From Things to Outcome
IoT Journey for Energy/Utilities Industry with SAP

SAP India
15th July, 2016

From Things to Outcome
IoT is About Creating Tangible Business Outcomes

Outcomes

Value chain

The Outcomes Customers Want

Lower cost	Optimized productivity	Improved turnarounds	New products & services
New revenue	Increased uptime	Faster deliveries	Usage-based pricing
Greater capacity	Better efficiency	Less waste	New business models

Create new business value and ecosystem advantages — Create — **Action to Outcomes**

Evolve business processes to turn insight into outcomes — Evolve — **Insight to Action**

Know where opportunity and risk exists from connected data — Know — **Thing to Insight**

Things

Digital capabilities are changing everything.

1 Hyper-connectivity

2 Super-computing

3 Cloud computing

4 Smarter world

5 Cybersecurity

SAP envisions the digital energy network.

Digital energy network

Connected hydrocarbon logistics

Connected assets

Connected customers

Connected oilfields

Connected Projects

Connected workforce

IoT is at the Heart of the Energy Industry Transformation

IoT Use Cases for Oil and Gas Industry

- Monitoring of remote assets
- Carrying out SAP Transactions in remote sites
- Predictive Maintenance
- Well Performance Management
- Production Analytics

- Pipeline monitoring through drones
- Predictive Maintenance
- Condition based Maintenance
- Pipeline Monitoring Dashboard
- Asset Information Network

- Link to enterprise resource planning (ERP) data to trigger maintenance workflow
- Plant dashboards and trend analysis
- Real Time Alerts
- Asset Information Network
- Monitor and Manage Refinery Performance

- Connected Logistics
- Geo Fencing
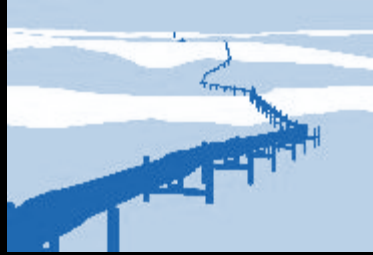- Optimized Distribution

- Connected Cars
- Parking assistance
- Smart appliances
- Heat as a service
- Smart Retailing
- Connected Homes (LPG Leak/LPG Cylinder Re-fill)

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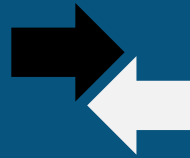- Optimized Distribution

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Transaction Availability for Remote Sites

Disconnected Scenarios

Extend SAP Transactions Offline

Inventory Management
Materials Management
Plant Maintenance

The solution can also be used to extend other SAP functional areas to be available offline. Functional areas could include SRM, SCM, HR, EH&S, QM, ESS, Time Entry, POS, etc.

Inventory Management

1. Create/print Inventory Document
2. Enter/change Inventory Count
3. Process List of Differences
4. Reports

Materials Management

1. Display/manage Materials and Stock in multiple storage locations
2. Display Purchase Orders and Create/Change Requisitions
3. Goods Movements (issue, receive, reverse materials)
4. Service Entry Sheets
5. Display/change Equipment Bill of Material
6. Approvals
7. Reports

Plant Maintenance

1. Notification Processing (malfunction only)
2. Work Order Processing (planned/corrective, repair, services)
3. Display Functional Location / Equipment
4. Display/create/change Measurement Documents
5. Enter/cancel Work Order Confirmations
6. Attachments to Work Order
7. Reports

Transaction Availability for Remote Sites
Significant Savings and Rapid User Adoption
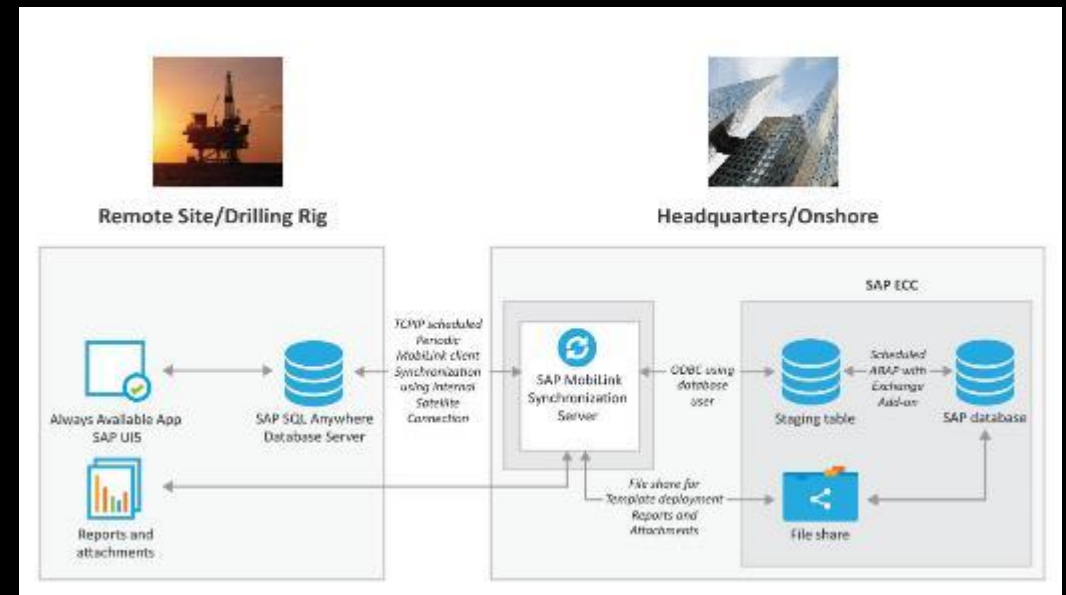
Business Challenges

- High latency communication (over VSAT / satellite) at remote sites
  - Causes delays or inability to complete work processes

- Intermittent to no connectivity
  - Leads to loss of productivity, labour inefficiencies, and frustration

- User experience is complex and slow for the needs of remote end users

Solution

- Co-innovated with SAP for a TARS (Transaction Availability for Remote Sites) solution to extend SAP functional areas such as Inventory Management, Materials Management, Plant Maintenance to be available offline at remote sites

Business Benefit

- **€1.7M** Upfront savings - Decrease in training budget of €244K per rig (7 rigs)

- **€235K** annual saving - Decrease in annual operating costs for managing the solution

- Rapid user adoption and ongoing user productivity

Production Analytics Dashboard
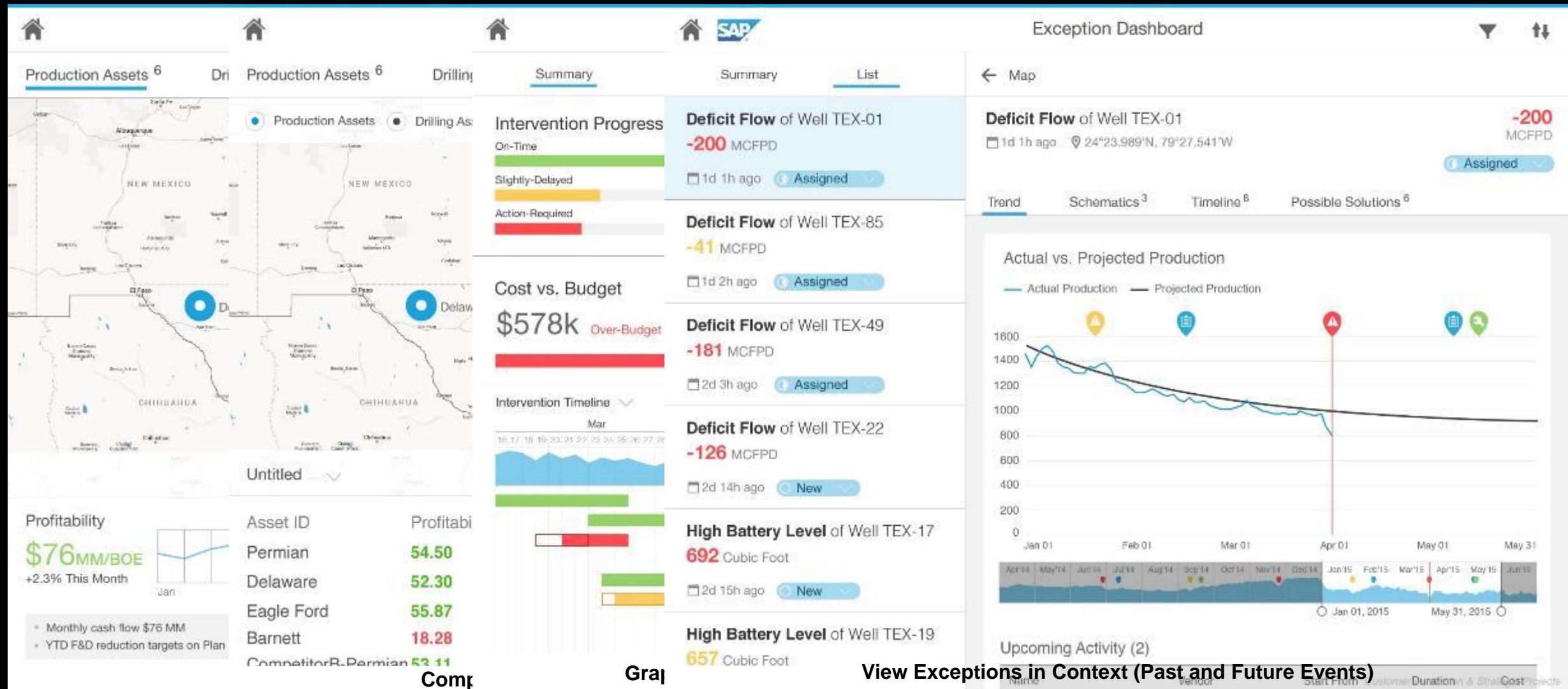
Wells, Reservoirs and Facility Management
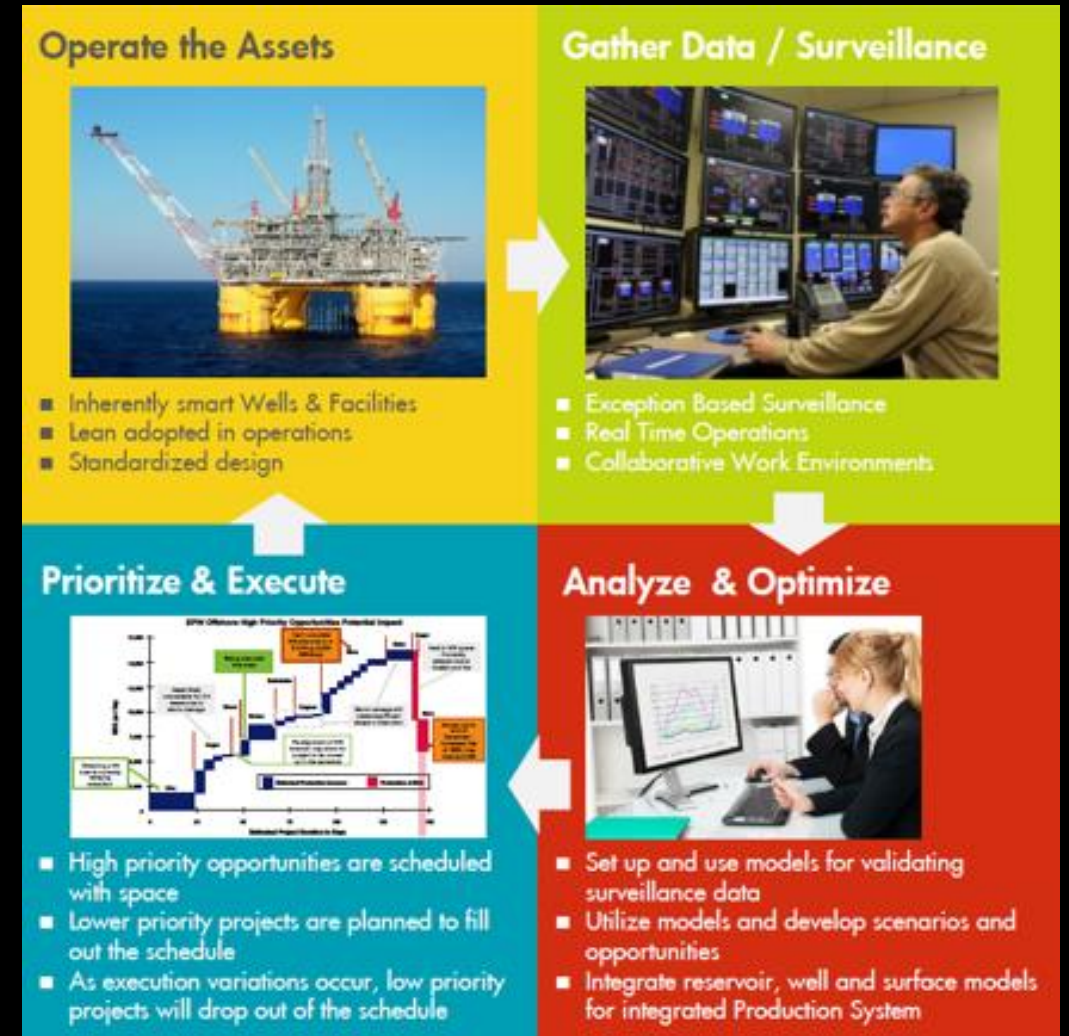# Shell Case Study

Business Challenge

- Wells, reservoirs, and facility management includes integration of multiple disciplines: reservoir engineering, geology, production technology, petro physics, operations, and seismic interpretation

- Objective is to create tools which will allow asset teams to build a professional understanding of their asset and identify opportunities to improve operational performance

- The challenge is that data required for decision making reside in numerous disparate data sources often distributed across the enterprise

Solution

- Utilize HANA platform to access disparate data sources, to create a virtual data model, compute statistics required for decision making, and display information in a user-friendly and interactive front-end tool

Business Benefit

- Enables asset teams to readily identify opportunities to minimize or reverse production decline

