Enabling Business Transformation with the PI System:

The DCP 2.0 Journey

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Chapter 1 – 2017 – The Beginning
Chapter 2 – 2018 – Acceleration
Chapter 3 – 2019 and beyond - ????

Chapter 1

DCP 2020 / DCP 2.0
Laying the Foundation for Transformative Business Value & Customer Satisfaction
Forward-Looking Statements

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Outline

• DCP at a Glance
• Overview of DCP 2.0
• PI System Selection and Implementation Approach
• Chapter 1 Highlights
• Best Practices & Lessons Learned
• Chapter 2 Focus and Deliverables
• Summary
DCP Midstream - Who We Are

• We provide the full range of midstream services
  • Gas gathering, compression, treating, and processing
  • Natural gas liquid (NGL) production and fractionation
  • Condensate recovery
  • Transportation, storage and sales of residue gas, NGL, and propane
• One of the largest U.S. natural gas processing companies
• One of the largest U.S. producers of NGLs
• One of the largest NGL pipeline operators

Fast Facts
- 61 Gas Plants
- 57,000 Miles of gathering PL
- >400 Booster Stations
- 1400+ Compression Units
- 1M+ gathering system HP
- >42,000 meters
- 4,500 miles NGL PL

Through our *DCP 2020* strategic framework, DCP is committed to being sustainable in any market environment
Vision of Differentiation & Digital Value Chain

• Large portfolio of E&P customers who have G&P options

• Differentiation with low cost, reliability, and service

• Our vision is to leverage digital value chain to provide unparalleled service
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Recognition of OT Data & Information as Strategic Asset

- Digitally enabled operational excellence
- Major focus on foundation & cultural alignment - 2016
- Rapid rollout and momentum
- From 4 in 2016, DCP 2.0 team has grown to ~50 people
Recognition of OT Data & Information as Strategic Asset

• DCP2020 Strategy & Vision Framework - 2015

• Digitally enabled operational excellence

• Major focus on foundation & cultural alignment - 2016

• Rapid rollout and momentum

• From 4 in 2016, DCP 2.0 team has grown to ~50 people
Delivering Disruptive & Transformative Business Value

• $20MM-25MM investment in 2017

• ~1 year Payback!

• Projected incremental $20MM EBITDA in 2018

• Continuing to drive EBITDA impact 2019+
DCP 2.0 at Work

Business Transformation In Action: Operations of the Future - Now

- People, Process & Technology

- The PI System and PI AF underpins the ICC and associated apps & solutions

- Energy Lab rapidly develops digital solutions using PI System data and infrastructure as key technology stack component

 Integrated Collaboration Center (ICC) the operations of the future

- ICC ties multiple data sources, including SCADA, engineering data, contracts, real-time market prices, financial systems, KPIs and daily theoretical margins
- Facilitates real-time decisions... driving asset optimization throughout the full business value chain
- 30 of 61 plants currently on the ICC platform... remaining by the end of 2018

 Business Solutions

- Energy Lab rapidly develops digital solutions, including apps, to automate, streamline and digitize work streams
- Deployed 12 solutions to optimize workflow, automate processes, improve compliance, reduce costs and solve employee and customer pain points
- Now accelerating additional solutions throughout operations, commercial and corporate functions

~50 employees dedicated to DCP 2.0

Higher margins

Significant cost savings

Tens of thousands of reduced work hours

Better reliability and safety

Culturally transforming the way we work through process optimization and digitization
Digital Solutions Deployed & Processes Improved

From 2 to 5 Agile Delivery Teams

Agile Methodology defined and adopted

Tech Stack and Design System architected, built, and implemented
**ICC Rapid Standup & Transition**

- **Jan/Feb**
  - Construction Begins for new ICC

- **March/April**
  - EA Kick Off Meeting & PI AF Jump start/SME training
  - Rapid Rollout of PI System Infrastructure

- **May/June**
  - Initial ICC begins 4 Gas Plants on-boarded in ICC

- **June**
  - ICC moved to 23rd Floor in Denver HQ

- **July/August**
  - 1st Regional Rollout – 6 Plant Screens and supporting business processes deployed

