Digital Oil Field

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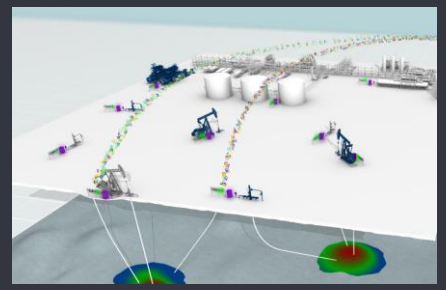
Production Challenges

Measurements



Type of needed measurements

Lack of measurements

Measurement's accuracy

Measurement's utilization

Impact: Decision!

Flow Assurance

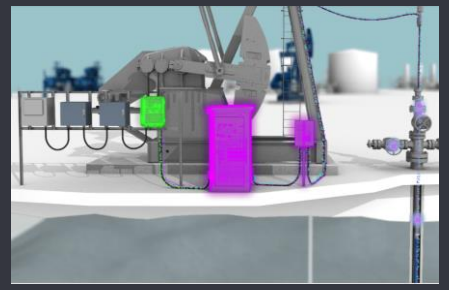
Thermal Management
- Wax
- Asphaltene
- Hydrates
- Scale

Impact: Blockage, production decline

Integrity
- Corrosion
- Erosion

Impact: leakage

Operations Efficiency



AL performance

Chemical Management (Inventory/Dosage)

Equipments Health

Pigging operations

Operating Conditions

Impact: CAPEX/OPEX

Downtime

Leakage

Equipment failure

Planned/Unplanned

Immediate cause vs. root cause

Cease to flow

Impact: production deferment

Bottlenecks & Constraints

Well constraints

Pipeline constraints

Equipments constraints

Valves constraints

Facility constraints

Impact: constrained production

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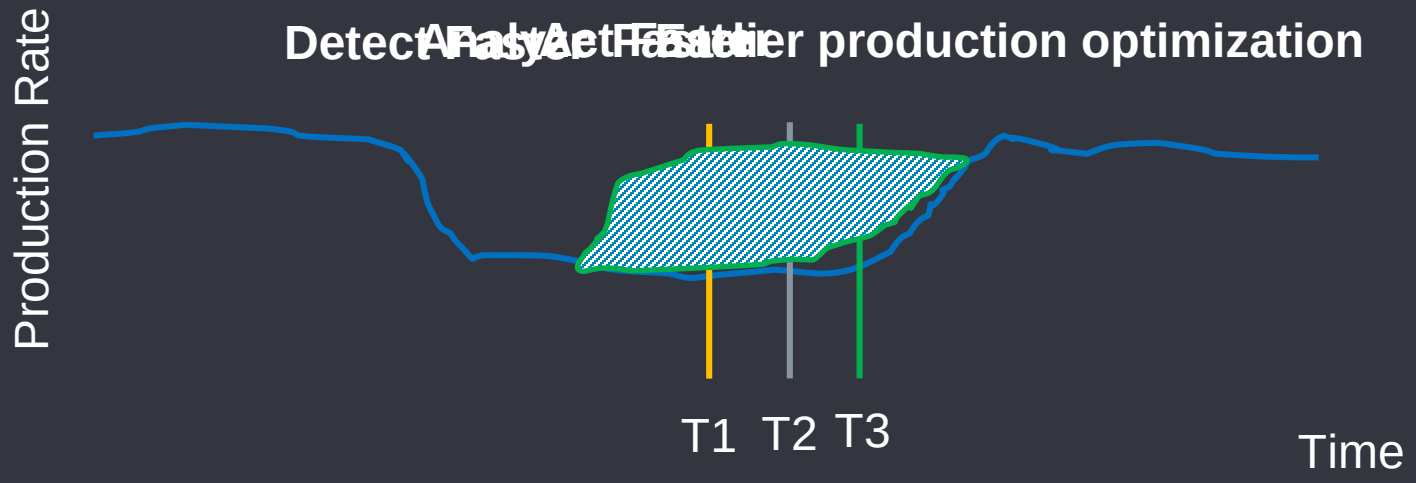
Interconnected Production Solutions | Value Added



T1 = Time to **Detect** the event
T2 = Time to **Analyze** and **Diagnose** the event
T3 = Time to **Take actions**

