NBTC – ITU Training on Building IoT solutions for e-applications

Session 2b: Internet of Things and the Future of Oil & Gas Industry

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Industrial Internet of Things

MACHINE
+ SENSOR

DATA

DATA CENTERS

Fancy Industry Term = “CLOUD”

Fancy Industry Term = “BIG DATA”
Still fancier?
“EDGE!!!”

ARTIFICIAL INTELLIGENCE

ANALYTICS

Fancy Industry Terms = “PREDICTIVE / PRESCRIPTIVE /EDGE ANALYTICS”

Fancy Industry Term = “COGNITIVE INTELLIGENCE”

INTERNET

Fancy Industry Term = “CONNECTIVITY”

CYBER SECURITY
(Fancy term by itself)
IoT Trend (Gartner Hype Cycle for Emerging Technologies)
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Oil & Gas Industry Introduction

Crude oil is highly flammable and is an excellent source of energy. It's "sister" hydrocarbon, natural gas, is another source of energy. Oil is called a non-renewable energy source because it cannot be replenished.

Petroleum deposits are often found in natural underground reservoirs called oil fields. The oil in these fields can then be extracted by drilling and pumping.

Underground oil accumulations are formed when three conditions are met.

FIRST, there must be a "source" rock rich in hydrocarbons and buried deep enough so that the heat from the Earth’s core can "cook" them into oil.

Three-Layer Cake:
- The bottom layer is water.
- The middle layer is oil.
- The top layer is gas.
Oil & Gas Industry Introduction

**Upstream**
- Exploration & Production (E&P)
- Firms explore new hydrocarbon fields
- Discovered fields developed and petroleum produced

**Midstream**
- Transportation of oil and natural gas
- Shipping
- Pipelines
- LNG Terminals

**Downstream**
- Refinery processes crude oil to produce different products
- Petrochemical plants
- Polymers, Plastics and other products
Oil & Gas Industry Introduction
Oil & Gas Industry Introduction (offshore)

Sea-based offshore platforms and drilling rig for oil
Oil & Gas Industry Introduction (onshore)
Oil & Gas Emerging and Disruptive Trends
The Global Oil & Gas Value Chain

- Exploration
- Field Development
- Production Operations
- Transportation
- Processing
- Storage & Distribution
- Manufacturing
- Refining & Petro-Chemicals
- Wholesale & Marketing
The Oil Value Chain
Oil & Gas IIoT and Digital Transformation

OIL AND GAS - industrial IoT and digital transformation

Industry experts on the evolutions, challenges, benefits and priorities
Investments in Digital Technologies

Ref: World Economic Forum, 2017
Shifting Trends in Supply and Demand Are Reshaping the Oil and Gas Industry

**SUPPLY FORCES**

- **Rise of new hydrocarbon sources**
  - Unconventional to be ~12% of global supply in 2025\(^1\)
  - Offshore to be ~18% of global supply in 2025\(^2\)

- **Changing geopolitical equations**
  - US Light Tight Oil (LTO) overtaking Middle Eastern operators as swing producers
  - Changing role of OPEC\(^3\)

- **Greater penetration of renewables**
  - Renewable sources becoming increasingly economical (e.g., potential reduction of ~60% in cost of solar by 2025\(^4\))

- **New technologies and materials for hydrocarbons**
  - Developments in advanced materials (e.g., nano-fluids for drilling) pushing efficiencies further

**DEMAND FORCES**

- **Shift in global demand patterns**
  - 96% of demand growth from non-OECD\(^5\) countries
  - Fall in OECD demand
  - Millennials embracing the sharing economy leading to reduced consumption\(^6\)

- **Rise of electric vehicles and autonomous driving**
  - Potential reduction in oil demand by ~1.5 million\(^7\) BOE/d

- **Development of storage capabilities leading to possible increase in adoption of renewables**
  - Battery storage developments will significantly influence the energy landscape and lead to higher adoption of renewables

- **New utility models**
  - Smart grids
  - Real-time load balancing, network controls and connected markets, enabled by connected assets, machines, and advanced monitoring capabilities

- **Climate regulation and the push for emission reduction**
  - Stricter emission rules as a number of countries have ratified the COP21\(^8\) agreement