- Provides integration that allows for full WRFM workflow execution in a single environment
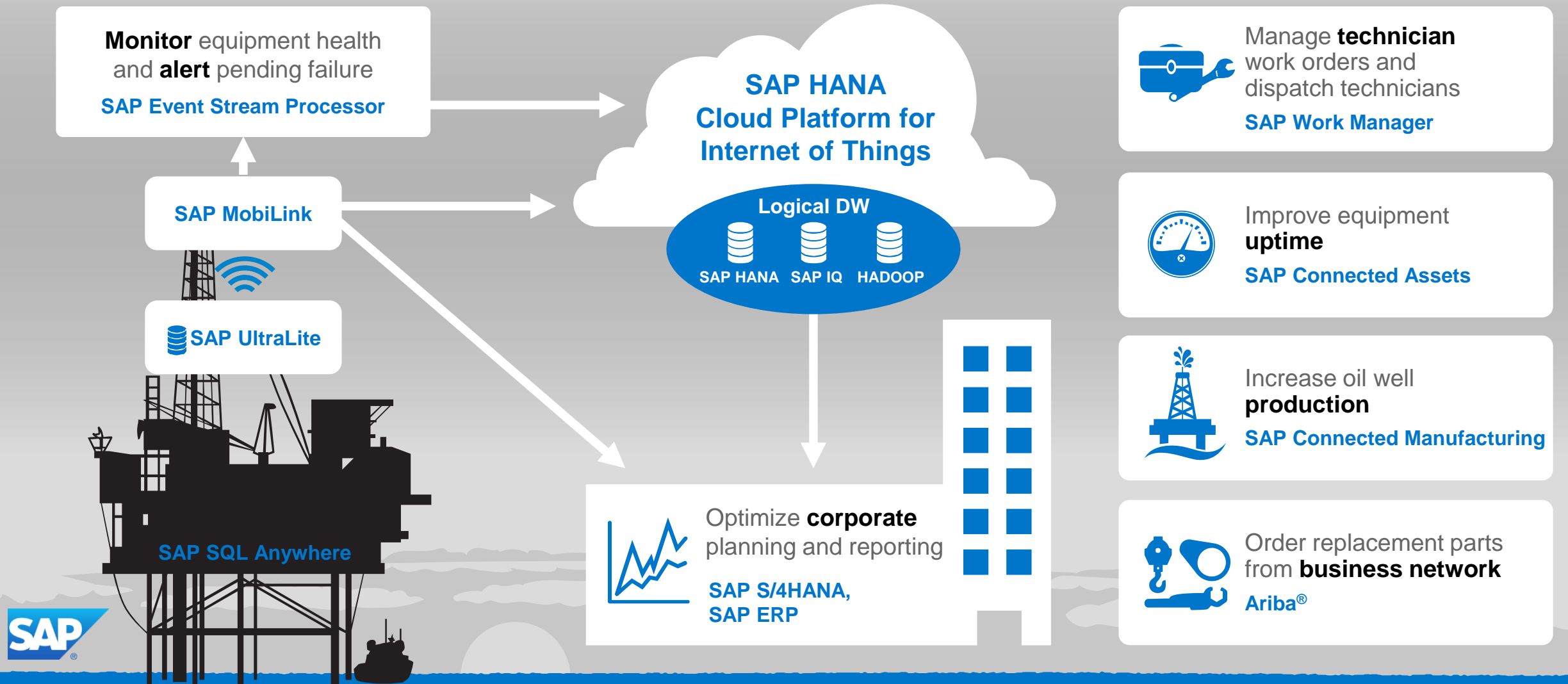

Operate the Assets
- Inherently smart Wells & Facilities
- Lean adopted in operations
- Standardized design

Gather Data / Surveillance
- Exception Based Surveillance
- Real Time Operations
- Collaborative Work Environments

Prioritize & Execute
- High priority opportunities are scheduled with space
- Lower priority projects are planned to fill out the schedule
- As execution variations occur, low priority projects will drop out of the schedule

Analyze & Optimize
- Set up and use models for validating surveillance data
- Utilize models and develop scenarios and opportunities
- Integrate reservoir, well and surface models for integrated Production System

Connected Oil Rig Maintenance with SAP Internet of Things

Connect with Intelligence at the Edge

Monitor equipment health and **alert** pending failure

SAP Event Stream Processor

SAP MobiLink

SAP UltraLite

SAP SQL Anywhere

Transform Business Operations

SAP HANA Cloud Platform for Internet of Things

Logical DW

SAP HANA   SAP IQ   HADOOP

Optimize **corporate** planning and reporting

SAP S/4HANA, SAP ERP

Re-imagine Business

Manage **technician** work orders and dispatch technicians

SAP Work Manager

Improve equipment **uptime**

SAP Connected Assets

Increase oil well **production**

SAP Connected Manufacturing

Order replacement parts from **business network**

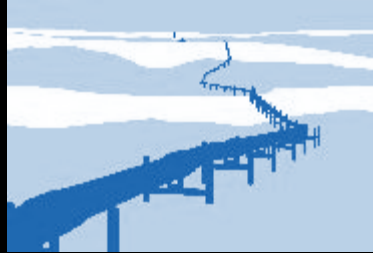**Ariba®**

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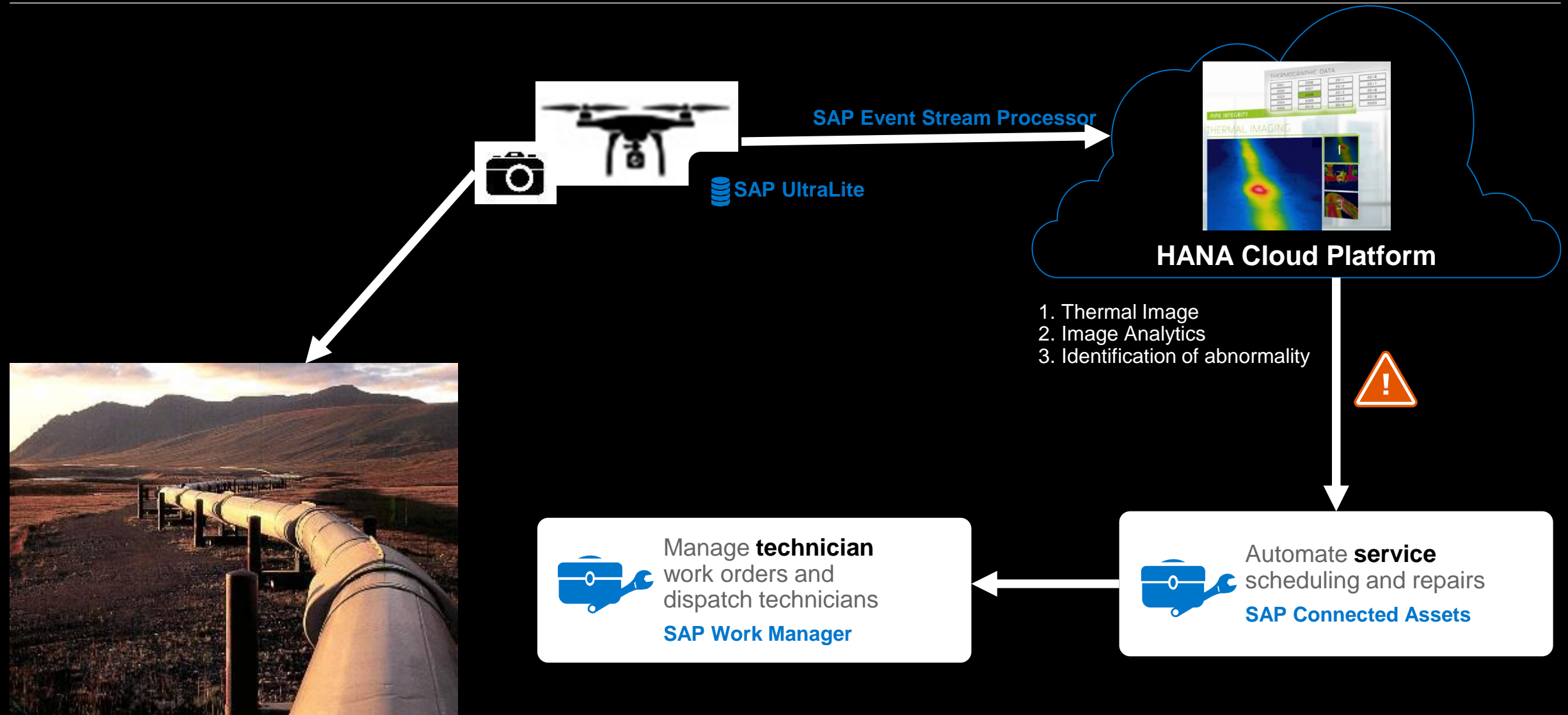- Monitor and Manage Refinery Performance

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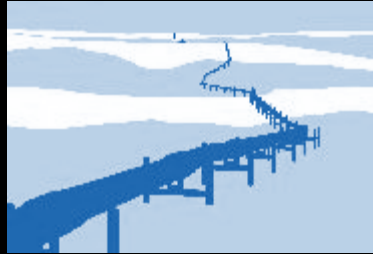- Connected Homes (LPG Leak/LPG Cylinder Re-fill)

Pipeline Monitoring Through Drones and SAP IoT Solution

SAP Event Stream Processor

SAP UltraLite

HANA Cloud Platform

1. Thermal Image
2. Image Analytics
3. Identification of abnormality

Manage **technician** work orders and dispatch technicians

SAP Work Manager

Automate **service** scheduling and repairs

SAP Connected Assets

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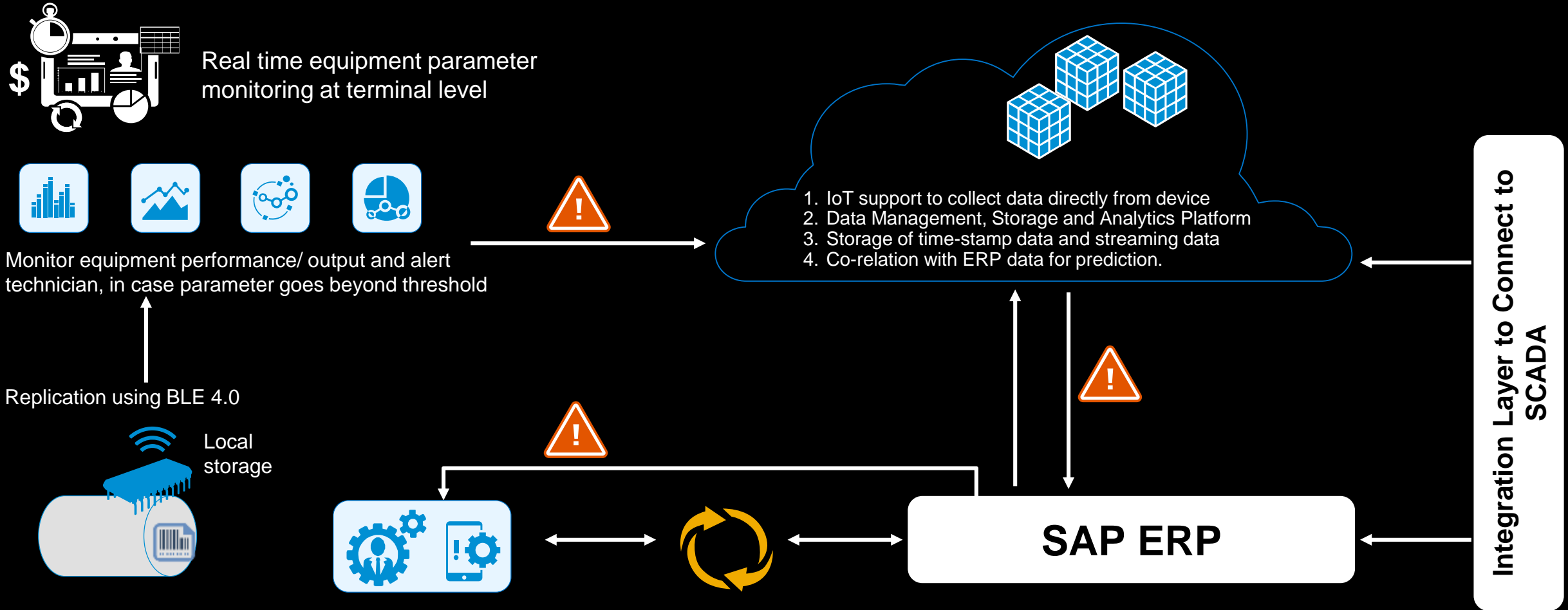- Monitor and Manage Refinery Performance

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Plant Dashboard, Trend Analytics and Condition Based Maintenance

Real time equipment parameter monitoring at terminal level

Monitor equipment performance/ output and alert technician, in case parameter goes beyond threshold

1. IoT support to collect data directly from device
2. Data Management, Storage and Analytics Platform
3. Storage of time-stamp data and streaming data
4. Co-relation with ERP data for prediction.

Replication using BLE 4.0

Local storage

SAP ERP

Integration Layer to Connect to SCADA

Maintenance Technician uses mobile for carrying out maintenance. Bar code/RFID is used to identify the equipment and post maintenance data is synched back to SAP ERP system

SAP Predictive Maintenance and Service
Leverage operational insights to drive innovative new business models
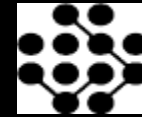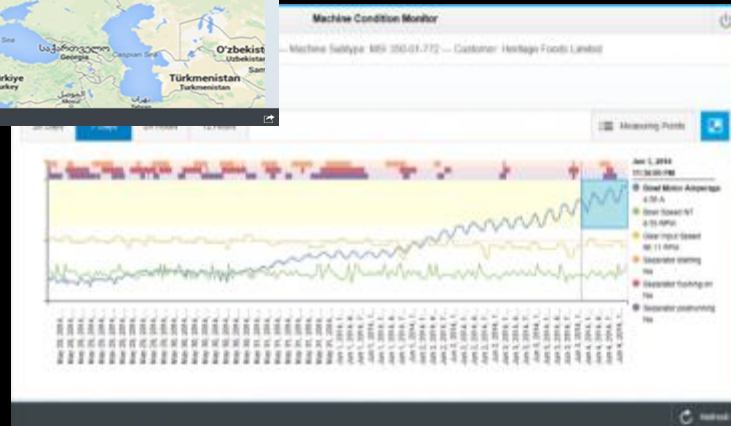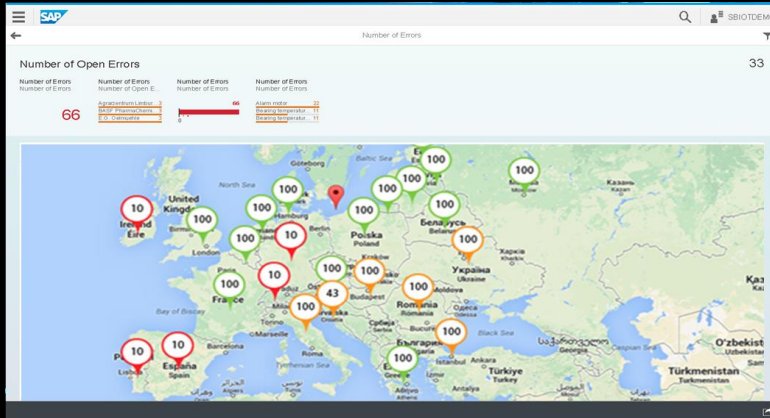
Sense

Remotely sense operational data from equipments

Monitor Analyze Predict

Analyze and monitor equipment data and correlate with business information to predict future malfunctions

Act

Optimize maintenance and service operations and enable new business models around the equipment

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Typical results*

Organizations adopting preventive and predictive maintenance and service approach as compared to organizations practicing reactive maintenance and service

-44% Lower unplanned downtime

-17% Lower annual service and maintenance costs

+28% Higher return on assets

* SAP Performance Benchmarking

Use Case - M2M Learning - BASF

Lighthouse Projects
Predictive Analysis in Maintenance

□ ▪ BASF
The Chemical Company

Goal of PoC :

- Identify direct / indirect root-cause(s) for asset failure in one particular plant by combining production process data (structured data) with mainly text-based maintenance information (unstructured data) from SAP PM module in an unguided form using „big data" technology.
- PoC should lay the ground for predicting asset failure and allow advanced steering of plant maintenance in a highly scalable way.

