Discover Your Untapped Assets – Digitalization for Oil and Gas Applications

Empower the value of data

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"Lower-for-Longer" O&G Market – Conditions Require Industry to Adapt

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Cost reductions do not compensate for price decline

Dated Brent Price

Price (US$/bbl)

120 · 100 · 80 · 60 · 40 · 20 · 0

Dec 13 Dec 14 Dec 15 Dec 16 Dec 17 Dec 18

-45%
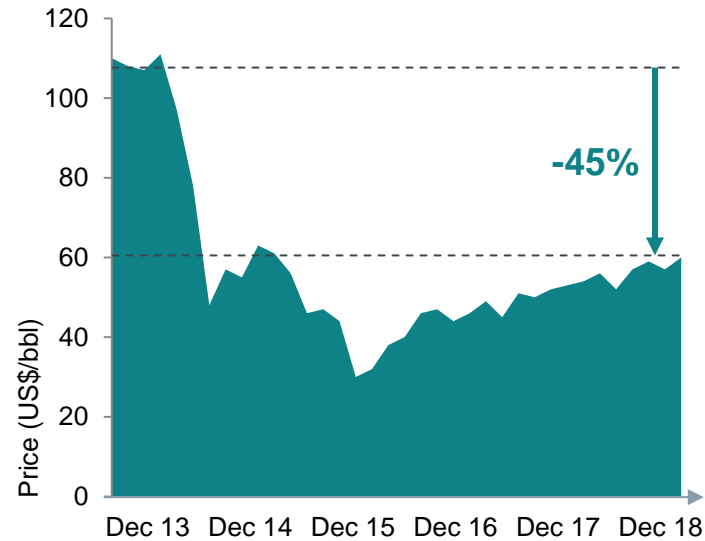
■ Brent Price

Upstream Cost Index

Cost Index (Year 2000=100)

250 · 200 · 150 · 100 · 50 · 0

2000 2002 2006 2008 2010 2012 2014 2016

-27%
-18%
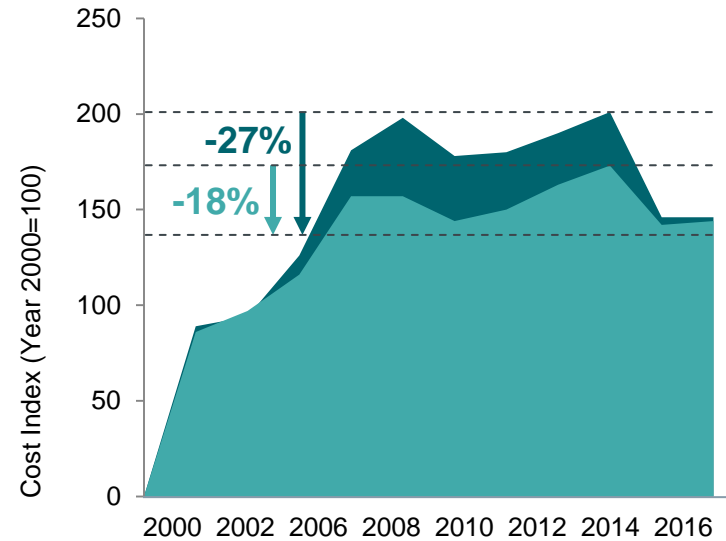
■ Operations Cost   ■ Capital Cost

$ Lower CAPEX

⚒ Lower OPEX

🕐 Maximize Recovery

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At Siemens, Industrial Transformation Is Where We Thrive

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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

Drive your competitiveness

Lead
Digitalization to turn data into value

Provide
Integrated Systems and Solutions

Apply
Our Automation Expertise

Leverage
Our Existing Products and Services

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Tools to Maximize Recovery

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Data Across Asset Life Cycle Drives Development of "Digital Twin"

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

Virtual World

Cyber Security

Siemens Software

Siemens Digital Services
Asset Performance Management

Data Analytics

MindSphere –
The IoT operating system

Real World

Digitally Enhanced Electrification, Automation, Rotating Equipment

Digital Twin

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

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Intelligent Digital Twin
Concept and FEED