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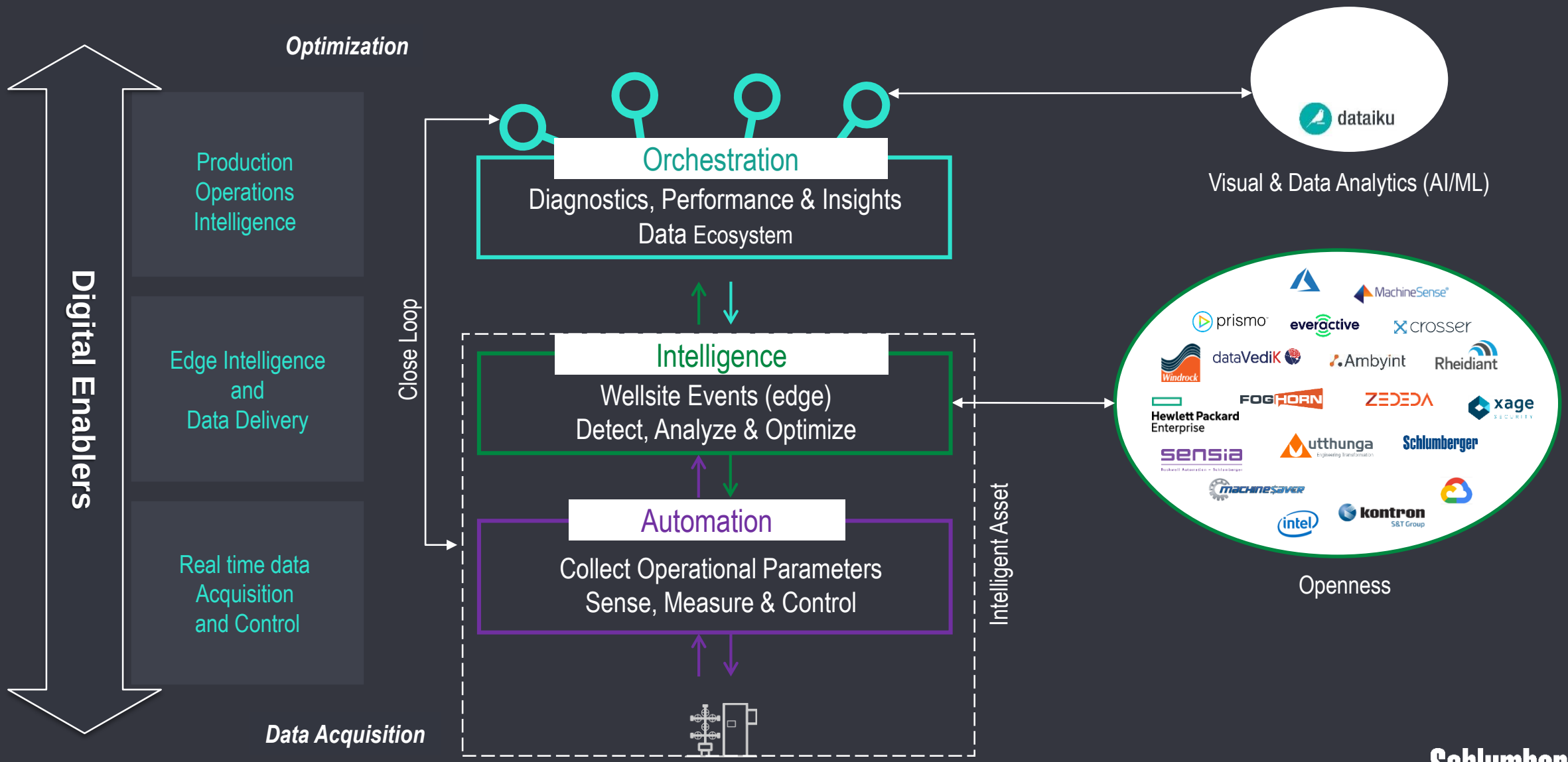
Interconnected Production Solutions



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Digital Solutions

Measure, control & Edge Analytics

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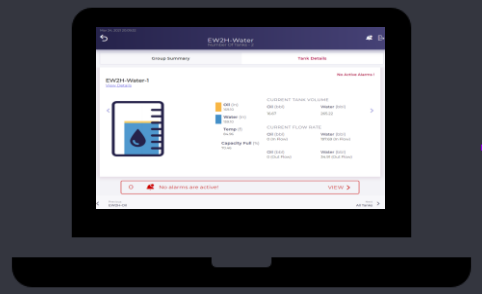
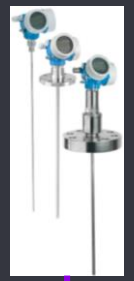
(Crude, Tank, Battery) Measurements & Truck Offloading Solution