Process :

- BASF provided > 200 GB of process control data historian from 3 consecutive years and the related SAP PM data for the same plant and period.

Special challenge :

- No request to check on a specific asset failure
- No information on production flow were given.
- Process control data and SAP PM with no direct link
- Solution should work for non-experts

t

Plant Structure

Sensor Data

Maintenance Notifications
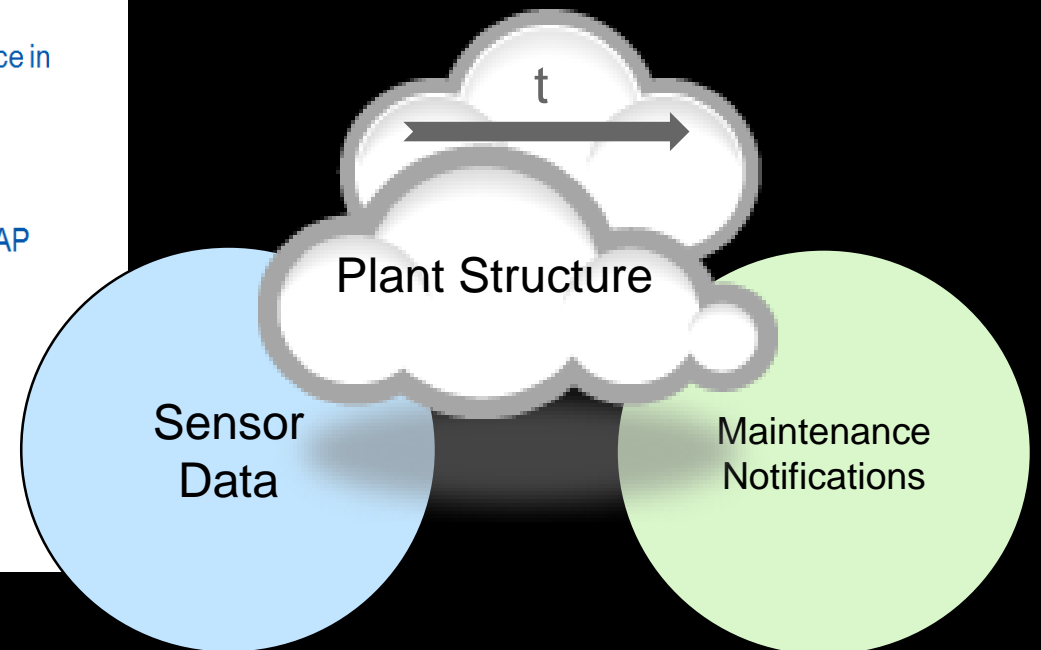
Sensors Across 3 Years Calculated in 9 Seconds

Aggregations based on of $6 \cdot 10^9$ sensor readings in less than 9 seconds

PM2 (BASF_USER)   ld9977.wdf.sap.corp 00

Table Name:

ANALOG

Columns | Indexes | Further Properties | Runtime Information

General

|	
Total Memory Consumption (KB):	192.010.282
Number of Entries:	6.022.679.366
Size on Disk (KB):	188.094.424
Partition Specification:	HASH 10 FEATURE

PM2 (BASF_USER)   ld9977.wdf.sap.corp 00

SQL | Result

```
select feature, count(*), min(sensor_value), max(sensor_value)
  from "BASF"."ANALOG"
  group by feature
```

	FEATURE	COUNT(*)	MIN(SENSOR_VALUE)	MAX(SENSOR_VALUE)
2743	T2220/R.SP	28.793	0	262,4952
2744	T2240/T_Oxid.LMN...	29.650	0	100
2745	T2240/T_Oxid.PV_IN	29.472	0	100
2746	T2241/M.U	44.990	0	155,6658
2747	T231601/M.U	69.063	0	186,6845
2748	T231602/M.U	71.025	0	186,3014
2749	T232600/R.PV_IN	13.742.045	0	187,4857
2750	T233000/M.U	40.910	0	53,7167
2751	T233620/R_KW.PV_IN	194.597	0	206,5627
2752	T2344/M.U	362.078	0	83,0707
2753	T236620/Y1_STAT_...	183.041	0	100
2754	T2604/M.U	116.561	0	62,2632
2755	T3020/R.SP	26.440	0	85
2756	T3050/R.SP	26.383	0	75
2757	T3135/R.SP	26.373	0	80
2758	T3140/R.PV_IN	26.794	0	70,2672
2759	T3140/R.SP	26.368	0	77
2760	T3150/R.PV_IN	28.103	0	80,6836
2761	T3180/R.LMNR_IN	33.002	0	100
2762	T3180/R.SP	26.368	0	50
2763	T351010/R.PV_IN	286.115	0	98,7965
2764	T351010/R.SP	28.013	0	98,7965
2765	T6030/R.LMNR_IN	450.085	0	100
2766	U231974/M.U	1.290.196	-14.849,905	1.236.579,5
2767	U232971/M.U	3.137.985	0	2,2369
2768	U232974/M.U	1.755.266	0	1.255.538,8
2769	U232978/M.U	3.174.836	0	173,8548
2770	U232982/M.U	3.139.359	-1,013	8.085.500,5
2771	U236981/M.U	3.677.048	0	390.602,25
2772	W233600/M.U	12.826.417	-10,6645	27.465,377
2773	WRI Z/PSGFS	5.474.287	-104.228	1.168.746

Statement 'select feature, count(*), min(sensor_value), max(sensor_value) from "BASF"."ANALOG"
group by feature'
successfully executed in 8.841 seconds (server processing time: 8.839 seconds)
Fetched 2773 row(s) in 55 ms 196 µs (server processing time: 9 ms 406 µs)

Failure Pattern Based on Maintenance Notifications and Sensor Data
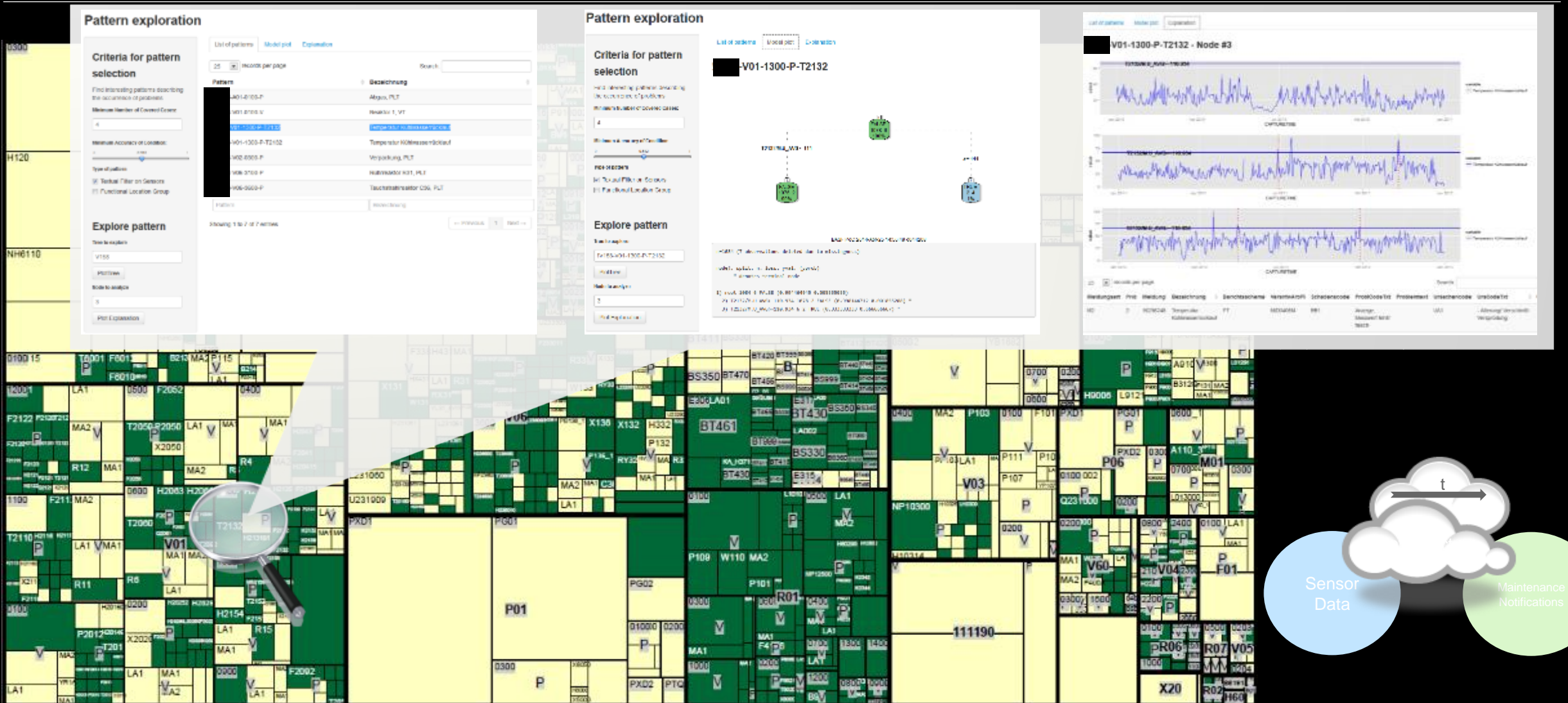
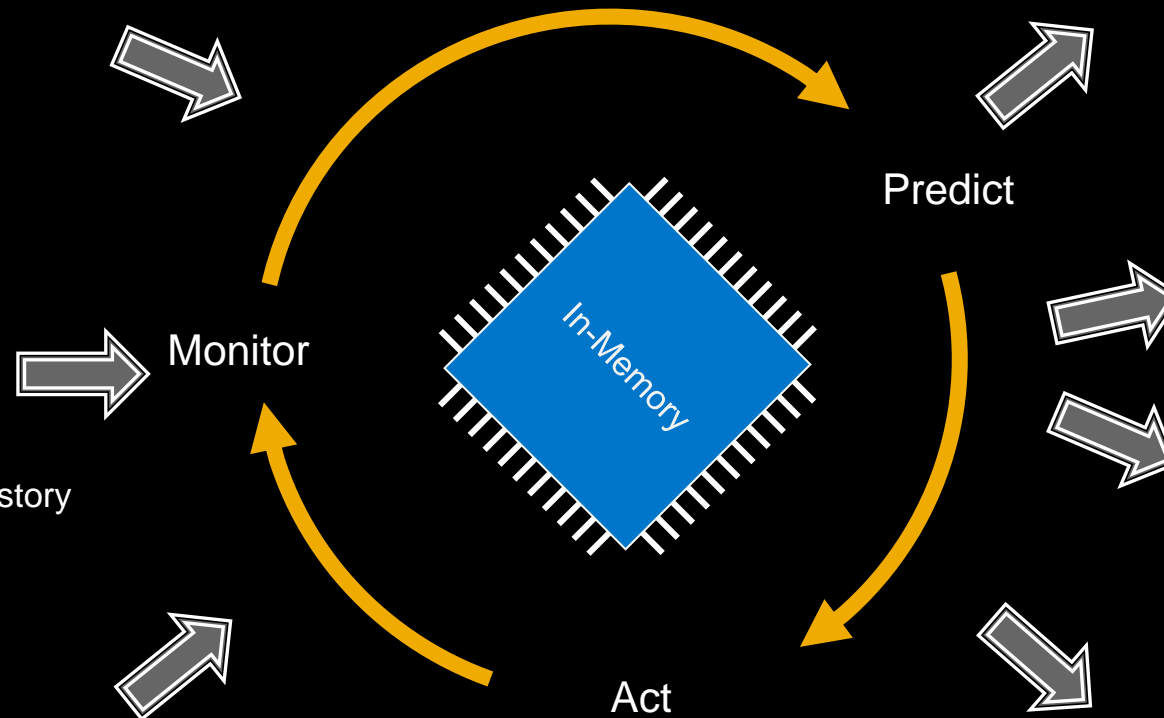# Our Approach – Combine Machine Data with Enterprise Data …

Machine Data

Sensor measurements
Production/Rework data
Geospatial data
Diagnostics
Events
Performance metrics
Battery status

…

Enterprise Data

Sales contract
Maintenance/ Service history
Customer profile

…

Third party data

Social media
Marketing/demographic data

…

Monitor

In-Memory

Predict

Act

Spare Parts Optimization

Production Quality Improvement

Maintenance Planning Optimization

Monitor and Manage Refinery Performance Leveraging IT/OT Integration
Valero Case Study - Youtube link: https://www.youtube.com/watch?v=ynjFEOk5Ncw

Business Opportunity

- Standardize metrics across refineries, provide headquarters real-time visibility

- Support industry leadership in worker safety and energy stewardship

- Integrate operational and financial data

- Support effective decision making with timely and consistent information

Solution

- The IT and OT was integrated using SAP MII (Manufacturing Integration and Intelligence)