Configurators for fast, best practice designs

3D Conceptual Plant Design

Detailed design and control logic config

Intelligent Digital Twin
Design and build

Data Hub

Process data

Process simulation for concept selection

Telecoms

3D drawings

Automation System

Safety System

Fire and Gas

Instrumentation

P&IDs

Electrical

Virtual commissioning, operator training, and integrated monitoring and control

Equipment data sheets

Isometrics

Learning algorithms

Service and maintenance data for asset management

Analytics for operations and maintenance optimization

Real time and historical asset generated data

Intelligent Digital Twin
Operate and maintain

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

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Process
simulation
for concept
selection

**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.

**SIEMENS
MindSphere**

**Intelligent
Monitoring**
Analytics and
reporting for
operational KPIs
and equipment
condition monitoring

**OEM
Services**
Predictive
diagnostics,
asset and
production
optimization

Virtual
commissioning,
operator training,
and integrated
monitoring and
control

Learning algorithms

Service and maintenance
data for asset management

Analytics for operations and
maintenance optimization

Real time and historical
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**Intelligent Digital Twin
Operate and maintain**

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**Intelligent
Digital Twin**
Design and build

**COMOS
FEED**

**Bentley
PlantWise**

COMOS-PCS7
Plant Automation
Accelerator

**COMOS
PFD**

Data Hub

Simulation
for concept
selection

SimTwin

**Process
Twin**

**Plant
Twin**

**SIEMENS
MindSphere**

**Intelligent
Monitoring**

**OEM
Services**

PCS7
VCO, Monitoring,
Control, OTS

Virtual
commissioning,
operator training,
and integrated
monitoring and
control

3rd Party
Info Sources

MindTwin

Learning algorithms

Service and maintenance
data for asset management

Analytics for operations and
maintenance optimization

Real time and historical
asset generated data

Intelligent Digital Twin
Operate and maintain

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 Value Package	**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.**
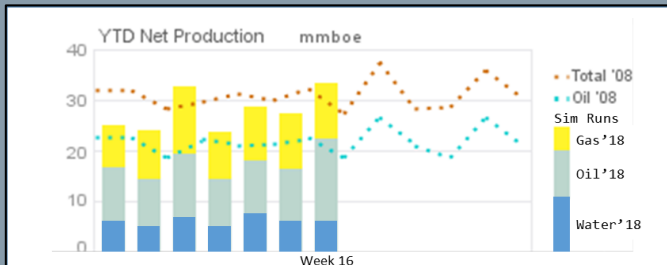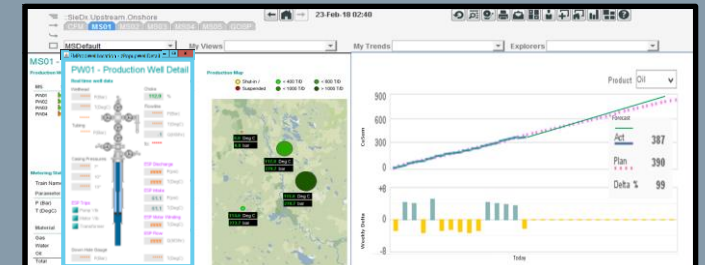
Value to the Customer	- Real-time visibility – results of simulation runs are presented at **SimTwin's** dashboards – *as soon as they are produced* - Historical trends and stacked bars provide tracking of actual production vs. simulator results - **XHQ Target Management** and **Alert Notification** 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

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Process Flow Diagrams (PFD)
COMOS PFD

Project

Advanced Integrated Process Design Platform

Customer

Sinopec Engineering Incorporation (SEI)

Location

Beijing, China

Siemens Scope

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

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."

Higher Engineering Quality

Reduced Project Times

Enhanced Project Efficiency

COMOS FEED – Industry proven standard solutions to reduce costs and raise quality

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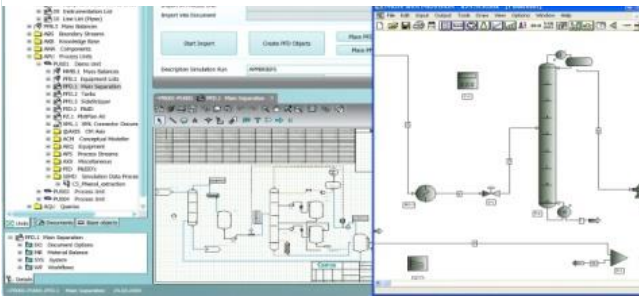|			
Main challenge today	Disconnected environment forcing manual rework and limit world wide collaboration	Huge amount of manual work caused by limited standardization	Unmanaged change causes rework and failures with negative influence to the subsequent project