Scanner 3100 Flow Computer / Data Concentrator

Level Tx



iSens Wireless PT & TT

Wired PT & TT

Edge Intelligence

CamCor Coriolis Meter

Water cut Analyzer

Cliff Mock Sampling

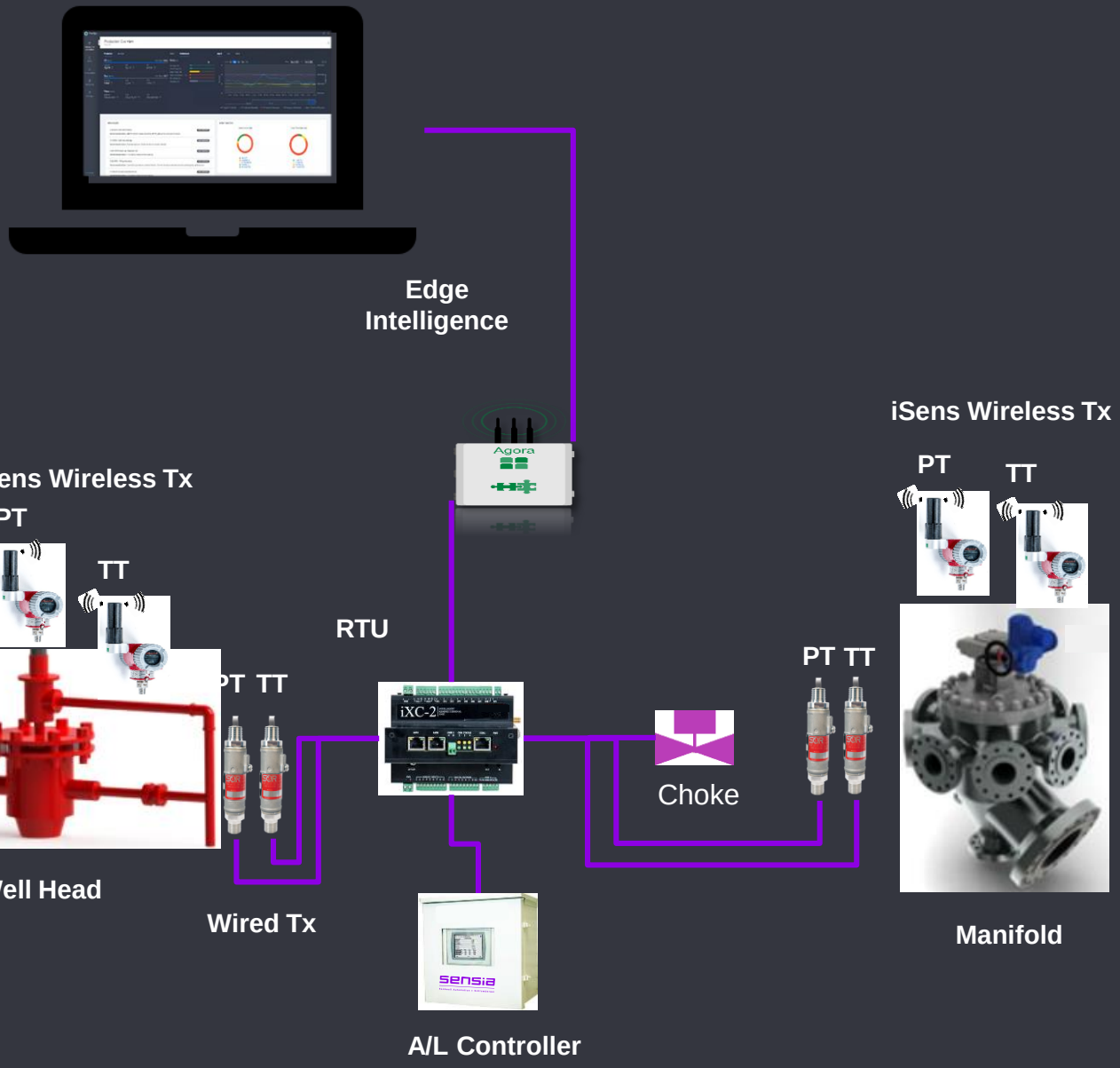
Description:

- Alerts & calculations in real-time
- Supports both traditional flow meters and calculated “virtual metering”
- API 18.2-compliant electronic tickets
- Easy to use interface, Local HMI and mobile device compatible
- Manual, fixed volume, and continuous transfers are supported
- Distribute tickets via MQTT, SQL db, email, or FTP
- Wired & Wireless Sensors

Benefits:

Total Production STB/D	0.5 % Enhancement -Gain MUSD	
	Annual	5 Years
10,000	$ 2M	$ 10M
20,000	$ 4M	$ 20M
50,000	$ 9M	$ 45M
100,000	$ 18M	$ 90M

Well Instrumentation and Control



Description:

- In real-time: events captured, analyzed, classified and intelligently prioritized
- Advanced analytics and continuous machine-learning adapt to changing field conditions and build predictive capabilities Supports both traditional flow meters and calculated “virtual metering”
- Wired & Wireless Sensors (as applicable)
- Integration with DOF Platform that supports fast & slow loop requirements

Benefits:

- Utilize existing infrastructure
- Remote monitoring, control & Optimization over the air
- Detection-to-correction times reduced
- Reduce manual unloads and wellsite visits for controller intervention
- Enhance operational efficiency
- Minimize HSE exposure

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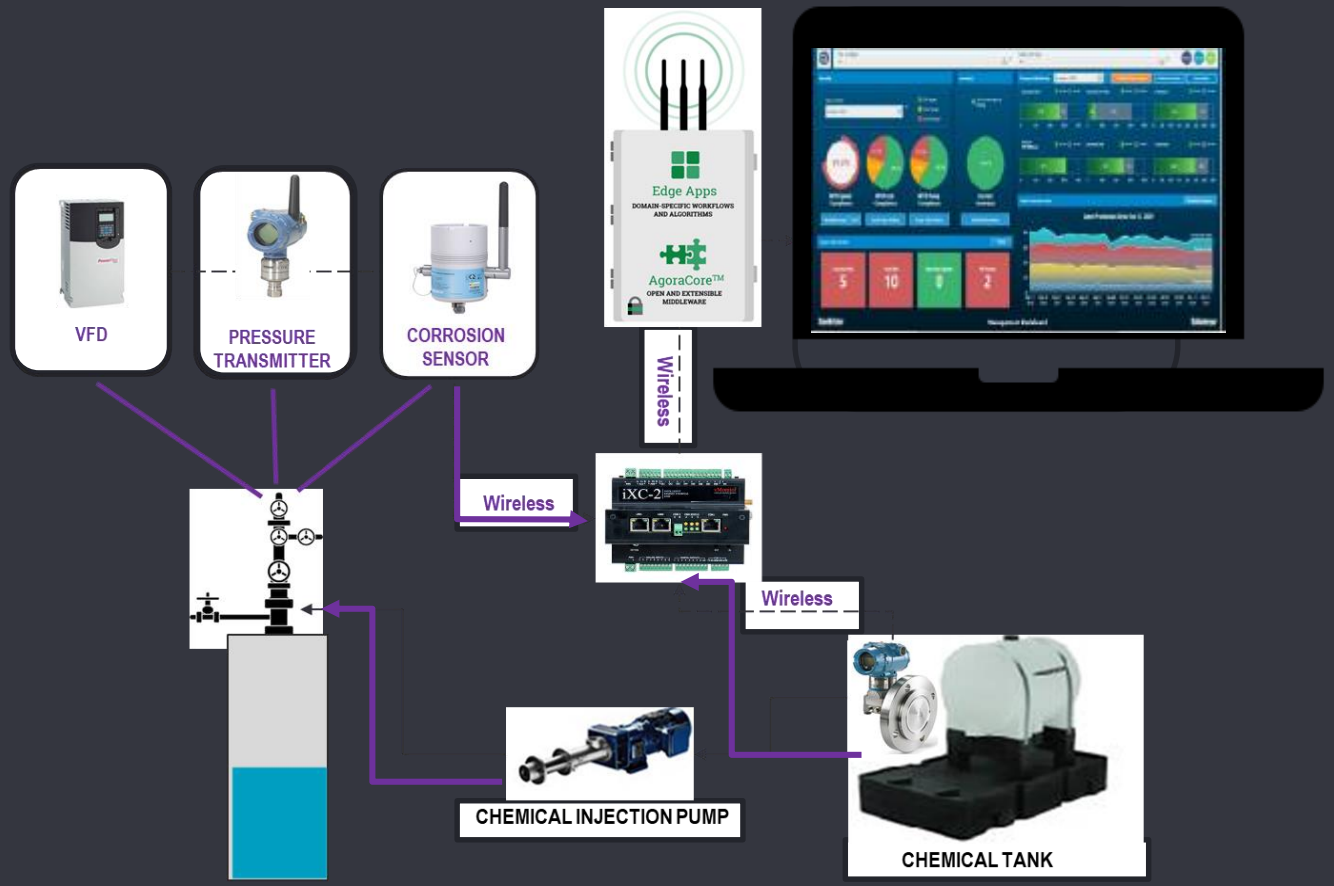
Chemical Injection Orchestration