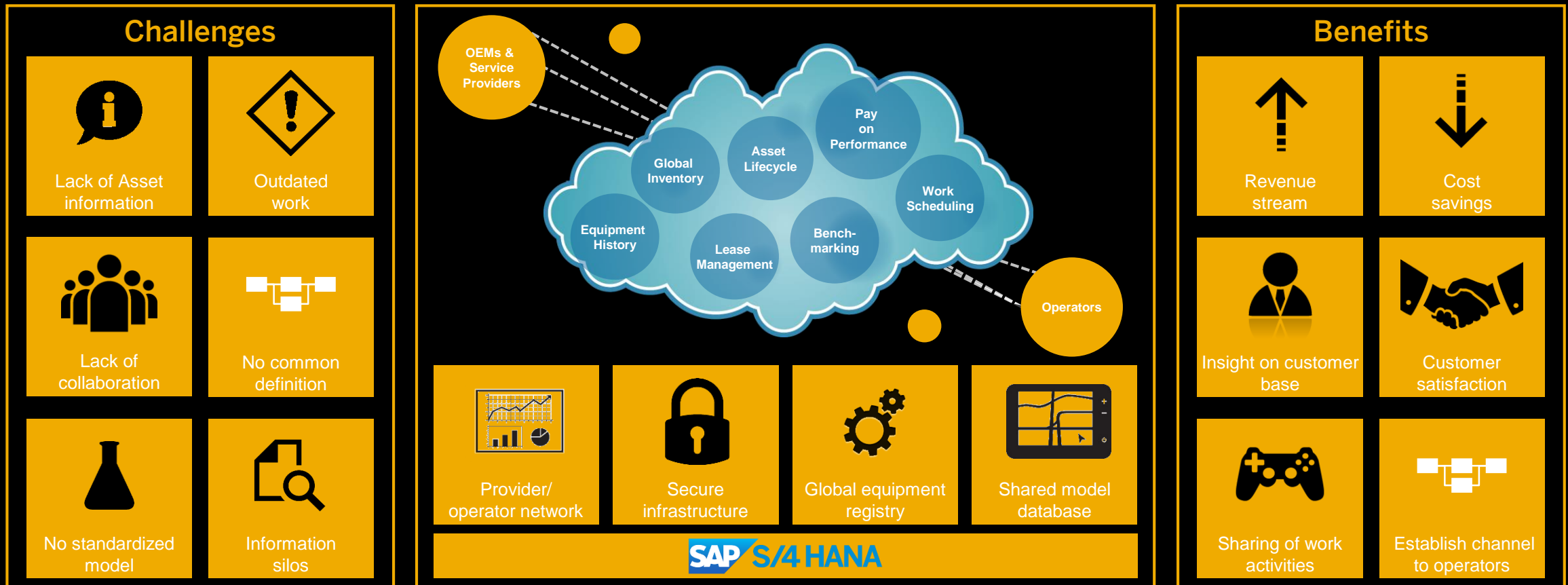## Business Benefit

- US$120 million in annual energy savings in one year

- Ability to trace financial impact of operational changes

- Cross-comparison of all refineries with common dashboards and key operational metrics

- Reduction in incidents

The Valero Refinery Management Team, at Headquarters and at the Refineries

"Same version of the truth in right time"

The Backbone of IoT in Asset Management – Asset Information Network

SAP Asset Intelligence network, a global network of machines bringing together business partners

Challenges

Lack of Asset information	Outdated work
Lack of collaboration	No common definition
No standardized model	Information silos

OEMs & Service Providers

Pay on Performance

Asset Lifecycle

Global Inventory

Work Scheduling

Equipment History

Lease Management

Bench-marking

Operators

Provider/ operator network	Secure infrastructure	Global equipment registry	Shared model database

SAP S/4 HANA

Benefits

Revenue stream	Cost savings
Insight on customer base	Customer satisfaction
Sharing of work activities	Establish channel to operators

SAP solution for collaborative asset management
SAP Asset Intelligence Network

Apps

Apps for collaborative processing of service bulletins, performance improvement, and spare parts change management

Content

A cloud portal of standardized content that defines and documents equipment and models, shared and stored, for a consistent definition between business partners

Network

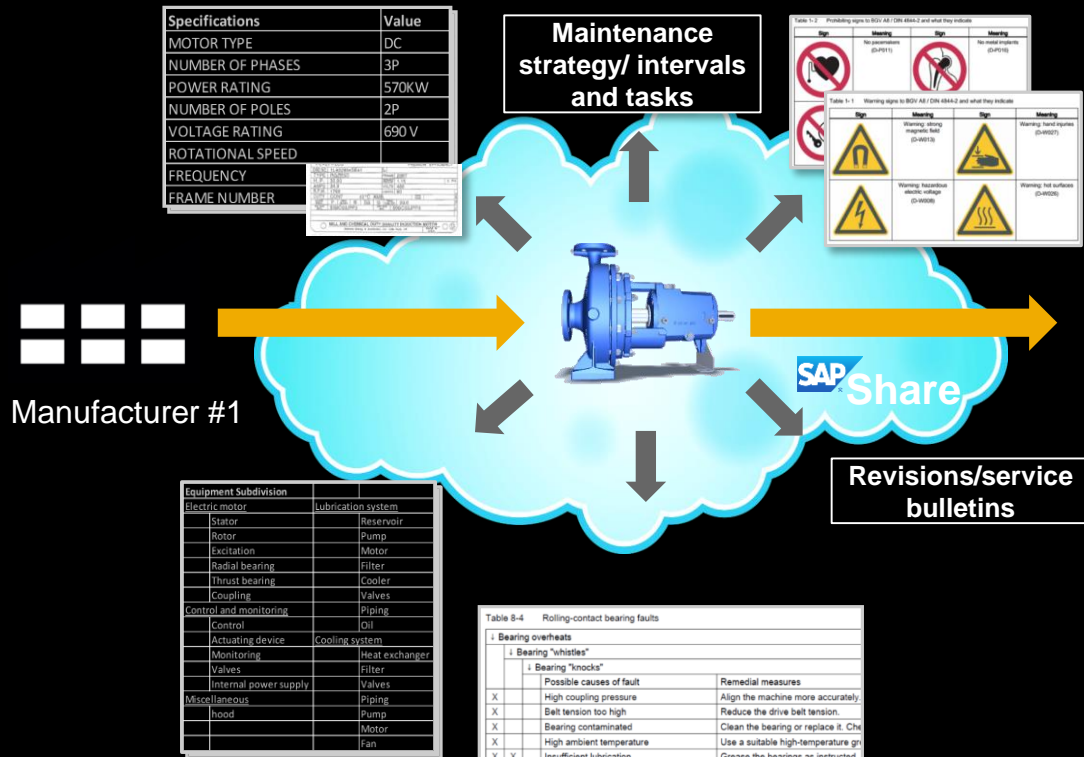A secure network to connect multiple business partners for inter and intra company collaboration

Combined together to deliver

SAP Asset Intelligence Network
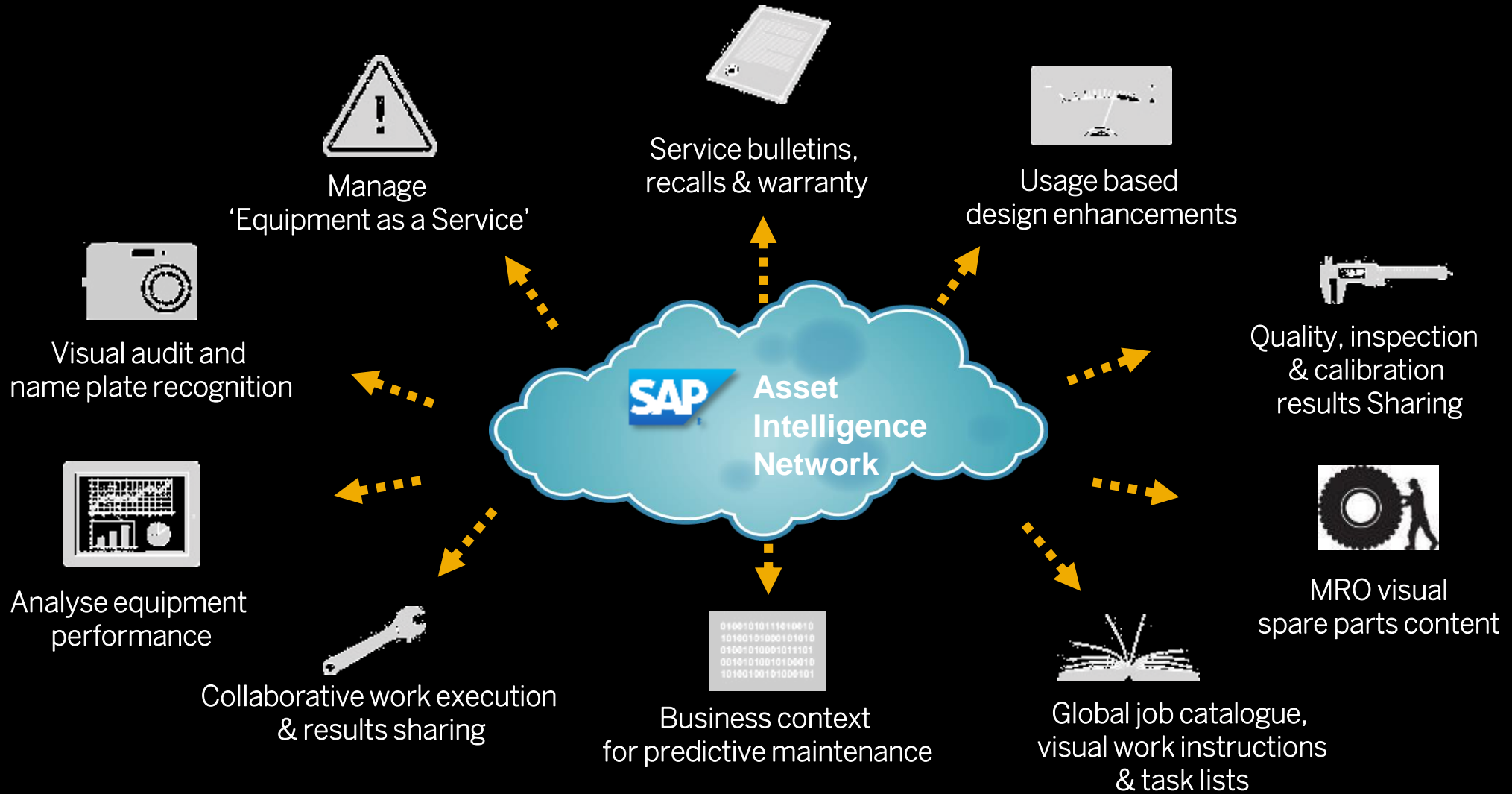
Publish & Subscribe to Asset Information

Manufacturer

Specifications	Value
MOTOR TYPE	DC
NUMBER OF PHASES	3P
POWER RATING	570KW
NUMBER OF POLES	2P
VOLTAGE RATING	690 V
ROTATIONAL SPEED	
FREQUENCY	
FRAME NUMBER	

Maintenance strategy/ intervals and tasks

Manufacturer #1

SAP Share

Revisions/service bulletins

Equipment Subdivision	
Electric motor	Lubrication system
Stator	Reservoir
Rotor	Pump
Excitation	Motor
Radial bearing	Filter
Thrust bearing	Cooler
Coupling	Valves
Control and monitoring	Piping
Control	Oil
Actuating device	Cooling system
Monitoring	Heat exchanger
Valves	Filter
Internal power supply	Valves
Miscellaneous	Piping
hood	Pump
	Motor
	Fan

Operator

Asset operator
Manufacturing
Industries

Asset operator
Chemicals

Asset operator
Oil & Gas

Asset operator
Utilities

Service Providers

Business Value

- Lower asset life cycle costs

- Establish one channel to many manufacturer's, EPCs and Service providers

- Higher asset availability

- Reduce manual asset search effort

- Receive notifications, service work summaries and service bulletins

- Push communication and alerts to manufacturers / service providers

- Reduce master data maintenance effort

- Higher process safety by transparent and bundled product – service offerings from manufacturer
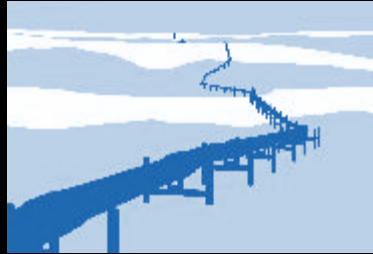
Rethink business processes:

Manage 'Equipment as a Service'

Service bulletins, recalls & warranty

Usage based design enhancements

Visual audit and name plate recognition

Quality, inspection & calibration results Sharing

SAP Asset Intelligence Network

Analyse equipment performance

MRO visual spare parts content

Collaborative work execution & results sharing

Business context for predictive maintenance

Global job catalogue, visual work instructions & task lists
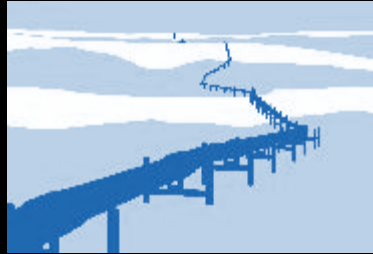
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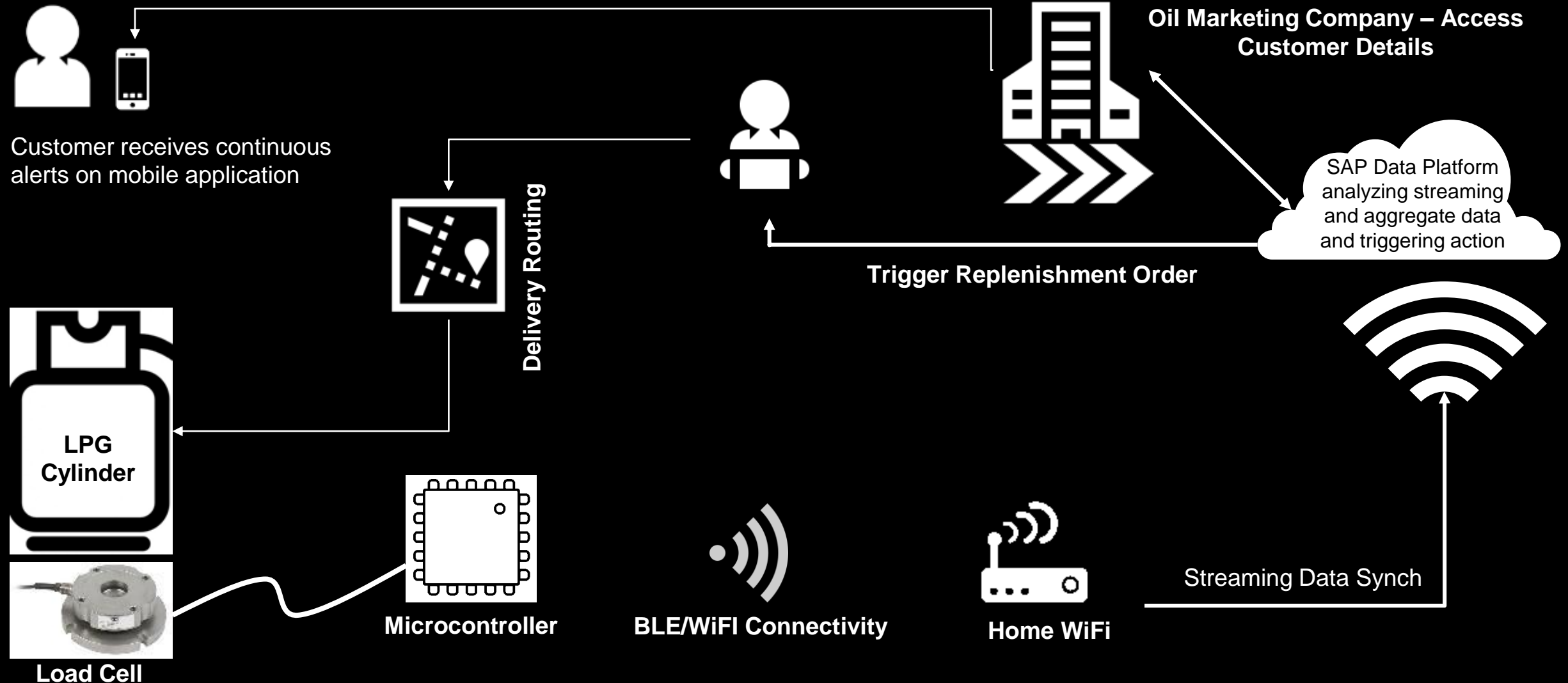- Geo Fencing
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Connected Fleet Management with SAP Internet of Things