COMOS FEED Value Package

| **Active Collaboration**	**Enable Reuse**	**Raise Quality**
Common data model from FEED across engineering to operation	Automatic creation of P&ID's, templates, run case management, knowledge base	Integrated change management across the entire supply chain
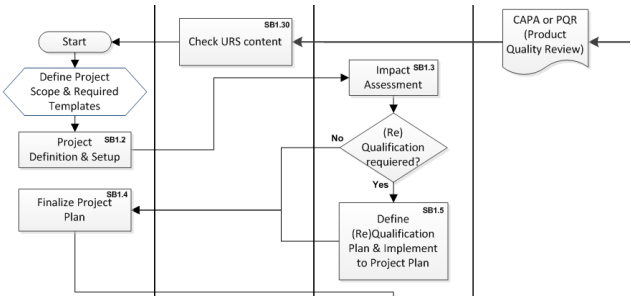
Value to the Customer

- 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

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3D Conceptual Plant Design – Bentley PlantWise

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Bentley Siemens Alliance
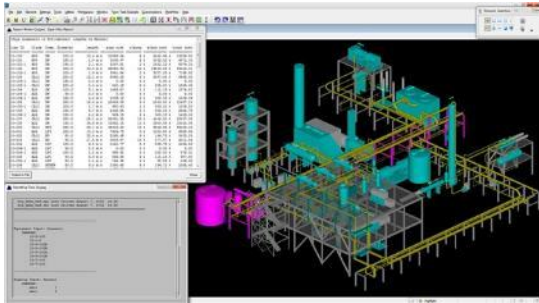
Customer

EPC's

Siemens Scope

- COMOS Platform
- COMOS FEED
- Bentley PlantWise

Joint solution offer with

Bentley

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

🛡 Raised Accuracy
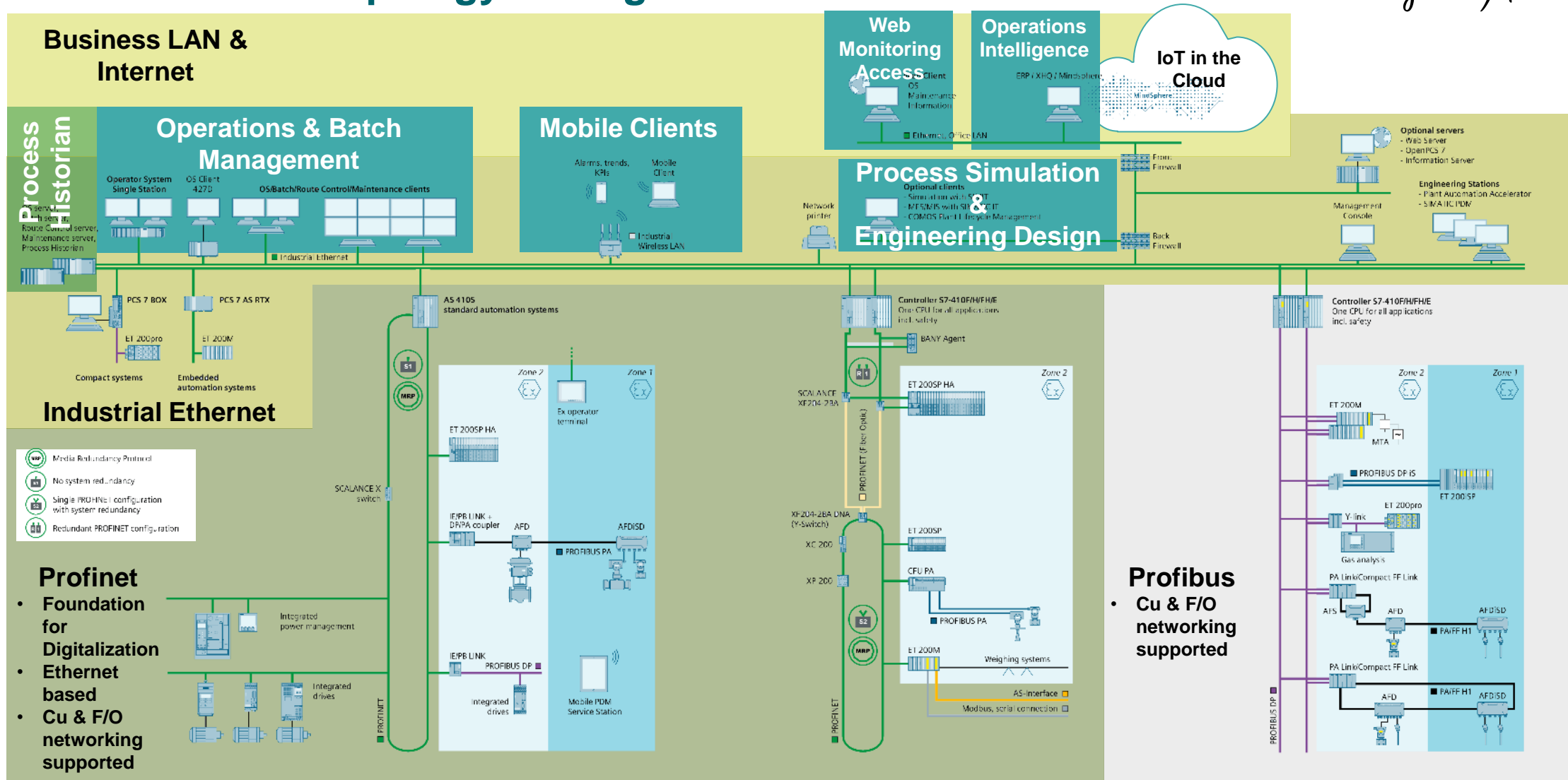
📈 Raised Efficiency During the FEED Phase

