Discover Your Untapped Assets – Digitalization for Oil and Gas Applications

Empower the value of data
“Lower-for-Longer” O&G Market – Conditions Require Industry to Adapt

Cost reductions do not compensate for price decline

Dated Brent Price

Upstream Cost Index

<table>
<thead>
<tr>
<th>Price (US$/bbl)</th>
<th>Brent Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 13</td>
<td>120</td>
</tr>
<tr>
<td>Dec 14</td>
<td>100</td>
</tr>
<tr>
<td>Dec 15</td>
<td>80</td>
</tr>
<tr>
<td>Dec 16</td>
<td>60</td>
</tr>
<tr>
<td>Dec 17</td>
<td>40</td>
</tr>
<tr>
<td>Dec 18</td>
<td>20</td>
</tr>
</tbody>
</table>

-45%

<table>
<thead>
<tr>
<th>Cost Index (Year 2000=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
</tr>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2006</td>
</tr>
<tr>
<td>2008</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>2012</td>
</tr>
<tr>
<td>2014</td>
</tr>
<tr>
<td>2016</td>
</tr>
</tbody>
</table>

-27%
-18%

Maximize Recovery

Lower CAPEX
Lower OPEX

S. Jacquin | COMOS Industry Solutions
We have the requisite expertise to make our customers more competitive through digitalization.

**Customer Needs**
- Maximize Recovery
- Lower OPEX
- Lower CAPEX

**Siemens Oil and Gas Answer**

**Leverage**
- Our Existing Products and Services

**Apply**
- Our Automation Expertise

**Provide**
- Integrated Systems and Solutions

**Lead**
- Digitalization to turn data into value

At Siemens, Industrial Transformation Is Where We Thrive.
Tools to Maximize Recovery
Data Across Asset Life Cycle Drives Development of “Digital Twin”

Pre-/Feed → Design and Engineering → Construction and Commissioning → Operation and Maintenance

Virtual World

Siemens Software

Siemens Digital Services Asset Performance Management

Data Analytics

MindSphere – The IoT operating system

Real World

Cyber Security

Digitally Enhanced Electrification, Automation, Rotating Equipment

Digital Twin
The Intelligent Digital Twin
for Fields, Pipelines, & Process Plants in Oil & Gas

Intelligent Digital Twin
Concept and FEED

- Configurators for fast, best practice designs
- Process simulation for concept selection
- Learning algorithms

Data Hub

- Process data
- Telecoms
- P&IDs
- Service and maintenance data for asset management

Intelligent Digital Twin
Operate and maintain

- 3D Conceptual Plant Design
- 3D drawings
- Fire and Gas
- Electrical
- Equipment data sheets

Intelligent Digital Twin
Design and build

- Detailed design and control logic config
- Virtual commissioning, operator training, and integrated monitoring and control
- Real time and historical asset generated data

- Automation System
- Instrumentation
- Safety System
- Isometrics
- 3D Conceptual Plant Design
- Virtual commissioning, operator training, and integrated monitoring and control
- Real time and historical asset generated data

- Analytics for operations and maintenance optimization
- Analytics for operations and maintenance optimization

- Siemens
- Ingenuity for life

Unrestricted © Siemens AG 2018
Page 6
S. Jacquin | COMOS Industry Solutions
The Intelligent Digital Twin for Fields, Pipelines, & Process Plants in Oil & Gas

Intelligent Digital Twin Concept and FEED

- Configurators for fast, best practice designs
- Process Twin: Process and automation testing, ops training, what-if scenarios
- Plant Twin: Smart 3D view of facility for construction, P&IDs and maintenance planning, hazops, etc.

Data Hub

- Learning algorithms
- Service and maintenance data for asset management
- Analytics for operations and maintenance optimization

SIEMENS MindSphere

- 3D Conceptual Plant Design
- Detailed design and control logic config

Intelligent Monitoring

- Analytics and reporting for operational KPIs and equipment condition monitoring

OEM Services

- Predictive diagnostics, asset and production optimization

Intelligent Digital Twin Design and build

- Virtual commissioning, operator training, and integrated monitoring and control
- Real time and historical asset generated data

Intelligent Digital Twin Operate and maintain

- Service and maintenance data for asset management
- Analytics for operations and maintenance optimization

Unrestricted © Siemens AG 2018

S. Jacquin | COMOS Industry Solutions
The Intelligent Digital Twin
for Fields, Pipelines, & Process Plants in Oil & Gas

Intelligent Digital Twin
Concept and FEED

- Configurators for fast, best practice designs
- 3D Conceptual Plant Design

Data Hub

- COMOS FEED
- Bentley PlantWise
- COMOS-PCS7 Plant Automation Accelerator

- Process Twin
- Plant Twin
- Intelligent Monitoring
- OEM Services

Intelligent Digital Twin
Design and build

- Virtual commissioning, operator training, and integrated monitoring and control
- Real time and historical asset generated data

Intelligent Digital Twin
Operate and maintain

- Learning algorithms
- Service and maintenance data for asset management
- Analytics for operations and maintenance optimization
- Real time and historical asset generated data
SimTwin

Operations Intelligence provides easy access to key model input parameters and data output from simulator runs.