Connect with Intelligence at the Edge

Monitor truck health and **alert** technician
SAP Event Stream Processor

SAP MobiLink

SAP UltraLite

GPS

Transform Business Operations

SAP HANA Cloud Platform for Internet of Things

Logical DW

SAP HANA   SAP IQ   HADOOP

SAP Data Services

Optimize **corporate** planning and reporting
SAP S/4HANA, SAP ERP

Re-imagine Business

Monitor traffic and optimize **productivity** of truck fleet
SAP Connected Assets

Optimize truck fleet **agility** by location
SAP Work Manager

Reduce truck fleet **maintenance** costs
Ariba®

Order parts from **business network**
Ariba®

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Connecting **Operational Excellence** with **IoT**

Connected Home

Customer receives continuous
alerts on mobile application

**Oil Marketing Company – Access
Customer Details**

SAP Data Platform
analyzing streaming
and aggregate data
and triggering action

Delivery Routing

Trigger Replenishment Order

**LPG
Cylinder**

Microcontroller

BLE/WiFI Connectivity

Home WiFi

Streaming Data Synch

Load Cell

Connected Vehicle with SAP Internet of Things

Connect with Intelligence at the Edge

Monitor car health and **alert** technician
SAP Event Stream Processor

SAP MobiLink

SAP Data Services

SAP UltraLite

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SAP HANA   SAP IQ   HADOOP

Optimize **corporate** planning and reporting
SAP S/4HANA, SAP ERP

Re-imagine Business

Engage **customers** with personalized offers
SAP Connected Retail

Automate **service** scheduling and repairs
SAP Connected Assets

Enable responsive **manufacturing**
SAP Connected Manufacturing

Order auto parts from **business network**
Ariba®

Mill Products & Mining

Mining and Metals Innovations for the Internet of Things

Optimized Mine Operations

- Real-time machine and sensor integration
- Fleet operations monitoring
- Real-time alerts
- Plant dashboards and trend analysis
- Logistics and quality monitoring
- Ore-grade sensing
- Linking to enterprise resource planning data to trigger maintenance workflow

Sales & Supply Chain Management

- Fleet operations monitoring
- Autonomous haul trucks
- Real-time logistics informatics
- Location intelligence
- Port management
- Asset information network

Compliance and Risk Management

- Sustainability monitoring
- Wearable devices to monitor hazardous exposure and fatigue
- Emissions monitoring and control

Connected Mining with SAP Internet of Things

Connect with Intelligence at the Edge

Monitor asset performance/ output and **alert** technician

SAP Event Stream Processor

SAP MobiLink

SAP UltraLite

SAP Data Services

Transform Business Operations

SAP HANA Cloud Platform for Internet of Things

Logical DW

SAP HANA   SAP IQ   HADOOP

Optimize **corporate** planning and reporting

SAP S/4HANA, SAP ERP

Re-imagine Business

Discover patterns and define **maintenance** for high performing assets

SAP Connected Assets

Simplify and streamline **technician's** tasks using augmented reality

SAP Augmented Reality Service Technician

Increase warehouse and **supply chain** efficiency by monitoring vehicle activity

SAP Asset Management

Optimize mine **production** plans based on real time inputs

SAP Connected Manufacturing

Example of IoT Use Cases with Customers

Remote control center and Internet-of-Things sensors to prevent failures and maximize productivity

Simple user interfaces require zero training

Wearable technologies protect people, comply, avoid shutdowns
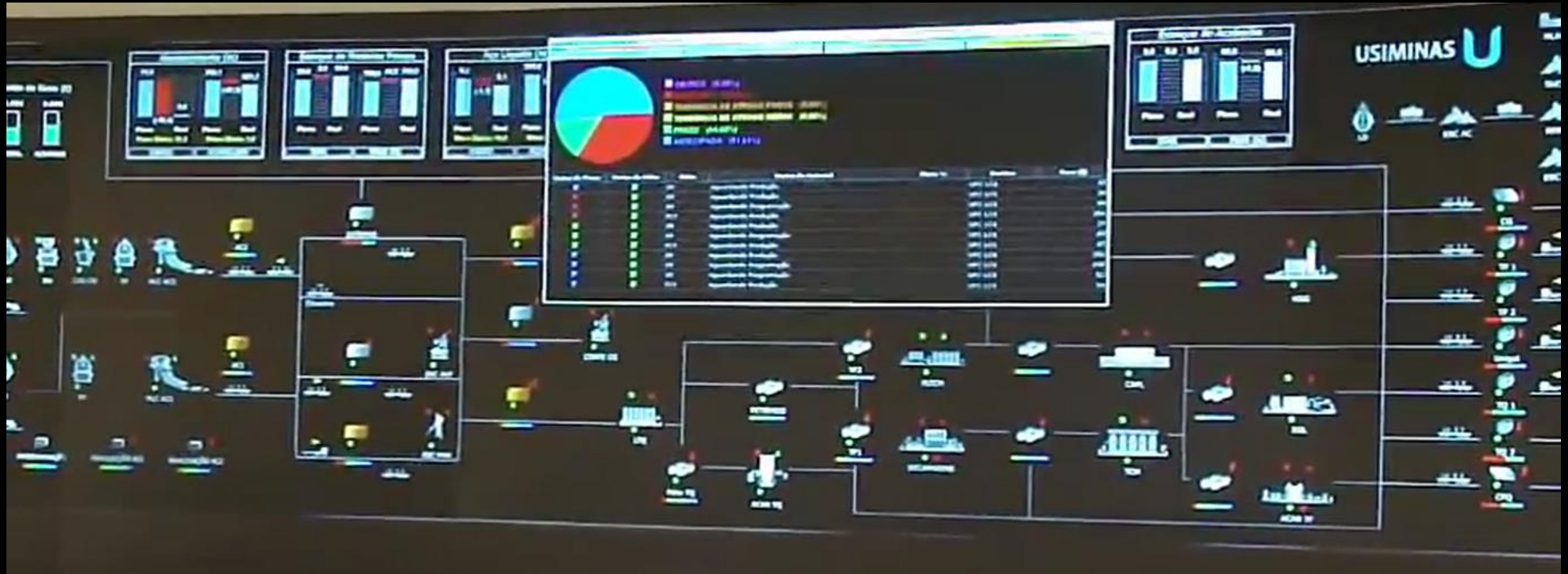
> "This is a differential that will allow even more efficiency in our operational lines, in addition to products' delivery efficiency gains."
>
> *Marco Antonio Castello Branco, President – Usiminas*

Chemicals

Chemical Industry Innovations for the Internet of Things
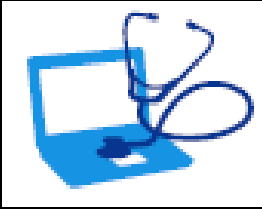
Predictive Maintenance - Assets can send signals about their status and performance to predict possible malfunctions and maintenance needs. 3D asset visualization delivered in a spatial context ("augmented reality") further enhances maintenance from a service perspective.
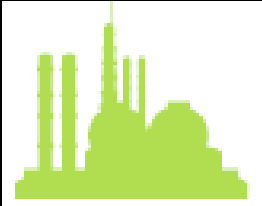
Operational Intelligence - By blending all your data, analyzing it in real time, and federating results for intelligent decision making, you can improve operational, safety, and environmental performance

Smart Products and Connected Logistics - Using sensors and active RFID tags, chemical firms can track and identify the location, condition, and authenticity of products. Such devices create Big Data that you can now process in real time to proactively mitigate supply chain risks

Utilities

SAP's Digital Strategy for Utilities

The new Energy World…

Electric Vehicles

Smart Homes

Consumers

Micro Generation

Charging Infrastructure

Smart Meters

Large Energy Storage

Large Power Plants

Smart Grid
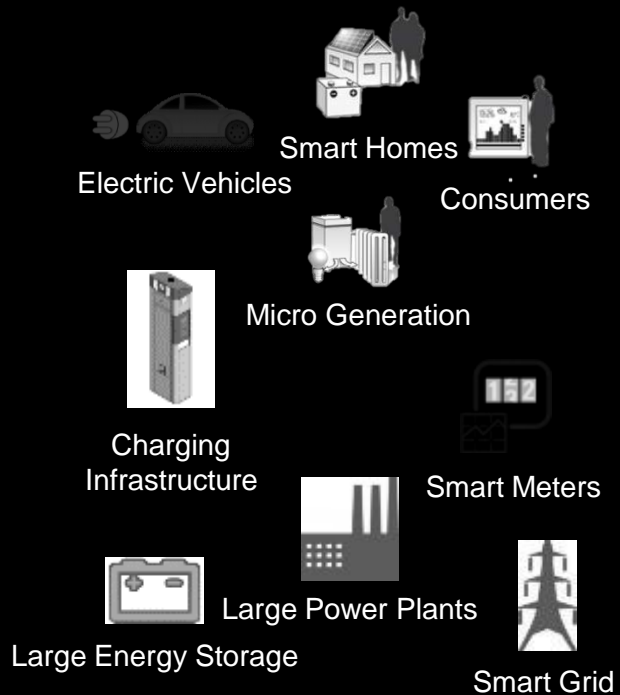
…requires integrated views on IT and OT data…

Customer View (IT)

- Contracts
- Interests
- Activity in Social Media
- Revenue / Profitability
- Installed Assets
- …

Asset View (OT)

- Energy Flow (Time Series)
- Sensor Data (temperature, etc.)
- Likelihood of Failure
- …

…which are provided by S/4HANA with CEC and Cloud for Energy

Customer experience Omnichannels

S/4 HANA Suite

IS-U

EDM

Cloud for Energy
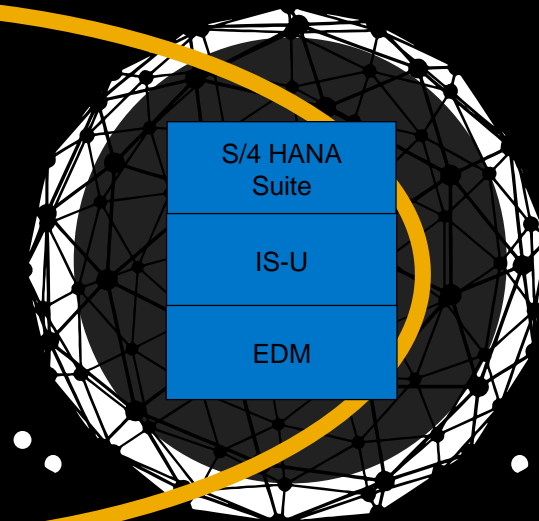
IoT in Utilities is the cornerstone for Digital scenarios
Connecting digital strategy with business strategy

Business Drivers

Renewable Energy Resources

De-Carbonization

Security & Reliability of Supply

Liberalization and Deregulation

Competition on existing and new business models

Energy Efficiency

Omni-Experience of the Digitalized Industry Society
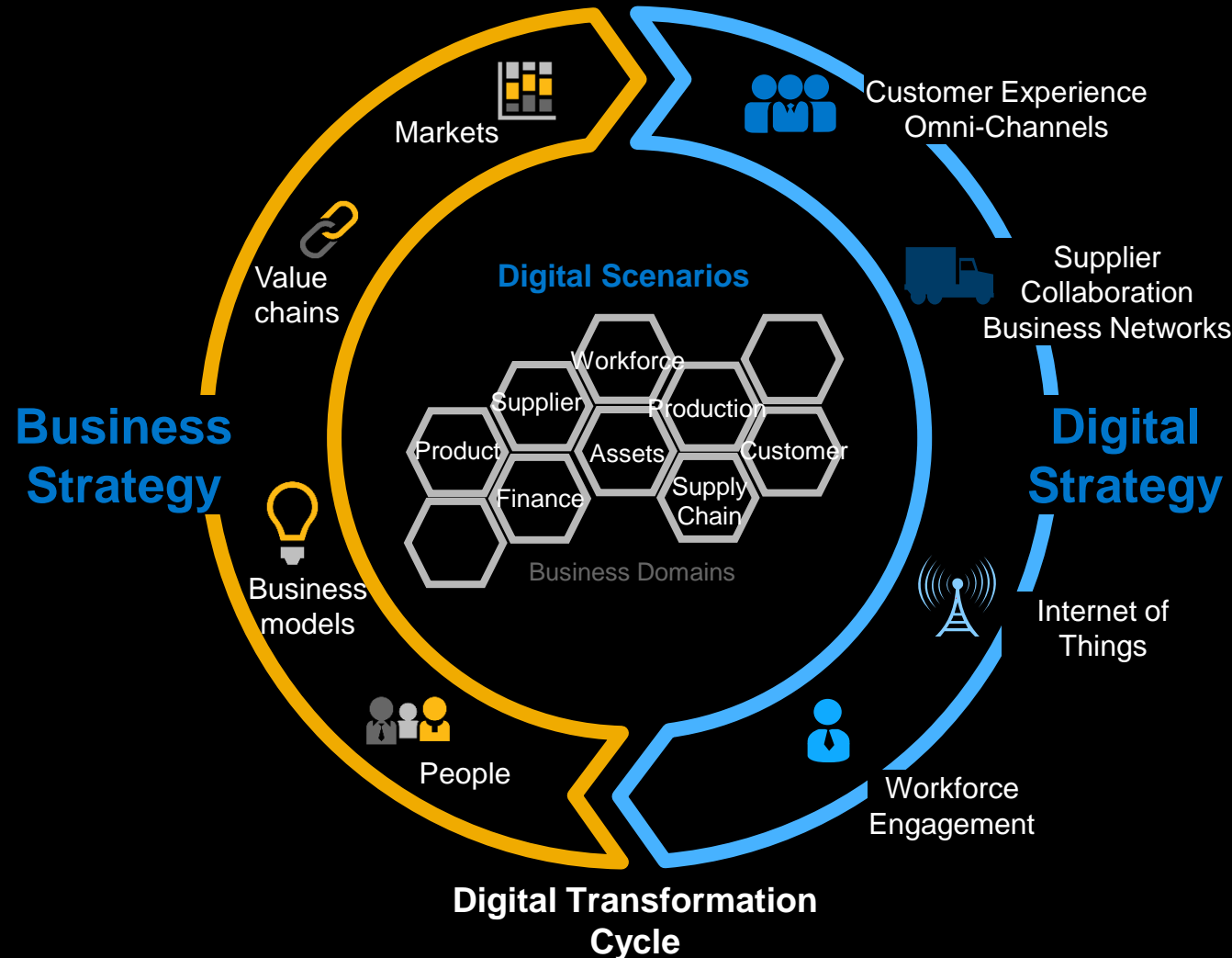
Digital Drivers