€ Repeatable Solution

Process Control System PCS 7
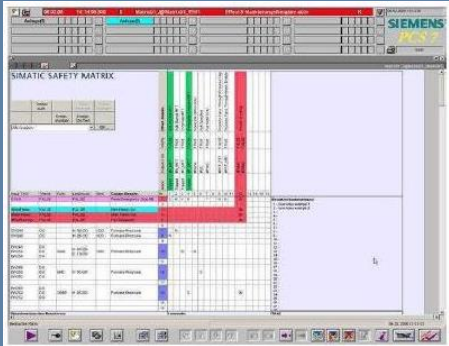# Flexible Network Topology for Digitalization

SIEMENS
Ingenuity for life
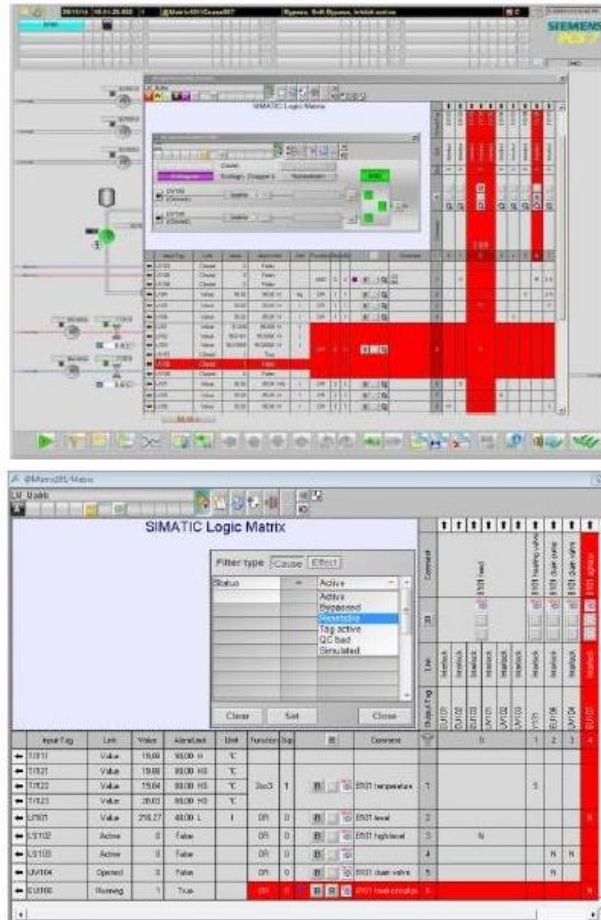
Business LAN & Internet