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Notes:
- \(^1\) Unconventional = Light Tight Oil and Shale gas, based on 2025 projection (BP Energy Outlook).
- \(^2\) Offshore projection: from 10% in 2013 to 18% in 2025 (BP Energy Outlook).
- \(^3\) OPEC = Organisation of the Petroleum Exporting Countries; Forecasts by the International Renewable Energy Agency.
- \(^4\) OECD = Organisation for Economic Co-operation and Development.
- \(^6\) https://www.tpls.com/2016/03/how-millennials-driving-sharing-economy/.
- \(^8\) https://cleantechnica.com/2016/05/14/millenials-and-the-sharing-economy/
- \(^9\) Based on 100 million electric vehicles as per the International Energy Agency’s Global Electric Vehicle Outlook 2016. *BOE/d = barrels of oil equivalent per day; COP21 = 21st Conference of the Parties
## Total Return to Shareholders across Industries

<table>
<thead>
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<td>Mining</td>
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<td>Bank</td>
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</tbody>
</table>

TRS: Total Return to Shareholders  
CAGR = Compound Average Growth Rate  

Ref: World Economic Forum, 2017
Investments in Digital Technologies

Global $30.57 Billion Internet of Things (IOT) In Oil and Gas (O&G) Market - Analysis And Forecast: 2017-2026

Focus on: IoT solutions such as platforms and analytics,
Applications such as Upstream, Midstream and Downstream
IoT Applications in Oil & Gas Industry (upstream)

The upstream industry Problem:
- loses billions of dollars every year due to nonproductive time (NPT)
- Deadly Accidents
- Processes are not optimized

IoT Solution:
- With the use of IoT, refineries can plan their shutdowns, minimize their downtime, and improve safety records
- Accidents can be prevented
- Processes can be optimized
IoT Applications in Oil & Gas Industry (upstream)

Upstream

Exploration
Exploration is always risky - make it an informed risk with Quintiq.

Scenario planning
Assess the profitability of exploration wells by comparing different demand and supply scenarios and plant capabilities.

Decision support
Compare the potential profitability of various sites in order to make the best decision for the future of your organization.

Multi-resource optimization
Optimize the scheduling of field services, equipment and contractors to control costs.

Real-world plans
Create practicable plans that incorporate all business goals, rules and legislation.
IoT Applications in Oil & Gas Industry (upstream)

Production

How do oil & gas producers cope with fluctuating prices and turbulent markets? Smart production planning is key to success - this depends on the ability to make reliable estimates of future demand.

- **Scenario planning**
  Explore what-if scenarios such as significant changes in demand to predict the impact on your short- and long-term plans, and prepare for scheduling disruptions

- **Demand forecasting**
  Forecast future requirements in order to determine capacity, expansion and contraction

- **Inventory optimization**
  Determine the optimal amount of inventory to be stored in each location based on existing and forecasted demand and the costs involved in each alternative, monitor and manage reservoirs and pipelines

- **Logistics optimization**
  Optimize production in collaboration with distribution and fleet and vessel operations

- **Flexibility and responsiveness**
  Respond quickly and efficiently to opportunities in the dynamic commodities market
IoT Applications in Oil & Gas Industry (midstream)

The midstream industry Problem:
- has the challenging task of transporting variable volumes and grades of products from multiple locations to new end-users and markets
- Connecting pipeline networks, sensors, leak detection, alarms, and emergency shutdowns to interact seamlessly

IoT Solution:
- With the use of IoT, To be available for analysis and interpretation in real time would significantly reduce some of the major risks that this sector of the industry deals with
IoT Applications in Oil & Gas Industry (midstream)

**Midstream**

**Processing**
Align LNG plant operation plans with production and storage facilities, and ports and terminals, in order to achieve impressive results.

**Simulation**
Simulate and model LNG, condensate and LPG tankage to predict Days to Tank Top and Days to Bottoms

**Scenario planning**
Explore production cut-back simulations in order to prepare for scheduling disruptions, such as inclement weather or route changes

**Agility**
Adjust processing facility schedules in real time to accommodate for disruptions and capacity constraints

**All planning horizons**
Generate long-term, mid-term and short-term plans, from production scenario planning and forecasts to annual delivery plans to daily schedules
Shipping

Optimize transportation plans and utilization to maximize profits.