Cyber Security

Internet Technologies

Smart Assets

Smart Metering

Cloud Computing

Augmented Reality

Social Networks

Mobile Computing

Big Data

Electric vehicles

Personal Battery Storage

Business Strategy

Markets

Value chains

Business models

People

Digital Scenarios

Business Domains

Workforce
Supplier
Production
Product
Assets
Customer
Finance
Supply Chain

Digital Strategy

Customer Experience Omni-Channels

Supplier Collaboration Business Networks

Internet of Things

Workforce Engagement

Digital Transformation Cycle

Capabilities across the Utility Value Chain can be Transformed with Digital Technologies and IoT

Value chain

Generation	Market Operations/ Trading	Transmission	Distribution	Smart Meters	Residential & SMB / Commercial & Industrial

Digital landscape – examples

Digital plant

Remote monitoring & operations	Electronic work package
Engineering data mgmt.	Substation automation

Digital grid

CVR and Volt/VAR optimization	Condition-based maintenance	Dynamic line rating	Fault detection, isolation and restoration
Advanced tele-protection		Intelligent grid devices	

Digital customer engagement

Advanced meter infrastructure	E-vehicle integration	Demand response	Energy information services
Distributed generation support	Energy efficiency/ conservation	Energy management	Digital channels

The shift towards a digital grid enables more real-time and factual decisions
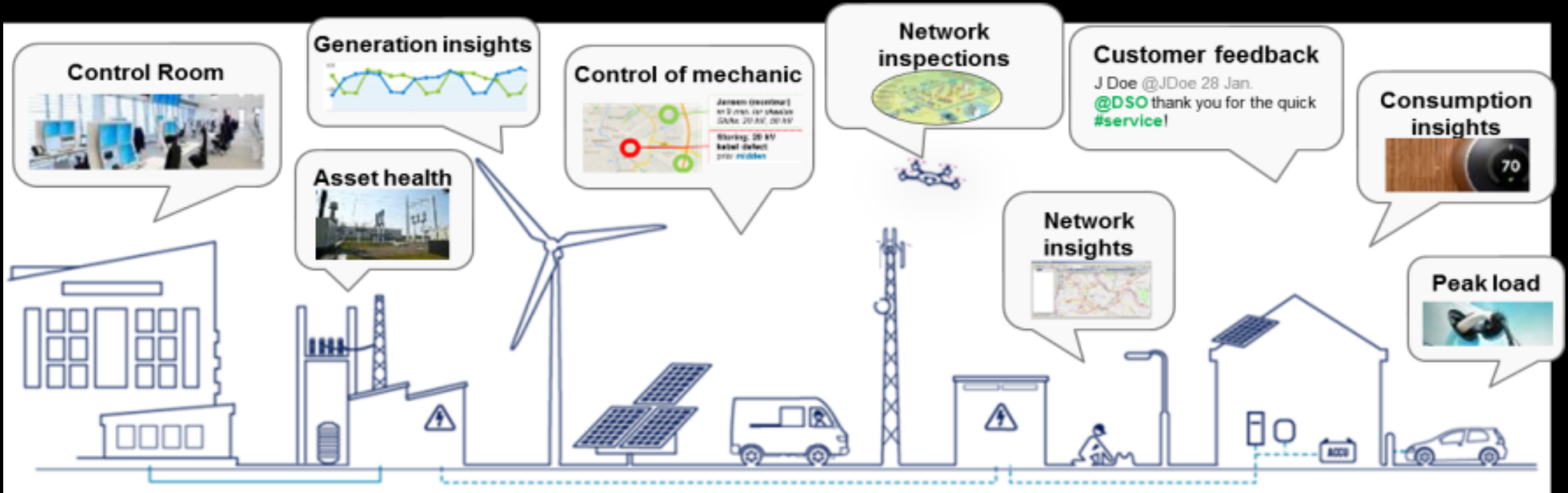
HANA Cloud Platform for the Internet of Things
Device and process integration capabilities

Edge

Device

Connectors from SAP
- IoT Connector
- Plant Connectivity

Device

Device — (3rd Party) Gateway — (3rd Party) Device Cloud

SAP Apps

PARTNER Apps

CUSTOM Apps

IoT Application Services & UIs

Service Repository

HANA Cloud IoT Services

HANA Cloud Integration

HANA Cloud Platform

HANA Big Data Platform
- Data Processing
- In-Memory Engines
- Extended Storage
- Storage
- Hadoop
- Streaming

Business Suite Systems (ERP, CRM , etc.)

Legacy Systems

Process Integration

S/4 HANA

Business Suite Systems (ERP, CRM, etc.)

Contextual Business data

Public apps and information

IoT Use Cases for Utilities Industry
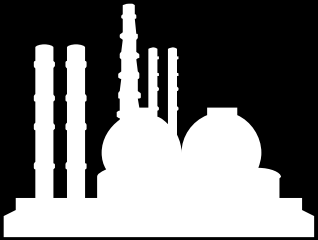
- Virtual power plants
- Asset health management
- Predictive Maintenance
- Merit Order Dispatch
- Load Forecasting
- Wind Farm Analytics
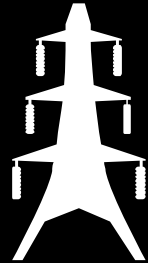
- Grid infrastructure analytics
- Geospatial Analysis
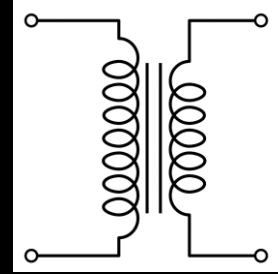
- Transformer Load Analytic
- Management of severe events / outages
- Predictive Maintenance
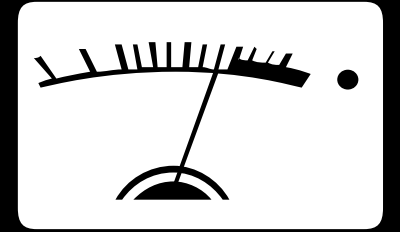
- Demand response management
- Consumption and load analytics
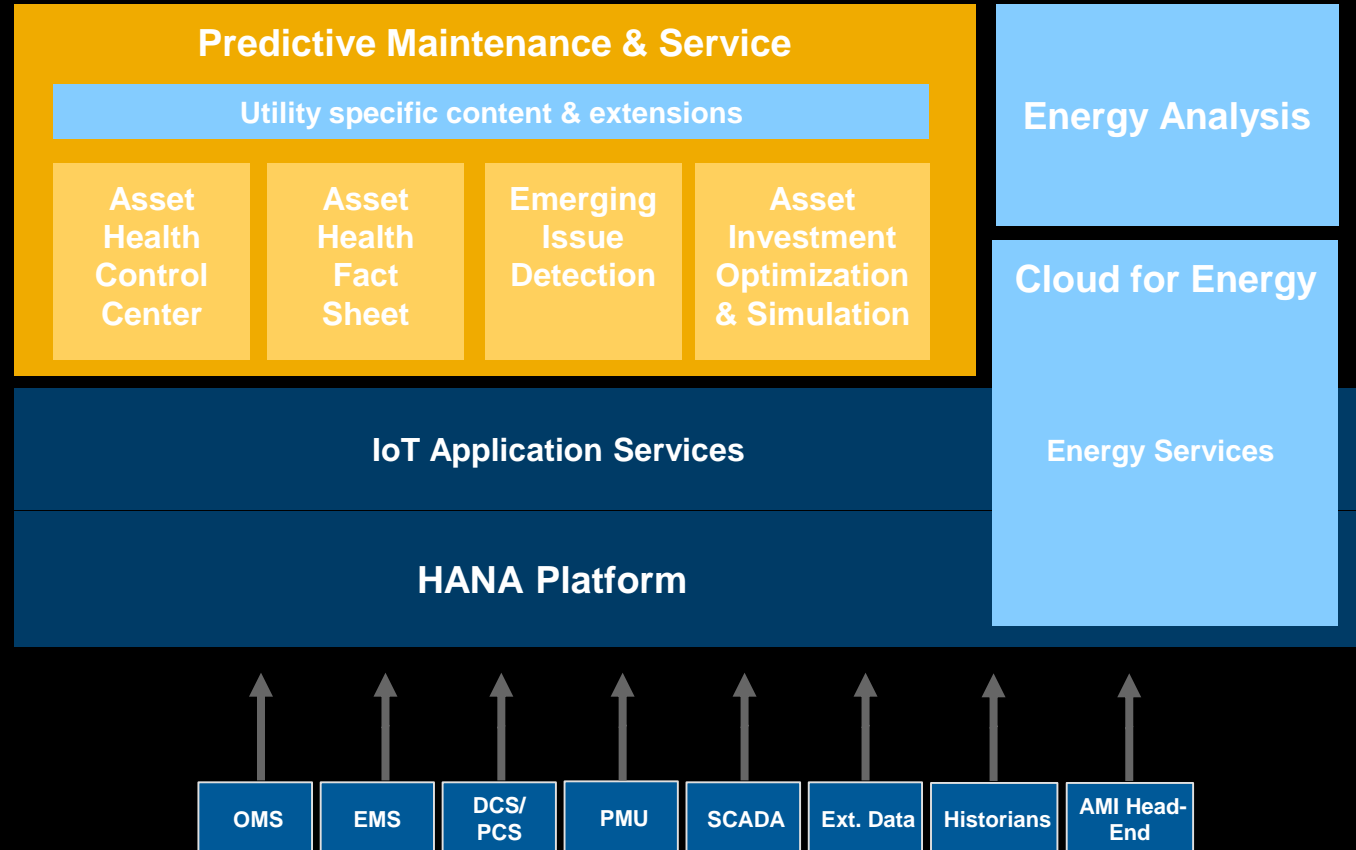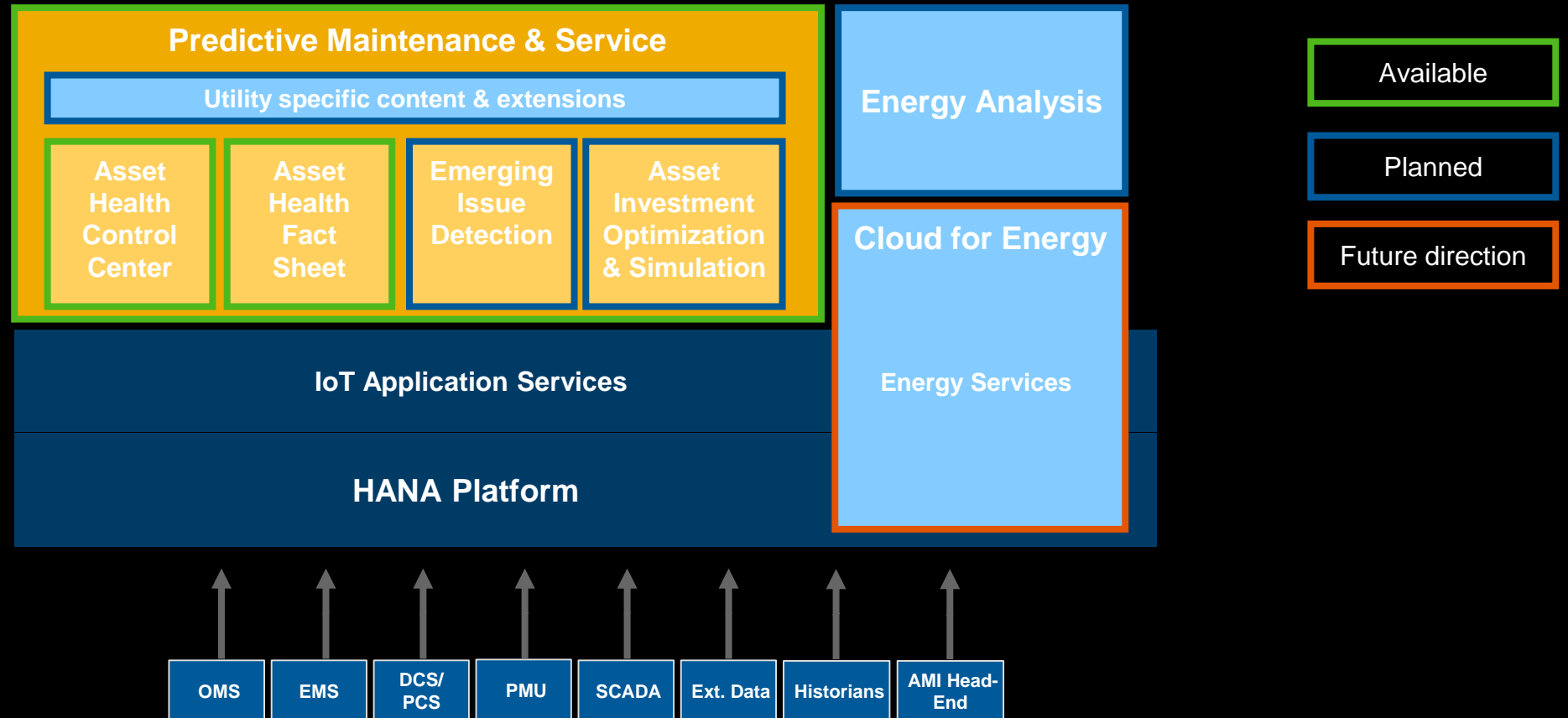- Leakage and fraud management

Re-imagine Maintenance Work

Prepare → **Predict** → **Perform**

Sensor Data	Peak Load Impact
Operational Data	Thermal Imaging
Historical Data	Vibration Detection
GIS/Spatial Data	Ultrasonic Detection
	Oil Analysis

- **Prepare Spare Parts**
- **Create Work Order**
- **Schedule Service**
- **Compare Asset Performance**
- **Training**
- **Safety**

Re-imagine Maintenance Work

Access

Analyze

- Energy Usage Patterns
- Cost of Service
- Price Elasticity
- Renewable Energy Alternatives

Act

- **Demand Response Programs**
- **Decarbonization Efforts**
- **Smart Home Products, Services**
- **Multi-channel Customer Intimacy**

Digital Platform Providing Comprehensive Solution

Things **Outcome** **Insights**

| Load Forecasting | Capacity Planning | Predictive Maintenance | Fraud Detection | Customer 360 | … |

SAP HANA Platform

Digitize Device   **Digitize Data**   **Digitize Document**

Devices / Sensors

SAP ERP

Non-SAP Apps

Envisioned High-Level IoT Solution Landscape

Predictive Maintenance & Service

Utility specific content & extensions

| Asset Health Control Center | Asset Health Fact Sheet | Emerging Issue Detection | Asset Investment Optimization & Simulation |