Process Historian

Operations & Batch Management

Operator System Single Station
OS Client 4270
OS/Batch/Route Control/Maintenance clients

Management server, Route Control server, Maintenance server, Process Historian

☐ Industrial Ethernet

Mobile Clients

Alarms, trends, KPIs
Mobile Client

☐ Industrial Wireless LAN

Web Monitoring Access

OS Client
OS Maintenance Information

☐ Ethernet, Office LAN

Operations Intelligence

ERP / XHQ / Mindsphere

IoT in the Cloud

MindSphere

Process Simulation & Engineering Design

Network printer

Optional clients
- Simulation with SIT
- MES/MIS with SIMATIC IT
- COMOS Plant Lifecycle Management

Front Firewall

Back Firewall

Optional servers
- Web Server
- OpenPCS 7
- Information Server

Engineering Stations
- Plant Automation Accelerator
- SIMATIC PDM

Management Console

Industrial Ethernet

PCS 7 BOX
PCS 7 AS RTX

ET 200pro
ET 200M

Compact systems
Embedded automation systems

AS 410S
standard automation systems

Controller S7-410F/H/FH/E
One CPU for all applications incl. safety

Controller S7-410F/H/FH/E
One CPU for all applications incl. safety

BANY Agent

☐ Media Redundancy Protocol
☐ No system redundancy
☐ Single PROFINET configuration with system redundancy
☐ Redundant PROFINET configuration

SCALANCE X switch

S1

MRP

Zone 2   Zone 1

Ex operator terminal

ET 200SP HA

IE/PB LINK + DP/PA coupler
AFD
AFDiSD

☐ PROFIBUS PA

SCALANCE XF204-2BA

ET 200SP HA   Zone 2

R0

XF204-2BA DNA (Y-Switch)

XC 200
ET 200SP

XP 200
CFU PA

☐ PROFIBUS PA

S2

MRP

ET 200M

Weighing systems

☐ AS-Interface
☐ Modbus, serial connection

ET 200M

MTA

☐ PROFIBUS DP iS
ET 200pro

Y-link

Gas analysis

PA Link/Compact FF Link
AFS   AFD   AFDiSD
☐ PA/FF H1

PA Link/Compact FF Link
AFD   ☐ PA/FF H1   AFDiSD

Zone 2   Zone 1

ET 200M

ET 200SP

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

Integrated power management

Integrated drives

IE/PB LINK
PROFIBUS DP ☐

Integrated drives

Mobile PDM Service Station

PROFINET

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

PROFIBUS DP

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SIMATIC PCS 7
Efficient Engineering and Intuitive Operation with one Tool

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

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

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

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

Solution   Digital twin provides situational awareness to predict and plan maintenance

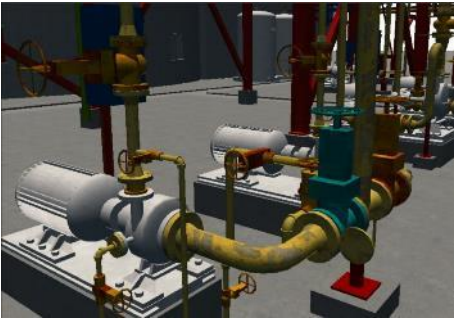Benefits   ↑ Asset life, ↑ Service factor, ↓ Maintenance spending

XHQ: visualization, navigation, integration, context, KPIs

COMOS: design, reference, MRO
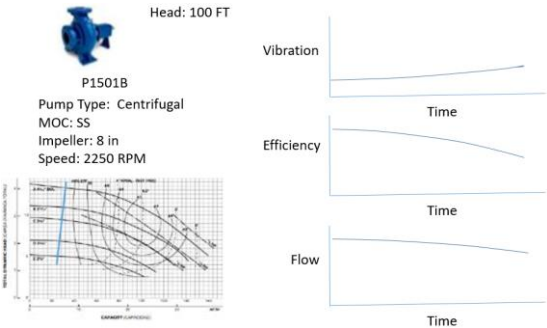
Walkinside: 3D/spatial