- Plan and optimize all modes of transportation including pipeline, rail, road and sea
- Design an optimal fleet network
- Maximize the utilization of every tank
- Minimize vessel idle time, cleaning and maintenance times, and bunker costs
- Optimize annual delivery plans and operational schedules to take advantage of lucrative out-charter and spot-market opportunities for your fleet
- Create plans which reflect all vessel, port, compartment and cargo specifications and constraints
- Accommodate last-minute changes with minimal impact on your fleet
- Explore what-if scenarios and simulate the impact of future events on fleet and production plans
- Plan and optimize trains and rail cars
- Optimize crude pipeline schedules

An optimal plan is not only a plan that takes into account the business rules and constraints impacting your fleet; it’s also a plan that is flexible, enabling you to take advantage of daily fluctuations in supply, demand and other market conditions. Quintiq provides you with the comprehensive planning support you need to ensure that all decisions regarding the utilization of your vessels are timely, profitable and optimal. Find out more when you download your guide to LNG transportation planning with Quintiq.
IoT Applications in Oil & Gas Industry (downstream)

The downstream industry Problem:
- Refinery shutdowns, handling various grades of crude oil, and changing environmental regulations are pushing gross refining margins down to a bare minimum

IoT Solution:
- With the use of IoT, refineries can plan their shutdowns, minimize their downtime, and improve safety records
IoT Applications in Oil & Gas Industry (downstream)

Downstream

Refining

Quintiq's integrated planning system for oil refineries enables you to:

• Simulate and optimize refinery processes to predict total processing time
• Explore production cut-back simulations in order to prepare for disruptions, such as equipment failure or feedstock shortages
• Adjust processing facility schedules in real-time to accommodate for disruptions and capacity constraints
• Generate long-term, mid-term and short-term plans, from multi-year investment planning to monthly supply and production planning to daily production scheduling
• Support traders in determining what feedstocks to purchase and what products to sell and at what price
IoT Applications in Oil & Gas Industry (downstream)

**Distribution**
How do you cope when market conditions upset the fine balance of your integrated supply chain? How do you minimize transportation and inventory costs associated with the primary distribution of fuels?

Quintiq’s planning and optimization software for oil & gas distribution supports:

**Optimization**
Achieve the right balance of inventory levels, transportation costs and customer service.

**Responsiveness**
Maintain an optimal operating schedule throughout the year in line with supply contracts and seasonal fluctuations.

**Forecasts**
Optimize primary and secondary distribution plans to take advantage of forecasted demand and lucrative market opportunities.

**Optimize logistics**
Optimize truck and rail car utilization, minimize empty mileage.

**Flexibility**
Amend schedules on the go without impacting your entire operation.

**Asset utilization**
Ensure gas station stock replenishment while maximizing utilization of your truck fleet.

**Scenario planning**
Explore what-if scenarios and simulate the impact of future events on capacity.

**Task optimization**
Minimize vessel idle time and optimize maintenance schedules.
There are countless opportunities for IoT Oil & Gas Industry

<table>
<thead>
<tr>
<th>Upstream</th>
<th>Midstream</th>
<th>Downstream</th>
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<tbody>
<tr>
<td>Asset Tracking</td>
<td>Tank Farm Monitoring</td>
<td>Perimeter Security Sensors</td>
</tr>
<tr>
<td>Vehicle Monitoring</td>
<td>Field Crew Monitoring</td>
<td>Perimeter Video Camera</td>
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<tr>
<td>Remote Video</td>
<td>Remote Video</td>
<td>Mobile Asset Tracking</td>
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<tr>
<td>Machine Monitoring</td>
<td>Pipeline Monitoring</td>
<td>Vehicle Monitoring</td>
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<tr>
<td>Site Monitoring</td>
<td>Terminal Access control</td>
<td>Production Sensors</td>
</tr>
<tr>
<td>Well Head Monitoring</td>
<td>Asset Tracking</td>
<td>IoT Cloud Storage</td>
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<tr>
<td>Security/Access Sensors</td>
<td>Flow Meter Connectivity</td>
<td>Lone Worker Wearables</td>
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<tr>
<td>Lone Worker Tracking</td>
<td>Pipeline Monitoring</td>
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<td>Refinery Monitoring</td>
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<tr>
<td>Tank Monitoring</td>
<td>Cargo Shipping Monitoring</td>
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</table>
Abadan Oil Refinery, Iran's largest refinery
Thank You

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