Description:

- Closed loop treatment to treat surface and downhole scaling
- Automated/Autonomous chemical injection through digitally connecting chemical pumps
- Continuous scale prediction modeled at the Edge using live ESP data

Benefits:

- 97% higher scale prediction
- Eliminated monthly trips for scale well tests
- Fully optimized chemical injection
- Corrosion is minimized – potential savings of up to MMUSD / year in avoided workover operations
- Closed Loop Control for Chemical Injection < 1 Min

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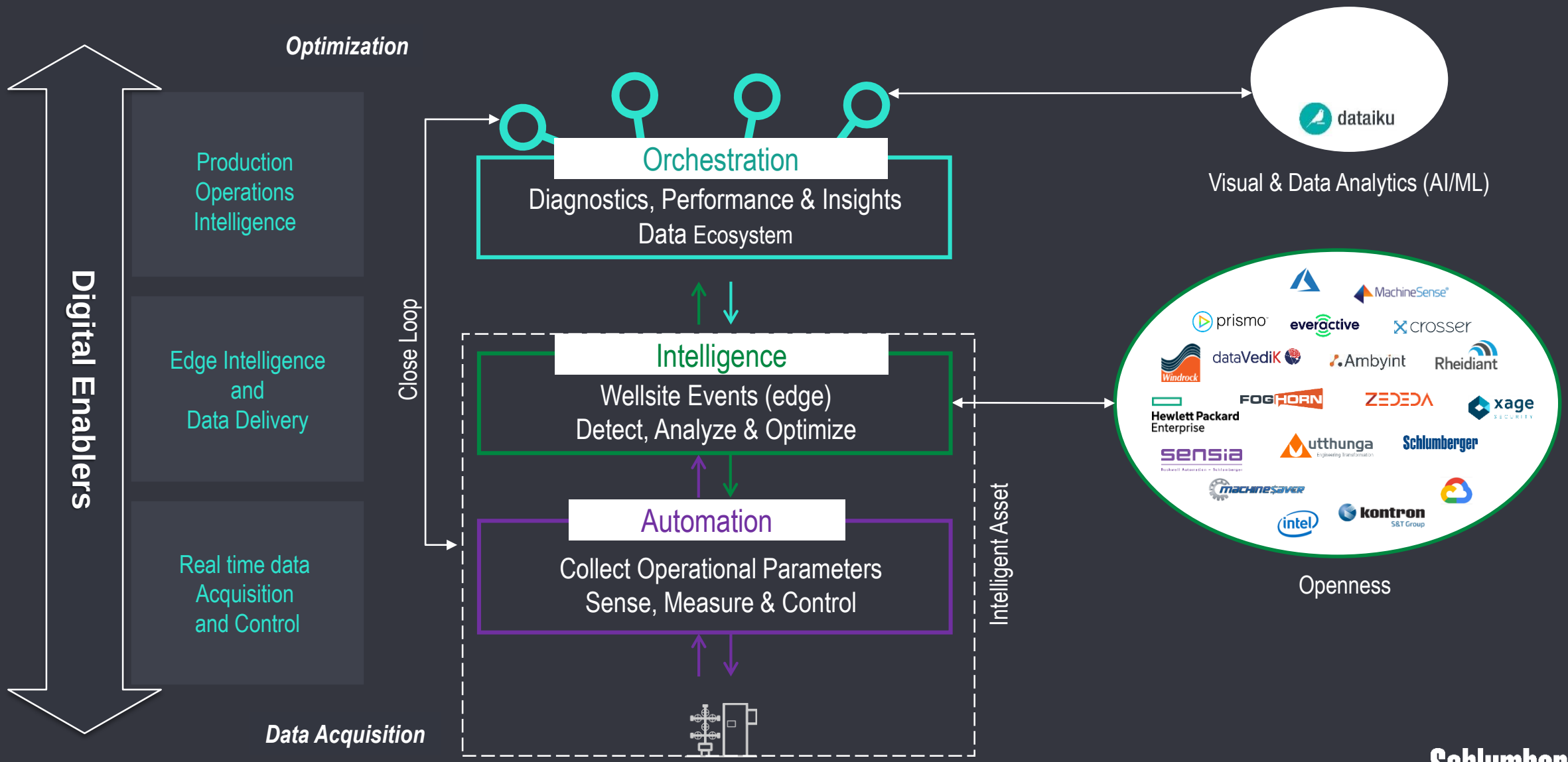
Interconnected Production Solutions