- **Sept/Oct**
  - ICC Coordinator in place 5 day per week operation

- **Nov/Dec**
  - Remaining Plants in ICC by EOY 2018

- **2018**
  - First of Month (FOM) Targeting Alignment coordination begins from ICC

- **30 Total Gas Plants in ICC**

- **First of Month (FOM) Targeting**

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**Other key points:**

- **Construction Begins for new ICC**
- **ICC Coordinator in place**
- **5 day per week operation**
- **First of Month (FOM) Targeting**
- **Alignment coordination begins from ICC**
- **30 Total Gas Plants in ICC**
The Integrated Collaboration Center (ICC)

Business Transformation In Action: Operations of the Future - Now
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Data Foundations - Embracing the Challenge

We need a deep understanding of our operational data in context, transformed into information and knowledge, but:

• Our existing data architecture was focused on process control and operations, with analytics and reporting almost an after-thought

• There was no centralized and normalized set of operational data across the company

• Multiple versions of the “truth,” often in spreadsheets that were emailed to multiple parties

To get our operational data house in order, we deployed an enterprise-wide PI System
Why OSIsoft, the PI System, and the EA?

- **Key Considerations:**
  - Performance, Scalability, Reliability, and Security (cyber & data)
  - Integration with other systems
  - Rapid deployment
  - Keeping control systems (DCS and SCADA) focused on control
  - Keeping up with ever evolving technological changes
  - Empowerment & innovation
  - Self sufficiency

- **Strong OSIsoft and the PI System Value proposition:**
  - Enterprise OT infrastructure – agnostic, scalability, performance, reliability
  - Analytics platform
  - Cyber/data security & governance
  - World class support - Account manager, NOC, Tech Support, Company
  - PI System community – large E&P customer base

*To rapidly attain DCP2020 Strategy, Vision, & Value, we chose an Enterprise Agreement*
Our Approach to Rapid Implementation & Value

1. **Hybrid PI AF Jump Start & SME Training with EA KO Meeting:**
   - Naming conventions – Element, category, attributes, expression syntax, etc.
   - PI AF structure, architecture & integration with SCADA/DCS/IT Systems
   - PI AF governance - SMEs guide, product team implement, PI Team provides standardization & QA

2. **Leveraged Enterprise Agreement – COE, EPM, rapid stand up of PI System**

3. **Rapid, agile method, heavy use of PI AF/PI Vision Templates**
   - Deployment team worked on 2 parallel tracks: data connections/tag creation and product development

4. **Formation of in-house PI Team augmented with OSIsoft COE and SIs**

5. **EA Governance – Parallel Leadership teams, Executive Sponsors, KPIs, quarterly leadership team meetings**
Our PI System Enterprise Architecture

- **PI System Infrastructure (full HA)**
  - 4 PI Archives ~ 580,000 tags
  - 96+ Interfaces
  - PI AF ~ 8,200 elements
  - PI Vision ~ 320 displays

- **Templates:**
  - ~ 325 PI AF Elements
  - ~ 55 Event Frames
  - ~ 90 notifications

- **Integrators:**
  - Business Analytics (BA)
  - ESRI ArcGIS
  - Azure & PI Cloud Connect
Developing PI AF – OT Data with Structure
The Power of PI AF Templates

Elements
- ~325 Templates
- ~8,200 elements

Analyses
- ~ 900 Templates
- ~103,000 analyses
Ability to do Predictive Analytics in PI AF
DCP Midstream PI System Development

Building the Tools for Reliability

PI Asset Framework (PI AF)

- Develop Hierarchy of Gas Plant, Compressor Station, Gathering System and Pipeline Assets
- Organization of Data Into Useful Sets
- Standardization Across Sites
- Templates for Scalability
- Translation/Integration With Other Business Systems

PI Vision

- Dashboards for Operational Monitoring
- Multiple Sources of Data Combined Into Single View
- Pair Analytics w/Real-Time Values
- Single Point Access Across Organization

PI Alerts & PI Notification

- 24/7 Monitoring & Communication of Anomalies
- Failure Detection, Efficiency Monitoring, Work Mgmt.
- Improve Operational Awareness
- Eliminate “Digging” for Issues
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Real Time Operational & Financial Targets