MindSphere: analytics

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Maximize Recovery:
Your Path to Success

Quantitative Savings and Qualitative Enhancements

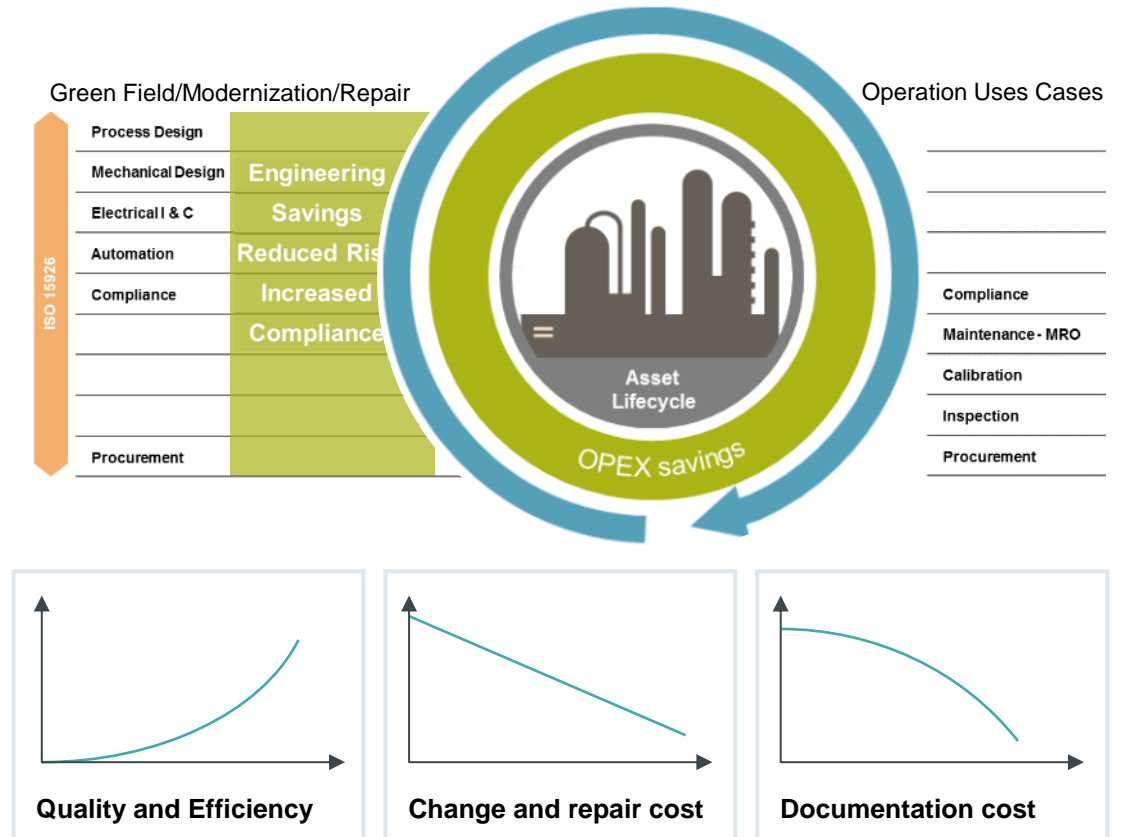## Integrated Approach for the entire plant lifecycle with

- 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

Green Field/Modernization/Repair — Operation Uses Cases

Process Design	Engineering
Mechanical Design	Savings
Electrical I & C	Reduced Ris
Automation	Increased
Compliance	Compliance

ISO 15926

Procurement

Asset Lifecycle
OPEX savings

Compliance
Maintenance - MRO
Calibration
Inspection
Procurement

Quality and Efficiency | **Change and repair cost** | **Documentation cost**

COMOS FEED Example – Cost Benefit Analysis

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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