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Digital Solutions

Diagnostics, Performance & Insights

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Diagnostics, Performance & Insights

Advisors (Automated Workflows)

Gas & Liquids Management	Start-Up & Shut-In	Thermal Management	Integrity Management		Metering & Equipment	Planning & Optimization	Data Analytics	Field Surveillance
Liquids Management	Cool Down	Steam				Shortfall Management	KPI Dashboards	Forecasting
Well Routing Decision	Settle Out	Scale	Blockage Detection	Erosion	Well Test Management	Choke Model	Volumes Management	Production Monitoring
Slug and Surge	Ramp Up	Asphaltene / Wax	Leak Detection	Annulus Pressure	ESP and MPP Surveillance	Production Optimization	Inventory Management	AFE / Workover Monitoring
Pig Tracking	Packing and Survival Time	Hydrate	Corrosion	Cathodic Protection	MPFM Surveillance	Artificial Lift Optimization	Reserves Management	Quality Management
Flow Regime	Blow Down	Inhibitor	Sand	Critical Event Training	Virtual Flow Metering	Chemical Management	Flared Gas & Fuel Consumption	Production Quality Tracking

Visualization

- Web Interface
- Decision Support Center &Crisis Mgmt.

Modes

- Historic Mode
- Real Time Mode
- Look Ahead Mode
- Scenario Planning Mode

Engine

- Custom Calculation
- Production Allocations
- PVT
- PIPESIM Engine
- OLGA Engine
- Integrated Asset Modeler
- Workflow Automation

Core

- Field Data Capture & Connectivity
- Office Data Capture
- Automated Processes & Scheduling
- Data Exploration & Reporting
- Events Management
- Well Management & Schematics
- Model Management

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Case Study

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B-1 Kuwait Intelligent Digital Field (KWIDF)

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Jurassic KwIDF Evolution

Key Objectives:

- Reduce Opex/Capex
- Increase Recovery
- Faster Root Cause Analysis
- Reach Production Targets in the Assets
- Reduce Downtime
- Improve and Share Knowledge and KPI's
- Design Specialized Engineering Workflows
- Optimise Production Using Combination of People, Process and Technology

2010

Phase I – Start Wells Instrumentation

2011

Collaboration Rooms

2012

Live System

- Sensors
- Automated Chokes
- H2S & Gas Detection
- Remote Wellhead control

2013

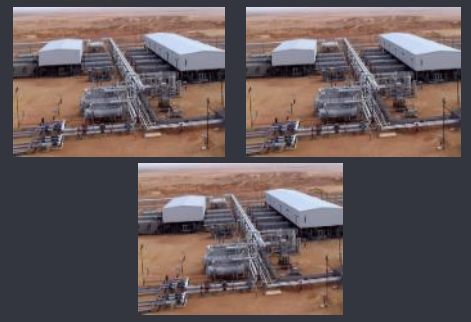
Initial value realized

2014-2016

KwIDF Workflow Enhancement

- Production Optimization
- Prevent Hydrates
- Fast Well Recovery
- Morning Gas Rush

2.1 MM BOE of Production Gain (3 % YoY)



2017+

KwIDF – JPF Full Digital Integration

- Safely achieve 510 MMscfd target
- Minimize unplanned production deferment
- Maximize Reservoir Recovery