Using Operational, Process Simulation and Financial Data to Optimize Plant Performance

Case Study: Real-time Process Simulation and Financials Provide Operating Targets and Potential Value Improvement

Background

- Optimal plant operation depends on many factors including feed composition, operating mode, plant and equipment design
- Target operating (e.g. temperatures, pressures) were not readily accessible
- Incremental value of operating at optimal conditions was unknown

Solution

- Linking process simulations to PI data & layers of analytics provides operating parameters for the plant at optimal conditions
- Financial info linked to real time and modeled data provides current and potential value of plant operation
- Real time optimized operating and financial data provide definitive targets for operators

Results

- More accurate, consistent and reliable plant operations provides significant margin improvement
- Quantifying impact of sub-optimal operation allows effective prioritization of plant maintenance and small capital projects
- Visibility to plant capability, current status and associated value is fundamental to ICC operation

<table>
<thead>
<tr>
<th>PLANT KPIs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAILY MARGIN</strong></td>
</tr>
<tr>
<td><strong>MARGIN Per MSCF</strong></td>
</tr>
<tr>
<td><strong>NAMEPLATE CAPACITY</strong></td>
</tr>
<tr>
<td><strong>INLET RATE</strong></td>
</tr>
<tr>
<td><strong>INLET PRESSURE</strong></td>
</tr>
<tr>
<td><strong>ETHANE RECOVERY</strong></td>
</tr>
<tr>
<td><strong>PROPANE RECOVERY</strong></td>
</tr>
</tbody>
</table>
Example of a Gas Plant Financial Calculation

<table>
<thead>
<tr>
<th>Name</th>
<th>Expression</th>
<th>Output Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProducerNGLC4</td>
<td>Convert('Producer NGL Volume</td>
<td>nC4','gpd') * 'Producer NGL nC4 Price'</td>
</tr>
<tr>
<td>ProducerNGLiC5</td>
<td>Convert('Producer NGL Volume</td>
<td>iC5','gpd') * 'Producer NGL iC5 Price'</td>
</tr>
<tr>
<td>ProducerNGLnC5</td>
<td>Convert('Producer NGL Volume</td>
<td>nC5','gpd') * 'Producer NGL nC5 Price'</td>
</tr>
<tr>
<td>ProducerNGLC6P</td>
<td>Convert('Producer NGL Volume</td>
<td>C6P','gpd') * 'Producer NGL C6P Price'</td>
</tr>
<tr>
<td>ProducerNGLCost</td>
<td>ProducerNGLC2 + ProducerNGLC3 + ProducerNGLiC4 + ProducerNGLnC4 + ProducerNGLC5 + ProducerNGLnC5 + ProducerNGLC6P</td>
<td>Gross Margin</td>
</tr>
<tr>
<td>Part6</td>
<td>6 // Pipeline Revenue</td>
<td>Map</td>
</tr>
<tr>
<td>PipelineRevenue</td>
<td>('NGL Outlet 1 Uplift' * Convert('NGL Outlet 1 Contract Portion','frac') + 'NGL Outlet 2 Uplift' * Convert('NGL Outlet 2 Contract Portion','frac') + 'NGL Outlet 3 Uplift' * Convert('NGL Outlet 3 Contract Portion','frac') ) * Convert('.\Cryo Unit</td>
<td>NGL Outlet</td>
</tr>
<tr>
<td>Part7</td>
<td>7 // Totals</td>
<td>Map</td>
</tr>
<tr>
<td>Margin</td>
<td>IF BadVal(ResidueRevenue+NGLRevenue+FeeRevenue-ProducerResidueCost-ProducerNGLCost+PipelineRevenue) THEN DigState(&quot;Bad Input&quot;) ELSE ResidueRevenue+NGLRevenue+FeeRevenue-ProducerResidueCost-ProducerNGLCost+PipelineRevenue</td>
<td>Gross Margin</td>
</tr>
</tbody>
</table>
Tracking Plant Downtime and Causes