— Benefits   — Costs   — Cost Benefit
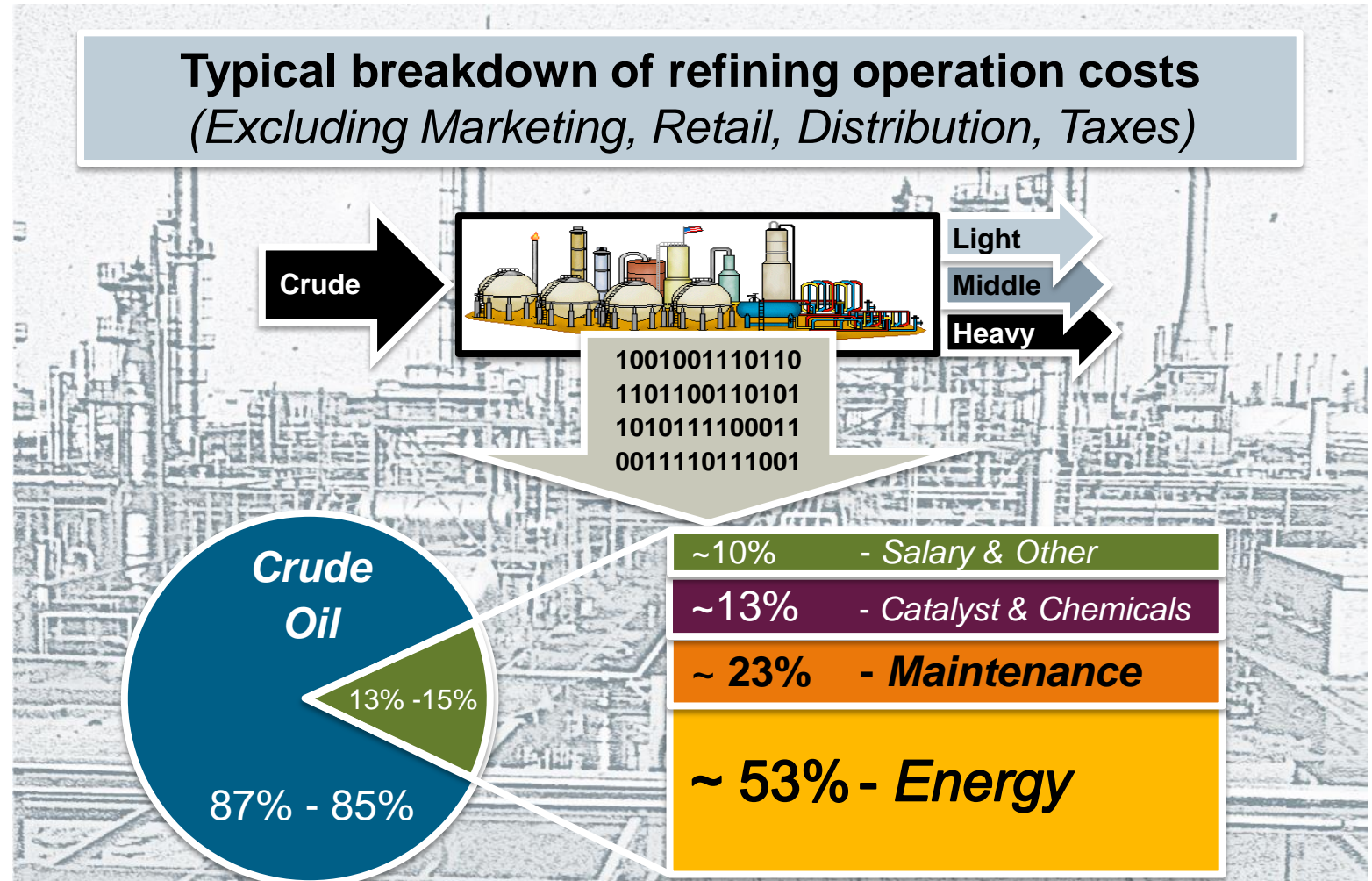
Technip FEED Example Business Case
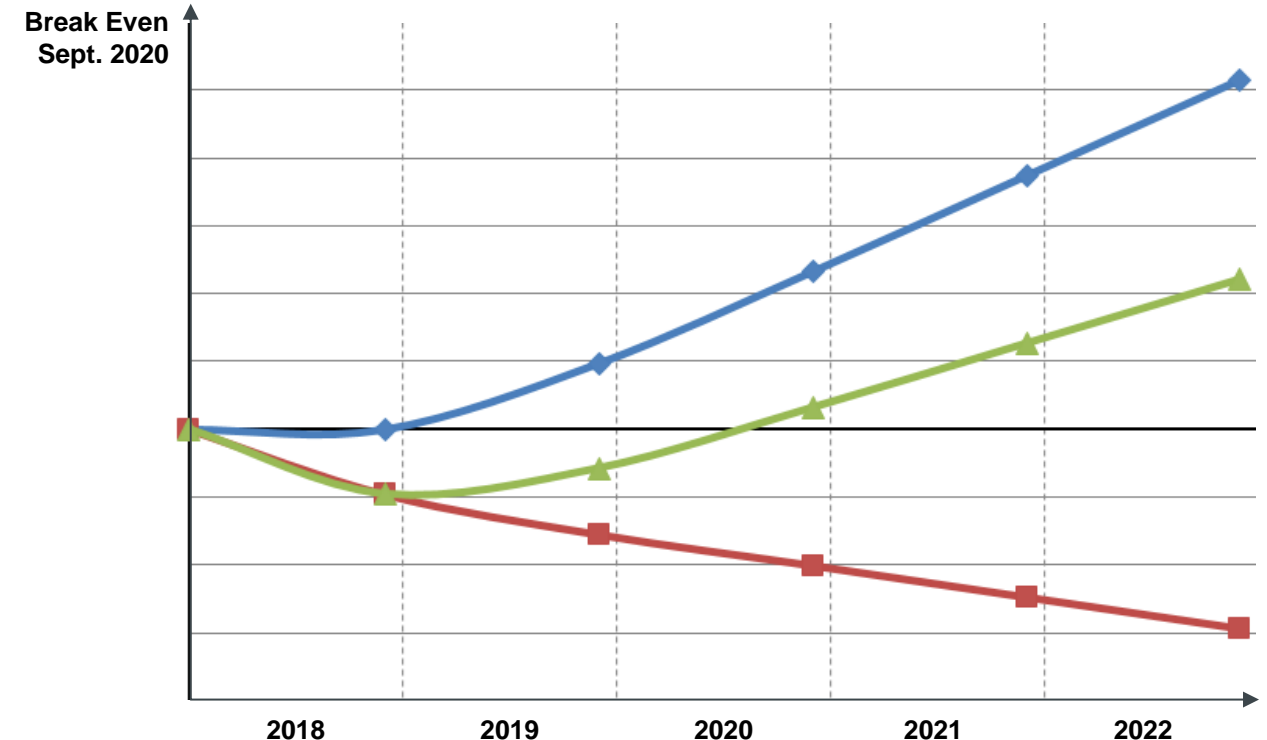
	2018	2019	2020	2021	2022
Benefits		€0.97 m	€2.32 m	€3.73 m	€5.14 m
Costs	€-0.96 m	€-1.55 m	€-2.01 m	€-2.47 m	€-2.93 m
Cost Benefit	€-0.96 m	€-0.58 m	€0.31 m	€1.26 m	€2.21 m

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The Value of a 1% Improvement

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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)

Crude

Light
Middle
Heavy

1001001110110
1101100110101
1010111100011
0011110111001

Crude Oil

13% -15%

87% - 85%

~10% - *Salary & Other*

~13% - *Catalyst & Chemicals*

~ 23% - *Maintenance*

~ 53% - *Energy*

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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 kbpd **US$ 6.4B /yr**
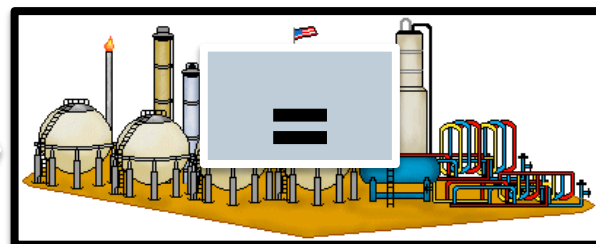
Refined Products & Data Volumes

Light
Middle
Heavy

0.5 GB/day | 165 GB/year | 1 TB/5 years

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

```
100100111011011011001101011010111100011
101011110001100111011100110101111100011
100100111011011011001101011010111110001
```

Possible **Time to begin achieving System ROI**

due to faster access to **0.5 GB**

of new data **per day**

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

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Contact

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