TRANSFORM NK JURASSIC GAS KwIDF INTO THE 1st INTEGRATED SMART FIELD

Pore to Process

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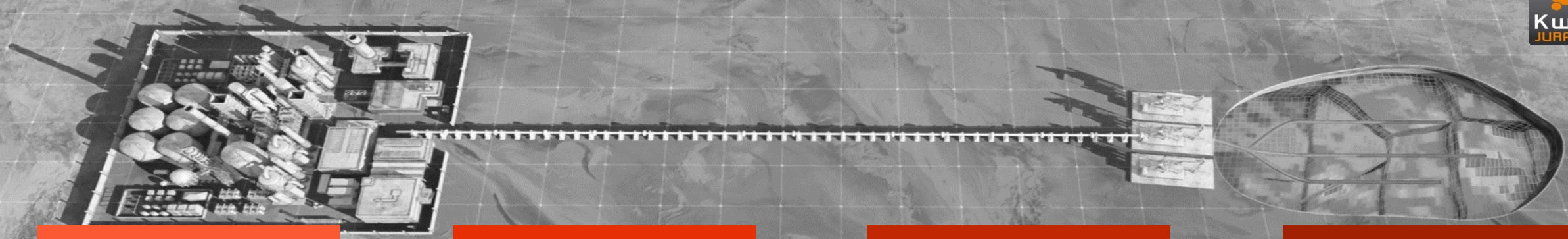
KwIDF | Pore to Process – DOF - IO - Transformation



Process | Facilities	HSE | Operations | Reporting	Wells	Reservoir
▪ Gas and Oil Dynamic Simulations ▪ Events and disturbances prediction ▪ Failure mode analysis for preventive maintenance ▪ Model Centric Optimisation	▪ Process and Wells minimum HSE compliance monitoring ▪ Daily reports automatization ▪ Operations tracking	▪ Production Forecasting ▪ Choke Optimization on Production Ramp Up ▪ Opportunities Management	▪ Integrated Asset Modeling | Reservoir Management ▪ Reservoir Pressure Decline Monitoring ▪ Reservoir Depletion Strategy

Holistic Reservoir Management | Bigger Recoverable Reserves

Better Decision Process Maximizing The Value Of Capital Spend

Integrated Technology Stack For Maximum Value Creation

Reduce Downtime | Less Deferment | Increased Reliability | More Production

149758 163365 163758 175398 173407 175364 182151 181284 187605 197920 198089

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B-2 Samarang Integrated Operation

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Samarang IO| Value

Reserves Enhancement	Improved Collaborative Decision Lifecycles	Faster Quality Decisions & Proactive Response	Efficiency Improvements & Cost Savings	Improved Production & Gas Lift Optimization	Reduced Well Construction Time
Recovery factor - **10%** improvement Field life extension by **18 years**	Decision cycles Med loop: **2-3 mths to days** Fast loop: **15 days to 2 hours**	**20-25%** increase in IO Wells Uptime	**70%** improvement in staff efficiency	**Trifold** production increase & **4%** incremental production with gas lift optimisation	**15-20%** Cost reduction during well & Platform construction

167435 167855 25035 171530 173578 173579 173580 182497 182495

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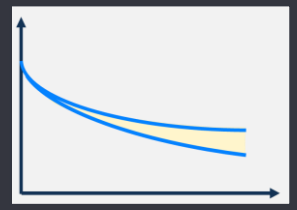
VALUE

Revenue – CAPEX – OPEX ± Intangibles

Revenue / Deferred Production

- EBS: detect losses quickly
- Unplanned downtime
- Continuity of operations
- Problem prediction: hydrate, wax
- Maintenance disruptions



Revenue / Accelerate Production

- Optimize transient operations
- Optimize resource use
- Understand operational constraints

Revenue / Recovery

- EOR, flooding, thermal
- Pressure support, voidage
- Zonal sweep and drainage
- Reduce field economic limit

OPEX / Efficiency, Productivity

- Automation; by exception mgt
- Field crew size
- Maintenance cost
- Chemical inventory
- Gas volume
- Shared SMEs
- Mobile data solutions
- Power consumption
- Rig time
- Logistics

Penalty Avoidance

- HSE incidents
- Contract penalties
- Travel
- Personnel

CAPEX / Investment

- Number of wells
- Surface equipment
- Capacity planning
- Equipment run life
- Loss of capital equipment
- Supply chain

Operational Excellence

- Standardized workflows
- Best practices
- Knowledge capture
- Open and inter-operable systems
- Collaborative teams
- Reuseable advisories
- Reduced uncertainty

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Thank You!

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