Energy Analysis

Cloud for Energy

Energy Services

IoT Application Services

HANA Platform

| OMS | EMS | DCS/PCS | PMU | SCADA | Ext. Data | Historians | AMI Head-End |

Envisioned High-Level IoT Solution Landscape

Predictive Maintenance & Service

- Utility specific content & extensions
  - Asset Health Control Center
  - Asset Health Fact Sheet
  - Emerging Issue Detection
  - Asset Investment Optimization & Simulation

Energy Analysis

Cloud for Energy — Energy Services

IoT Application Services

HANA Platform

Data sources: OMS | EMS | DCS/PCS | PMU | SCADA | Ext. Data | Historians | AMI Head-End

Legend:
- Available
- Planned
- Future direction

SAP Energy Analysis
First Utilities Application on the SAP IoT Platform

Leveraging the power of

CLOUD,

IoT,

SAP

HANA

and

SAPUI5

to create a state-of-the-art, next generation energy analytics solution
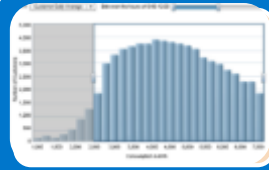
Aggregation
- *Instantly aggregate and analyze customers' energy*
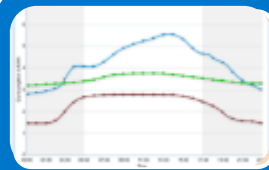
Consumption Pattern Determination
- *Categorize customers that share consumption behavior*
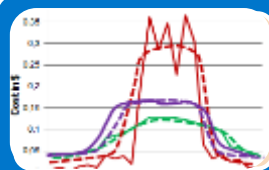
Peak Load Determination
- *Display peak demands, peak time periods, peak customers, etc*

Comparison/Benchmarking
- *Compare customer consumption with benchmarking, patterns, etc.*

Forecasting
- *Forecast consumption trends, peak demands, peak time periods*

Energy Analysis: Scope Summary

- Data upload

- Data filtering

- General KPIs

- Data distribution

- Aggregation

- Execute on sample

- Execute in background
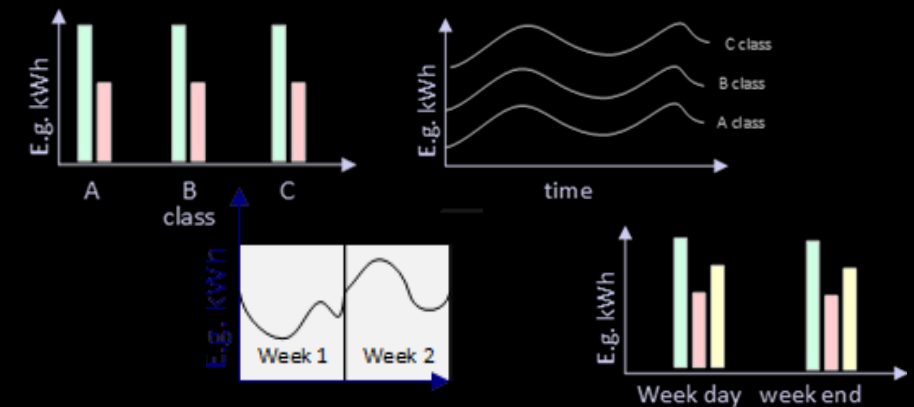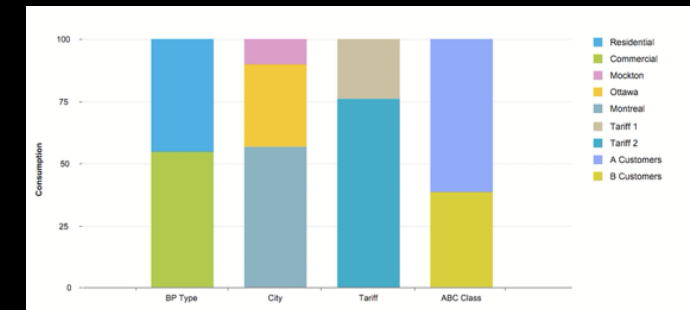
Improved Investment Planning

Challenges

- Gain insight from large volumes of data
  ~3.15 billion records per year from over 22,000 sensors at 400 substations

- Increase the frequency of analysis
  from once a year to once a month

- Reduce process time
  from 2 to 3 months to 2 days

- Improve forecast accuracy

Solution

- Forecasting with SAP HANA and data delivery with SAP Data Services

Value

- More information out of the data to drive investment decisions about replacing assets

- Improved effectiveness of the process through
  - Automating manual tasks
  - Increased frequency of calculations
  - Increased forecast accuracy
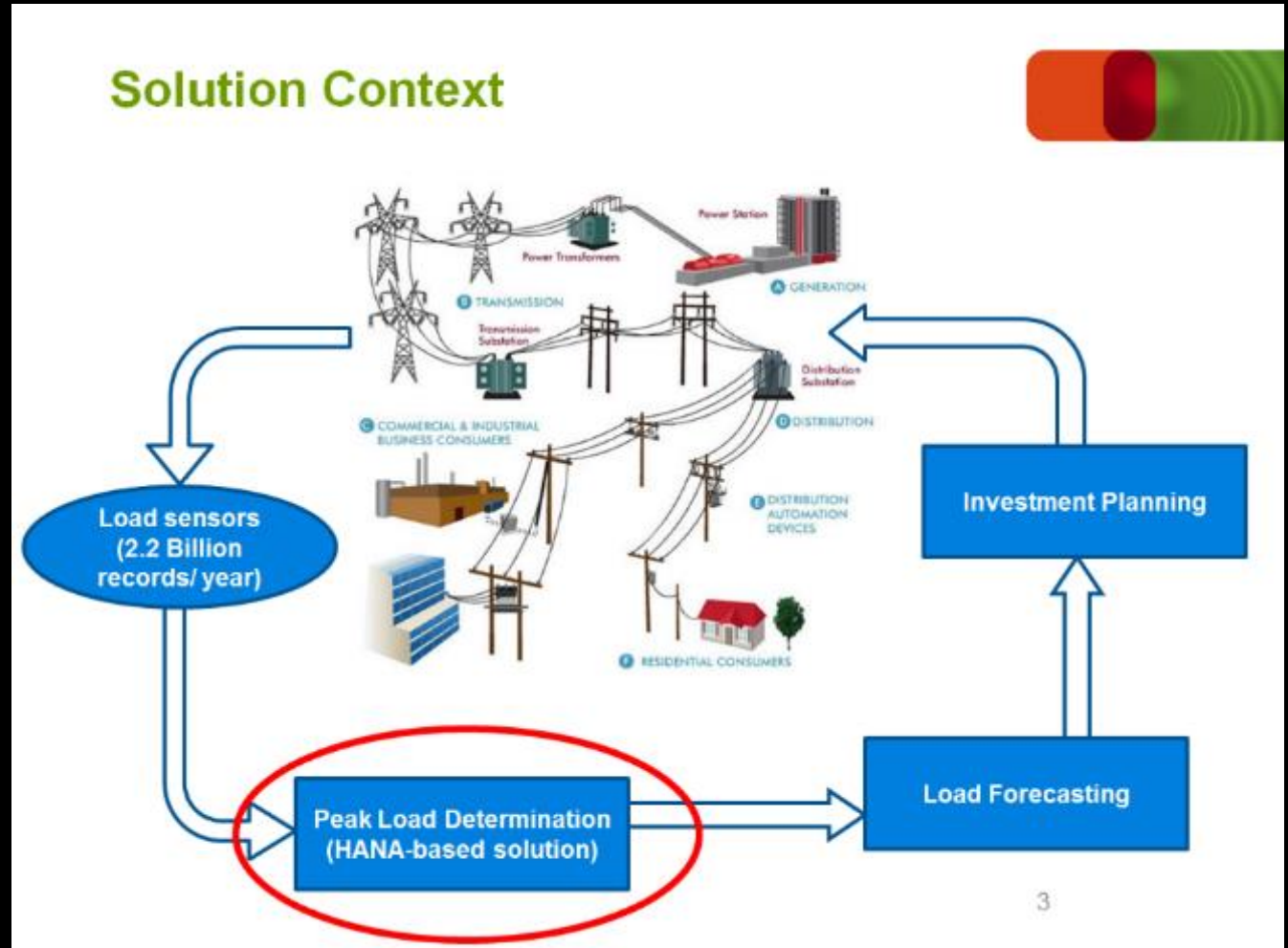
Improved Maintenance Strategy

Challenges

- Calculate transformer loss of life for one year of 1-minute measurements at your fingertip
- Correlate and analyze sensor data
- Integrate data from various sources
- Enable spatial analysis

Solution

- Data correlation, forecasting and spatial analysis with SAP HANA

Value

- Calculate true age of the transformer and thus drive replacement strategy
- Take forecasted data and business data (e.g. from SAP PM system) into account
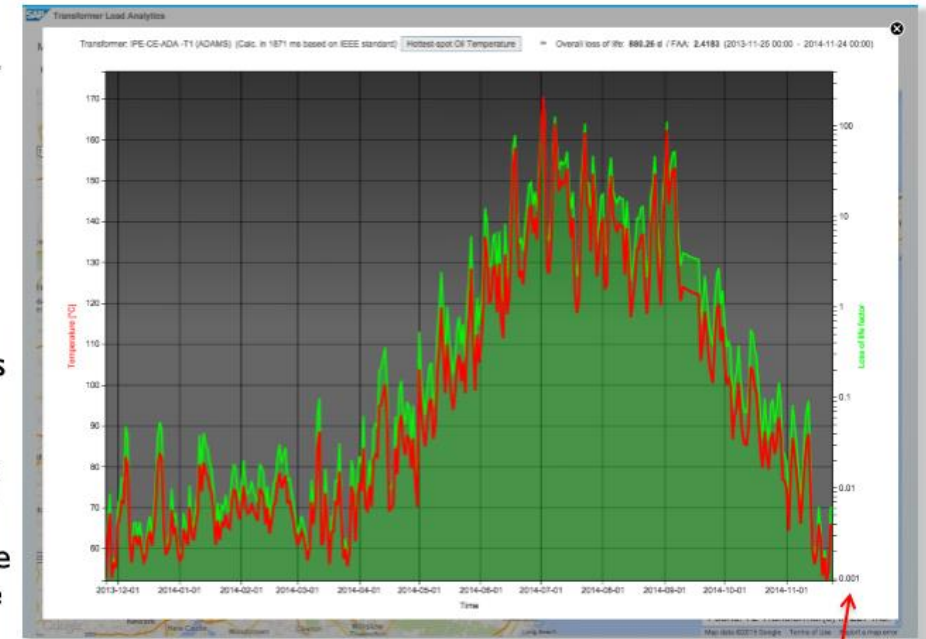
Customer Example
# Asset Health Management

Challenges

- Optimize asset investment program
- Reduce risk of outage
- Increase safety of crews

Solution

- Asset Health Management application based on the SAP Predictive Maintenance and Service Foundation