Main challenge today

Customers rely on sophisticated models and simulators provided by 3rd parties as services. Need real-time visibility as simulation runs are produced

Customers are looking to their Simulation/Modelling services vendors to expose more control over simulation runs. Need selective control over simulation runs.

Simulation/Modelling service vendors need a portal that unifies the experience for their customer end users. Need to expose the right tuning parameters and simulation output data.

Sim/Mod Cockpit

Dashboards and views provide user visibility on simulation runs as they are produced.

Toolsets provide user control over simulations – start, stop, tune parameters, re-start, observe.

Simulation & Modelling Cockpit provides the unified environment to view the interactions between models and their simulations within.

Value Package

- Real-time visibility – results of simulation runs are presented at SimTwin’s dashboards – as soon as they are produced
- Historical trends and stacked bars provide tracking of actual production vs. simulator results
- XHQ Target Management and Alert Notification add-ons update service provider and customer end users notice of simulation deviations
- XHQ features provide customer end users with start/stop control on the simulation as well as select parameters for tuning simulation for better accuracy of results

Value to the Customer

Operations Intelligence provides easy access to key model input parameters and data output from simulator runs.
Process Flow Diagrams (PFD)
COMOS PFD

Project

Customer Challenge
- Design quality enhancements required
- Design costs were too high
- FEED design time too long
- Design capacity limited
- Downstream discipline handover challenges
- Current software environment was disconnected

Siemens Digital Solution
- In 2010 the software solution COMOS is deployed by SEI as uniform and integrated process development platform
- The engineering quality in the development of PFDs (process flow diagrams) and PIDs was enhanced
- The Integrated process development platform is based on a consistent database for the plant planning projects

Zhu Chuntian Sr. Vice Director SEI China: “Above all, it was the object-oriented database structure of COMOS that convinced us. This directly met many of our requirements for an integrated process development platform. Using this approach, we can supply even better products to our customers.”

Customer
Sinopec Engineering Incorporation (SEI)

Location
Beijing, China

Siemens Scope
- COMOS Platform
- COMOS FEED
- COMOS P&ID
- COMOS Electrical

Advanced Integrated Process Design Platform

Higher Engineering Quality
Reduced Project Times
Enhanced Project Efficiency
COMOS FEED – Industry proven standard solutions to reduce costs and raise quality

Main challenge today
- Disconnected environment forcing manual rework and limit world wide collaboration
- Huge amount of manual work caused by limited standardization
- Unmanaged change causes rework and failures with negative influence to the subsequent project

COMOS FEED Value Package

### Active Collaboration
Common data model from FEED across engineering to operation

### Enable Reuse
Automatic creation of P&ID’s, templates, run case management, knowledge base

### Raise Quality
Integrated change management across the entire supply chain

Value to the Customer
- Higher efficiency will enable effort reduction to create and maintain information
- Reduced FEED duration and enhanced reusability due to standardization
- Reduced risk and increase compliance due to identification of inconsistencies
- Raised quality due to Integrated change management across the entire supply chain
- Enhanced cost transparency across departments and disciplines

Use Cases and Customer Feedback
- KBR
- Sinopec
- Bentley PlantWise
Customer Challenge

- Early cost calculations during the FEED phase are rough and forces uncertainty especially for fixed price projects
- Disconnected environment forcing manual rework and with high potential for failures
- Limited capabilities to reuse existing information to reduce effort

Siemens Digital Solution

- Create conceptual 3D models based on PFDs to execute early cost estimation
- Link between COMOS FEED and Bentley PlantWise will enable early 3D layout planning and general arrangement
- Raised accuracy of the project budget calculation in the FEED phase will reduce costs
- Repeatable solutions to support change management e.g. if new load cases need to be calculated across the FEED lifecycle
Process Control System PCS 7
Flexible Network Topology for Digitalization

**Business LAN & Internet**
- Operations & Batch Management
- Mobile Clients
- Process Simulation & Engineering Design
- Operations Intelligence

**Profinet**
- Foundation for Digitalization
- Ethernet based
- Cu & F/O networking supported

**Profibus**
- Cu & F/O networking supported

---

S. Jacquin | COMOS Industry Solutions
SIMATIC PCS 7
Efficient Engineering and Intuitive Operation with one Tool

**Key Benefits**
- Improved efficiency over interlock engineering with CFC
- Full integration in PCS7 engineering and visualization

**Safety Matrix**

**Logic Matrix**

**Cause-Effect Diagramming**
- Engineering tool for creating complex interlock logic
- Capable of auto-generating required logic

**Aligned with Safety Matrix**
- Look & Feel similar to Safety Matrix
- Engineering workflow similar to Safety Matrix
- Safety Matrix logic is TUV certified.

