valve Position	X		
Deviation Indicator Analytics - Normalisation		X	
Predictive analysis – future tags		X	
Gas Flow Analytics		X	
Level Inventory Monitoring Analytics	X		
Nitrogen system Analytics - Yevgeniy & Team	X		
Predictive facility trouble-shooter	X		
Produced water monitoring Analytics		X	
Product Quality Analytics	X		
Production Chemistry - Excursion Analytics		X	
Production Chemistry limit / like SDL, SOL	X		
Seperator - Density profiler Analytics		X	
Water injection system Analytics - Yevgeniy & Team	X		
Pipeline Stability	X		
Gas Turbines	X		
Lube oil & Utilities	X		
Choke Monitoring	X		

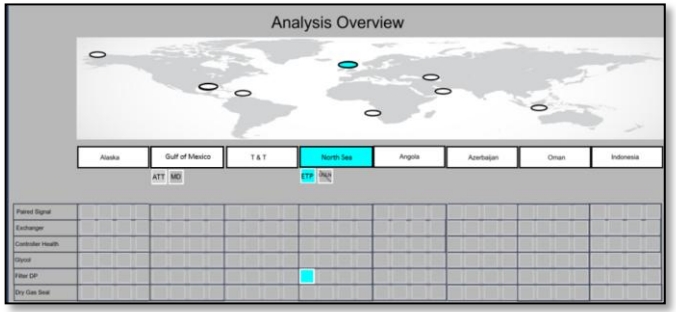
Evolving list – user input growing

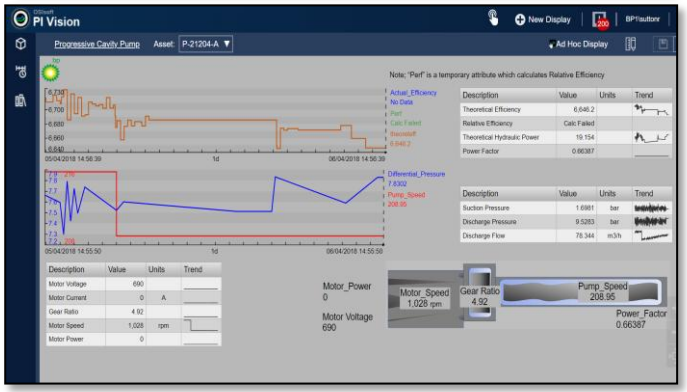


PI-AF Vision – One Team delivers Analysis in 3 days!

Remote Operations Pump Analytic delivered to Glen Lyon ACE for Critical Pump Start-Up.

- During the PI-AF roll out workshop in the North Sea, the Glen Lyon(GL) Team presented a business problem with produced water Progressive Cavity Pumps which were significantly impacting production. The pumps supported a 20 mboed production improvement opportunity. (Approx $400m/yr)
- The Analysis provides absolute and theoretical values of motor and hydraulic power and efficiency and is in the process of being extended to show leakage flows (also known as slip) and power offset relative to the Manufacturer's curves for the pumps. The analytic provides Absolute & Theoretical values which are visualised to create a clear insights into any potential deteriorating performance. Work is already underway to develop the Analysis even further.
- The PI-AF monitoring capability is part of a suite of Analytics and Dashboards to be deployed to additional regions over the coming months.





How Are We Measuring Success?

- Business Improvement – Availability/Reliability of Plant, Production Improvement. Early guesstimates used to justify the project. Actuals against baseline is measured.
- Speed of Development and Deployment – Metrics developed in Agile process in tranches of 6 and rapidly deployed globally
- End user feedback – both quantitative (usage of the tools and analytics) and qualitative (regular engagement)

Learnings

- No need to change core systems – maintain your investment AND when the time comes to change them – modern architecture and connectivity are extremely important for the future. VALUE CONNECTIVITY OVER FEATURES in selecting tools in the future.
- Data Lake is the beginning not the end. By itself, it does not solve any problems.
- Build useful data sets (digital twins) by equipment class for multiple use cases vs a use case per application.
- AF templates help to deploy at pace and enabled other initiatives as they materialized. Hard to scale AF without a “Federal Structure”.
- Enable the data owners to curate and maintain the models in order to democratize the data.
- We had to work with our key suppliers as partners vs a traditional customer/supplier relationship. MVP (Minimum Viable Product) vs POC (Proof of Concept). MVP → Scale.

Summary

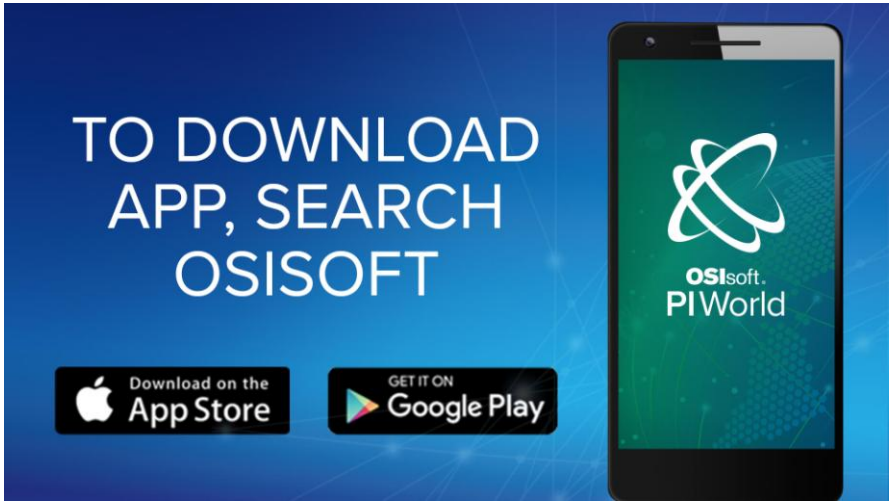
- Early collaboration with Strategic Partners (Palantir, BHGE, Microsoft) put is in the cloud/big data world early. Adoption of OSIsoft Enterprise agreement enabled the business to support many of the big data projects.
- Collaborating with key suppliers helped us to scale (MVP → Scale)
  - (BHGE and Palantir deploying solutions in a cloud/big data environment)
  - (OSIsoft and Element Analytics on organizing our data and deploying AF quickly)
- Alignment of data to a common Federal Structure in the Data Lake allowed us to develop and deploy fast for PI-Vision, POA, and several recent initiatives through the use of AF. Data Lake is one enabler not the complete answer.
- Use cases we did not anticipate at the time are leveraging the same data models to move more quickly.

Questions?

Please wait for the **microphone**

State your **name & company**

Please remember



BACKUP

Element AssetHub