Event Frames, Notifications and Reason Codes to Improve Plant Reliability
The Smart Gas Plant – “Layers of Analytics”
Near Real-Time Financial Optimization

- End to end view of plant
- Operational and financial targets
- PvA calculations

Optimization Model
VMGSim

Gas Plant Visualization including mobile

Optical Gas Plant

Physical Gas Plant

Gas Plant asset configurable templates

Digital Gas Plant

Financial Table

- Real-time Commodity Pricing
- Financials based on contract mix

PI AF Linked Table

PI AF

Visual Dashboards & Multidimensional Assessment

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Data & Trends for Condition Based Maintenance

PI Trends & PI Analytics to Maximize Component Life & Value

Case Study: Real-time Trending and Immediate Notification to Monitor and Respond to Equipment Condition

Background

- Historically, we used a control system-based monitoring (i.e. alarms and shut downs on small set of parameters)
- Limited advanced warning capability

Solution

- Compression Health Monitoring Team Developed Standardized Tools and Analyses using Operational Data to Monitor Equipment & Improve Reliability
- Use PI Vision & Notifications to Trend and Flag Abnormal Operating Conditions
- Local work groups are using the PI system to expand and customize monitoring capabilities beyond our initial “centralized” tools

Results

- More quickly identify and troubleshoot issues
- Reduce Frequency of Equipment Failures and associated downtime
- Simple first steps toward condition-based monitoring

Please reference the table below for Cylinder Temperature at Notification:

<table>
<thead>
<tr>
<th>Cylinder/Photometer Location</th>
<th>Temperature at Notification (°F)</th>
<th>Offset (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>129,860</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>119</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>370</td>
<td>0</td>
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<tr>
<td>D</td>
<td>378</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>358</td>
<td>0</td>
</tr>
<tr>
<td>F</td>
<td>322</td>
<td>0</td>
</tr>
<tr>
<td>G</td>
<td>154</td>
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<td>H</td>
<td>374</td>
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<td>362</td>
<td>0</td>
</tr>
<tr>
<td>K</td>
<td>309,200</td>
<td>0</td>
</tr>
<tr>
<td>L</td>
<td>321,600</td>
<td>0</td>
</tr>
</tbody>
</table>

Subject: Engine Cylinder Temp Deviation on C190 at Wells Branch C190, 11-01-17, 16:30:55 UTC, generated alarm

Event: Engine Cylinder Temp Deviation on C190 at Wells Branch C190, 11-01-17, 16:30:55 UTC, generated alarm

Notes: Engine Cylinder Temp

Server: VERO205101

Database: DCP Midstream

Start Time: 11-01-17 16:30:55 UTC

11-01-17 16:31:04 AM Mountain Daylight Time (GMT: -06:00:00)

Target: DCP Midstream/Environment and Processing/Stream/DI Bruneell-Waddie County Super/Wells Branch/C190/Engine

Severity: Notice

Send Time: 11-01-17 18:00:00 UTC

Mountain Daylight Time (GMT: -06:00:00)

Please reference the table below for Cylinder Temperature at Notification:
Real-Time Compression Optimization
Using PI AF & First Principles Models to Predict & Optimize Compressor Operations

Case Study: Real-time Compressor Optimization using PI Data and First Principles Models

<table>
<thead>
<tr>
<th>Background</th>
<th>Solution</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historically, we run compressor performance curves during design and then periodically to confirm proper performance</td>
<td>Compression Health Monitoring Team runs first principle models using real time PI data. Model output is used to define optimal compressor settings for current operation.</td>
<td>More quickly identify optimal compressor operating parameters</td>
</tr>
<tr>
<td>Changes in gas volume, composition, field pressures can significantly change the optimal operating point</td>
<td>PI Vision displays provides operating conditions based on optimal load step</td>
<td>Reduced operating costs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improved equipment reliability</td>
</tr>
</tbody>
</table>
Monitoring Pipeline Pump Rotation
Using PI AF and Vision to Monitor NGL Pipeline Pump Operations

Case Study: Comparison of real time pipeline pump usage to ensure even wear and tear of pumps

Background
- Reliability and operation team spent a lot of time tracking down asset utilization in the past
- Under/Over utilized pumps are more likely to experience issues with seal failing, mud daubers getting in the motors, and other problems

Solution
- PI Vision display of side by side pumps and pump stations throughout pipeline to compare and monitor run hours in current month and current year

Results
- Reliability and operation team can now easily track pump utilization
- Control center can proactively manage which pump to run, thereby ensuring even wear and tear and minimizing equipment failure in the future
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A Little Bit of Wisdom.....