Value

- Determine true age of the assets and likelihood to fail.
- Concentrate on high priority assets
- Long-term planning for asset maintenance and replacement
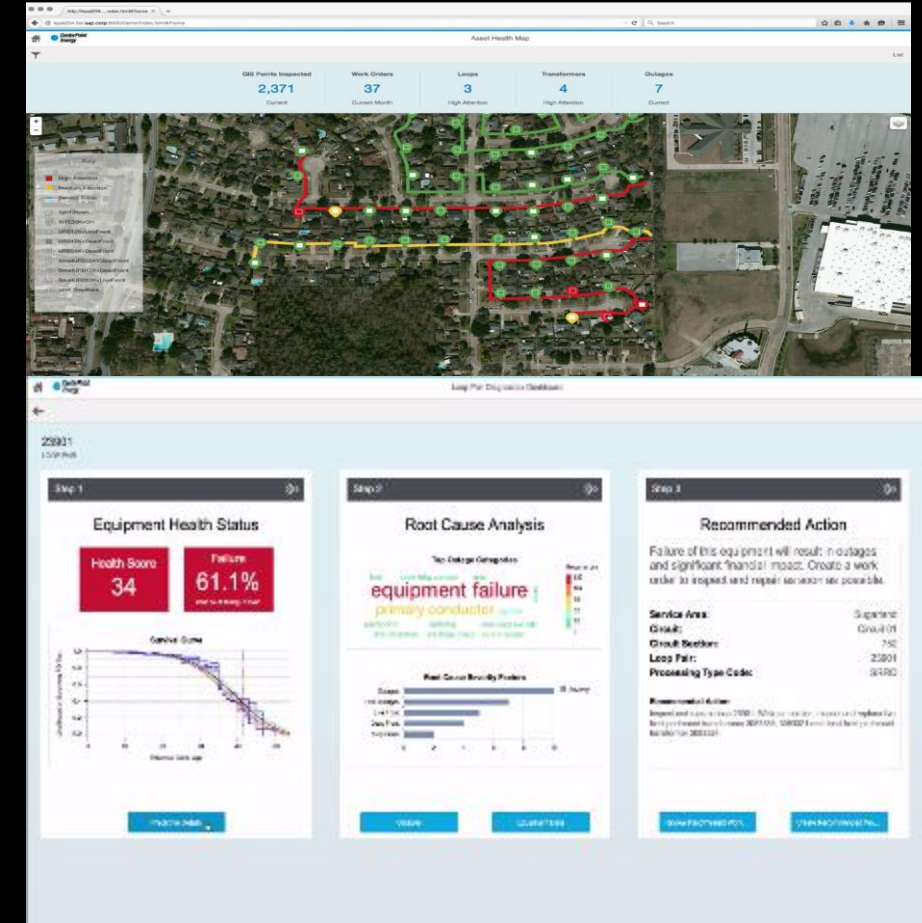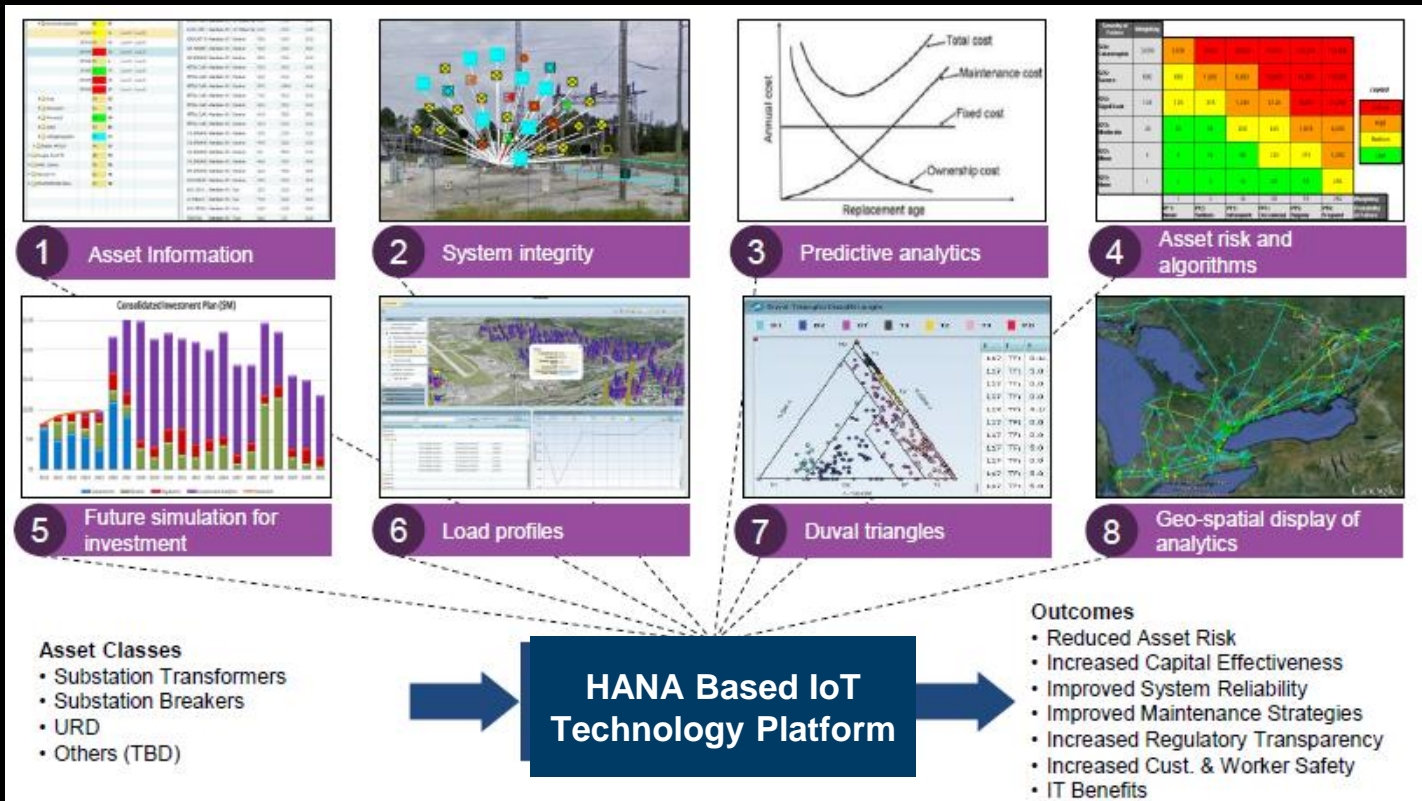- Prepare crew with regards to condition and site
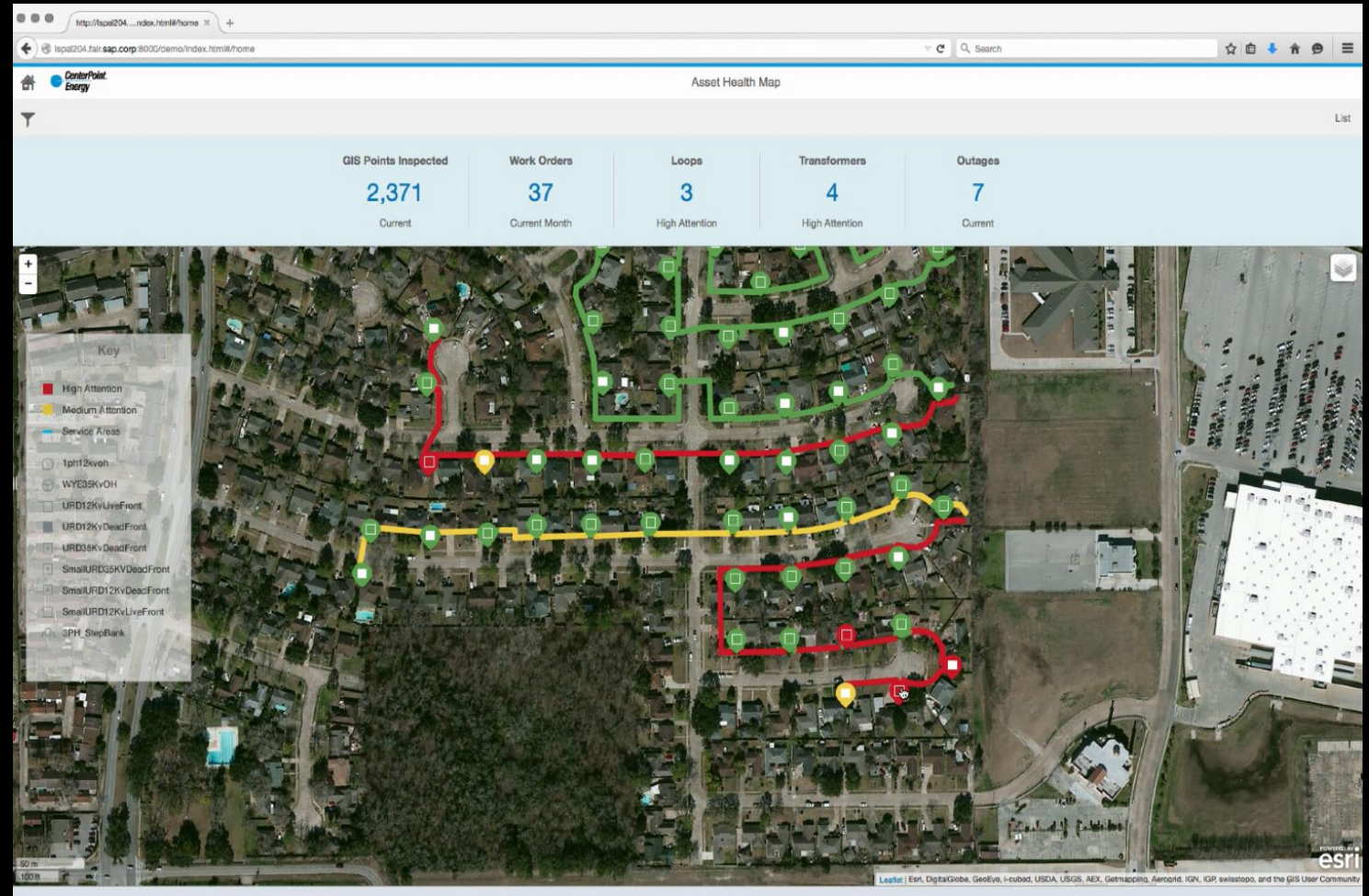
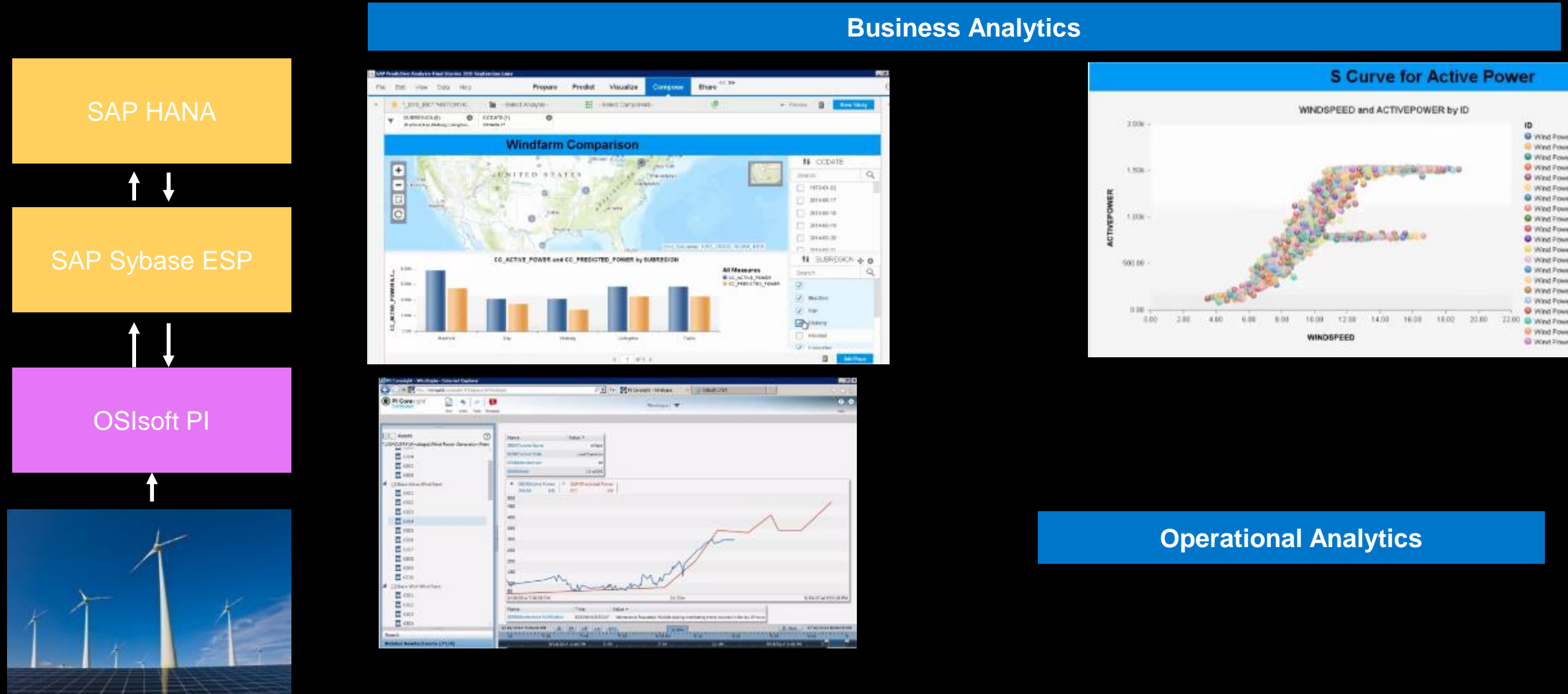# Predictive Maintenance Use Cases at CenterPoint Energy
Asset Health Application

Asset Health Application to monitor and predict the lifecycle of assets

1. Asset Information
2. System integrity
3. Predictive analytics
4. Asset risk and algorithms
5. Future simulation for investment
6. Load profiles
7. Duval triangles
8. Geo-spatial display of analytics

HANA Based IoT Technology Platform

Asset Classes
- Substation Transformers
- Substation Breakers
- URD
- Others (TBD)

Outcomes
- Reduced Asset Risk
- Increased Capital Effectiveness
- Improved System Reliability
- Improved Maintenance Strategies
- Increased Regulatory Transparency
- Increased Cust. & Worker Safety
- IT Benefits

- Determine true age of the assets & likelihood to fail to concentrate on high priority assets
- Long-term planning for asset maintenance and replacement

Co-Innovation project with Accenture

Wind Farm Analytics demo built with OSIsoft

Business Analytics

SAP HANA

↑ ↓

SAP Sybase ESP

↑ ↓

OSIsoft PI

↑

Operational Analytics

Connected Asset Management of Utilities with SAP Internet of Things

Connect with Intelligence at the Edge

Monitor utility tower and **send** real-time alerts
SAP Event Stream Processor

SAP MobiLink

Transform Business Operations

SAP HANA Cloud Platform for Internet of Things

Logical DW

SAP HANA   SAP IQ   HADOOP

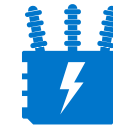Optimize **corporate** planning and reporting
SAP S/4HANA, SAP ERP

Re-imagine Business

Predict **maintenance** of core assets
SAP Connected Assets

Automatically schedule **service** technician
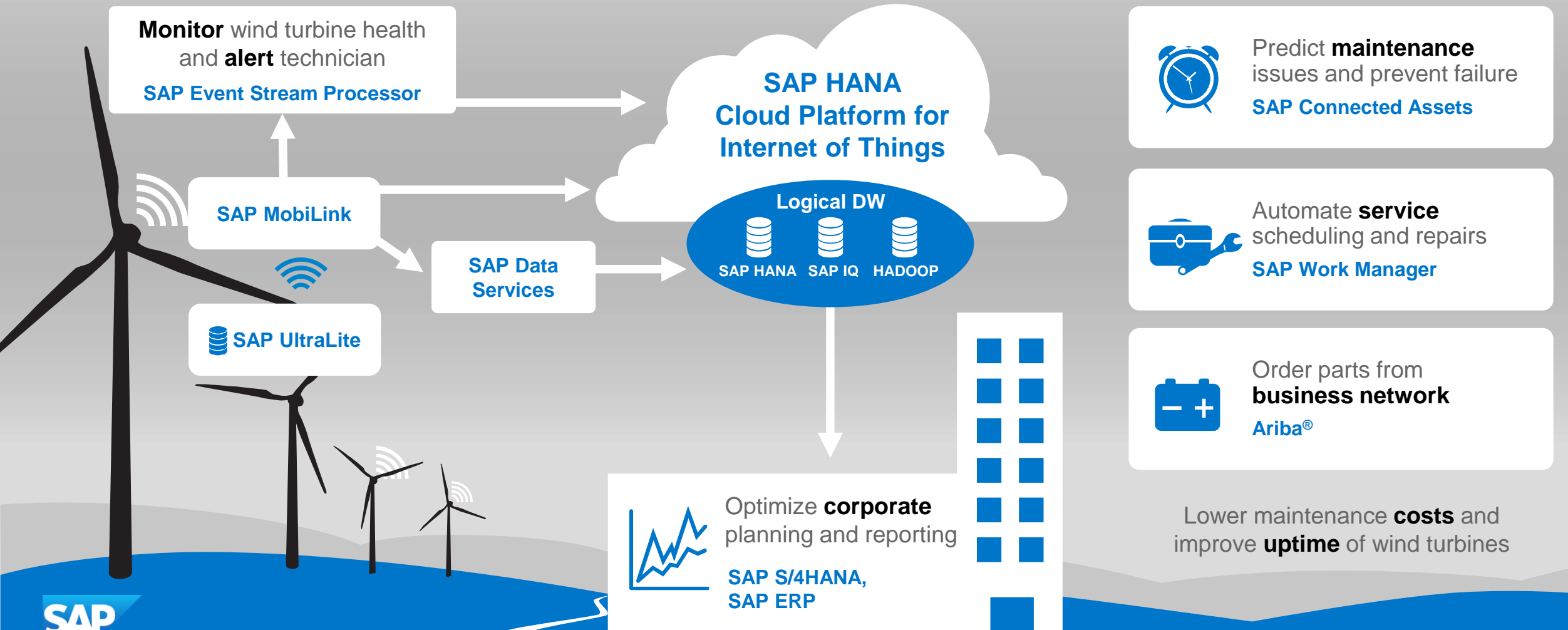**SAP Work Manager**

Order parts from **business network**
Ariba®

Manage **assets** from warehouse to field
SAP Asset Management

Thank you

Nubeel Ansari
Industry Value Advisor Expert
Oil & Gas and Utilities Industries

SAP India Pvt. Ltd.
6th Floor, MGF Corporate Park
Saket, New Delhi 110 017

Phone: +91 99581 29898
mailto: nubeel.ansari@sap.com