**Features**
- Aligned with Advanced Process Library
- Intrinsic alarming triggered by cause and effect status changes
- Intrinsic n-out-of-m evaluation of causes
- Support for analog inputs
- Bypassing of causes and effects
- Time-controlled bypassing

**Unrestricted © Siemens AG 2018**

Page 14
MindTwin – Your Digital Asset Portal
XHQ, COMOS, Walkinside, and MindSphere

Problem
Inadequate knowledge of asset conditions leads to inefficient or inadequate maintenance

Solution
Digital twin provides situational awareness to predict and plan maintenance

Benefits
↑ Asset life, ↑ Service factor, ↓ Maintenance spending
Quantitative Savings and Qualitative Enhancements

Integrated Approach for the entire plant lifecycle with
- Common data model from FEED across engineering to operation
- Reuse based on standardization
- Up-to-Date and consistent As-Is data and documentation
- Integrated change management across supply chain

Expected Quantitative Savings
- Efficiency Enhancements
- Decrease of cost for change during project and operation

Qualitative Enhancements
- Reduced risks and increase compliance
- Avoidance of EHS penalties
- Cost transparency across departments and disciplines
- Industry 4.0 enabled – Foundation for next steps
COMOS FEED Example – Cost Benefit Analysis

Boundary Conditions
• 60 FEED User, 15 Viewer
• 200 working days p.a. and per user
• €560 per day cost per user

Calculated Benefits
• 15% efficiency enhancements (€1.26 m Potential)
• 10% NCC costs reduction (€0.15 m Potential)
• 100% effective with €1.41 m in the 4th year:

Cost Estimations based on standards
• €245 k license costs p.a. (60 edit and 15 view licenses, subscription, named user, list price)
• €356 k for 220 external service and training days
• €1,090 m 3 years total costs for Siemens offering
• Internal project costs

Break Even
September 2020 if project starts in January 2018

Technip FEED Example Business Case

Break Even Sept. 2020

<table>
<thead>
<tr>
<th>Year</th>
<th>Benefits</th>
<th>Costs</th>
<th>Cost Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>€0.97 m</td>
<td>€-0.96 m</td>
<td>€0.01 m</td>
</tr>
<tr>
<td>2019</td>
<td>€2.32 m</td>
<td>€-1.55 m</td>
<td>€0.77 m</td>
</tr>
<tr>
<td>2020</td>
<td>€3.73 m</td>
<td>€-2.01 m</td>
<td>€1.72 m</td>
</tr>
<tr>
<td>2021</td>
<td>€5.14 m</td>
<td>€-2.47 m</td>
<td>€2.67 m</td>
</tr>
<tr>
<td>2022</td>
<td>€5.14 m</td>
<td>€-2.93 m</td>
<td>€2.21 m</td>
</tr>
</tbody>
</table>
The Value of a 1% Improvement

What is 1% Worth?
• Faster access to information can mean faster, better informed, decisions
• Better decisions can easily yield **1% or more in savings or improvements** in many areas:
  • Profitability
  • Production Efficiency
  • Cost Reductions
  • Energy
  • Operations
  • Maintenance
  • Health and Safety
  • Environmental Impact
  • Product Quality

Typical breakdown of refining operation costs (Excluding Marketing, Retail, Distribution, Taxes)
System Payback – How soon to begin achieving ROI?

Typical Mid-Sized U.S. Refinery

Manageable Costs + Crude Cost

- US$ 3.5M /day
- US$ 1.0B /yr
- 428 kbdp
- US$ 6.4B /yr

XHQ – Typical Refinery System Costs

- XHQ Software Licensing ~US$ 300k
- Annual Maintenance ~US$ 60k/yr
- Solution Services ~US$ 300k
- H/W & 3rd Party S/W Costs ~US$ 30k

Total System Costs 1st yr ~US$ 690k

1% Energy Reduction = US$ 18k/day = US$5.4M/yr ROI in 0.18 yrs = 66 days
1% Maintenance Reduction = US$ 8k/day = US$2.4M/yr ROI in 0.29 yrs = 105 days
1% Cat & Chemical Reduction = US$ 4.5k/day = US$1.4M/yr ROI in 0.49 yrs = 180 days
1% Salary & Other Reduction = US$ 3.5k/day = US$1.0M/yr ROI in 0.69 yrs = 252 days
1% Total Possible Reduction = US$ 34k/day = US$10.2M/yr ROI in 0.07 yrs = 25 days
Thank You
Contact

Steve Jacquin
CIS PreSales Solution Architect and Account Manager
Siemens Industry Software
24 – 1930 Maynard Rd S.E
Calgary, AB, Canada
T2E 6J8
Mobile: +1 403 472 6524

E-mail: steven.jacquin@siemens.com

siemens.com/comos
siemens.com/xhq