1. Focus on PI AF standards, structure, and governance
2. Get SMEs up to speed on PI AF & developing templates w/COE support
3. Establish PI COE and EA governance with KPIs for success
4. Use of PI System/PI AF/PI Vision with experienced SI
5. Just showing the data to the users is huge (requires good data quality)
6. Democratic versus Centralized
7. Transformation encompasses People, Process and Technology (and technology is the “easy” part)
8. EA to support digital transformation & rapid time to value
If we had to do it over....

1. Simple starts and simply start

2. Develop broad PI System awareness, competency, and process to ensure full leverage

3. Keep an eye on the PI System roadmap and new functionality
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Linking Operational to Geographic Data

Using Operational and Geospatial Data to Optimize Gathering and Processing Performance

Future Opportunity: Real-time operational data in space can lead to greater efficiencies and operating margin

Background

• The midstream business is spread over a wide area, requiring lots of driving miles for operations and maintenance

• With its long distances and extensive interconnections, our gathering system operations must consider geography of our assets

Solution

• Linking operating data with geospatial gathering system and pipeline information will allow rapid understanding of issues and responses to normal and upset conditions.

Expected Results - KPIs

• Optimal gas routing
• Increased volumes
• Greater reliability
• Fewer miles driven
IIOT Enabled Advance Machinery Analytics

Spotlight Site Installation = 2 hrs
IIOT sensory inputs that augments existing SCADA/PLC inputs in the PI System

Integrate with the PI System for Complete Cause and Effect Analytics via PI AF and PI Analytics Embed Windrock specialized analytics displays into PI Vision

From Data to specialized Analytics (Cloud based)

Collect Raw IIOT Data
i.e. high frequency, pressure, vibration and spectrum

Create Calculated Data
i.e. pressure vs volume

EDGE AI ANALYTICS
i.e. “this is how the valve is leaking”
The Smart Booster Station – Real-time VR

Enterprise OT Data Infrastructure
Application & Analytics Platform

DCP Midstream
OT Connectivity Accounts

Plant A...n
DCS/PLCs
Assets

Logistics
SCADA/
Assets

IIOT
Edge
Gateways
Assets

R&D
PLC & other
Assets

Infrastructure
BMS/
Assets

JVs
DB/
Assets

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Enabling Business Transformation with the PI System

COMPANY AND GOAL
DCP Midstream provides a broad array of midstream services from the well head to market and wanted to use data and information as a strategic asset to enable a Business Transformation to deliver differentiated customer satisfaction, safety, & performance.

CHALLENGE
Disparate data sources from SCADA, and DCS inhibiting ability to make timely, business decisions

• Multiple data sources
• Lack of tag and asset naming stds
• Low level of collaboration
• Average asset reliability and margin performance

SOLUTION
Selected the PI System as a strategic enterprise OT infrastructure with an EA to underpin DCP2.0 Business Transformation and ICC

• Implemented multi-tiered PI System enterprise architecture in a rapid, agile method in 10 months
• Focus on PI AF-based OT data structure – abstraction, normalization, and context
• Enabled Business Transformation and Integrated Collaboration Center (ICC)

RESULTS
Saved $20MM-$25MM in EBITDA benefit first year from improved gas plant operation, asset reliability, & ICC coordination

• Financial optimization of 30 gas plants (remainder in 2018)
• Reduced O&M costs & growth momentum from new projects
• More proactive/predictive vs reactive…a culture of innovation
• Improved customer service, satisfaction and differentiation
Questions

Please wait for the microphone before asking your questions

State your name & company

Please remember to...

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Optional: Click to add a takeaway you wish the audience to leave with.