EMERGING TECHNOLOGIES
&
REFINERIES: HURRICANES

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Geographical overview

Loss events worldwide 2017
YEAR-END SUMMARY
2017 Atlantic Hurricane Season

ACTUAL

6
Major Hurricanes

10
Hurricanes

17
Named Storms

SEASONAL OUTLOOK

2-5
Major Hurricanes

5-9
Hurricanes

14-19
Named Storms
Hurricane Harvey
August 26, 2017
Landfall: Port Aransas
1:30 mph
Storm with winds of
Texas, as a Category 4
and Port O'Connor,
August 26, 2017
Hurricane Harvey
Hurricane Harvey - Petrochemical

Wind (mph)
- Cat 4: 130-156
- Cat 3: 111-129
- Cat 2: 96-110
- Cat 1: 74-95
- TS: 39-73
- TD: < 38

Source: U.S. Energy Information Administration
Hurricane Harvey Record Rainfall
In Houston, dams and reservoirs opened their flood gates due to the heavy rainfall leading to flash flood.
Hurricanes & Flood Protection

Component of Risk

- Hazard
- Exposure
- Vulnerability

Flood Mitigation

Component of Risk

Hurricanes & Flood Protection
Houston Petrochemical Industry Example
Crude Oil and Petrochemical Tanks - Identity Vulnerabilities

(24 tanks approximately).

Number of failed tanks during Harvey: 145,000 gallons

Approximate equivalent wind pressure: 35 to 50 psf
DESMONE

Tanks – Significant Vulnerability
How to Protect Flood Walls

Source: FEMA & ASCE 7-10

Design Loads:

- Dynamic pressure (wave action)
- Debris impact
- Wind pressure
- Hydrostatic pressure

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How to Protect Flood Walls

Source: FEMA & ASCE 7-10
Sheet Piling
Levees
Top Refinery Technologies

- DIGITAL SYSTEMS
- ARTIFICIAL INTELLIGENCE
- DRONES

DESMONE
• Only 19% recognize digital systems as one of their top 3 priorities.

62% indicated they intend to invest “more” or “significantly more” over the course of the next 3-5 years.

57% stated that current levels of investment are greater than they were 12 months previous.

Based on survey of over 200 refinery professionals worldwide

* Trend No. 1: Only 19% recognize digital systems as one of their top 3 priorities.
Digital Technologies

- 5 Major Trends*

  1. Analytics is number one for performance followed by cybersecurity.
  2. Analytics (including big data) is overwhelming choice for digital technology that will impact performance.
  3. Cybersecurity viewed as one of the top digital technologies affecting operational performance.

* Based on survey of over 200 refinery professionals worldwide.
Digital Technologies - 5 Major Trends

- National Oil Companies (NOCs) leading the way in digital maturity.
- Roughly 25% making significantly higher investments in past 12 months.
- 89% of refiners consider themselves still digitally immature.
- NOCs rank higher – 20% indicate maturity.

* Based on survey of over 200 refinery professionals worldwide.
Digital Technologies

5 Major Trends*

• TREND NO. 4: It’s no longer “Can refiners afford to”, but instead “Can they afford not to?”

• 40% of refiners cite operating costs as their top priority – yet half of refiners cite cost as predominant barrier to digital implementation.

* Based on survey of over 200 refinery professionals worldwide
Digital Technologies

- TREND NO. 5: Digital benefits are clear, the ability to realize them is not.
  - Value-added proposition difficult to develop without solid business case.
  - 38% of refiners cite lack of digital strategy as barrier.

* Based on survey of over 200 refinery professionals worldwide
Digital strategy required for solid business case. Decision matrices, profitability.

Digital requires senior executive leadership, vision, and proof of concepts that quickly lead to scalable programs focused on maximizing return on investment.

Is the cost worth the gain?

Companies need to drive a culture of innovation and technology adoption — a parallel focus on OT & IT.

Investment in human capital and development programs are needed to promote new, digital thinking and new ways of working.

Cultural Paradox Paradigm
DIGITAL TECHNOLOGIES - EXAMPLES

Sensors – Continuous monitoring vs scheduled monitoring

- Molecular Composition
- Flow
- Position
- Hysteresis
- Electrical
- Temperature
- Pressure
- Dissolved Gas Analysis - Chromatography
- Moisture

Moisture

DESIMONE
Digital Technologies - Summary

The current state of the oil and gas market is forcing companies to reinvent themselves to improve productivity and profitability. Investing in digital technologies is a sound move that can significantly increase efficiency and productivity with existing operations, reduce operating costs, increase revenue generation, while also increasing reliability and minimizing risk.

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The Future is Already Here
Artificial Intelligence Technologies

- Artificial Intelligence on target to eclipse human intelligence by 2029 – The future is here

- AI on target to eclipse human intelligence by 2029 – The future is here

- Predictive maintenance models used to avoid failure and unplanned outages

- Analyze weather patterns, economic dispatch

- Optimize processing cycles and transportation

- Massive productivity gains attributed to plant & process optimization

- Artificial Intelligence Technologies - Downstream
Artificial Intelligence in Oil & Gas - Upstream

- Equipment Ratings
- Seismic Vibrations
- Strata Permeability
- Thermal Gradients
- All can be layered and used to determine optimal drill direction, depth, and rate
- Identify new well locations – AI used to assess historical well performance data
- Production increase 30%
- Billions in revenues at stake
Impact of Artificial Intelligence on Oil & Gas Industry

In upstream only, there is around USD 50bn at stake.
Drone Technologies - Refineries

- Tank roof inspections
- Vessel inspections
- Tower inspections
- Flare stack inspections
- Thermographic inspections
- Flare re-ignition
- Contamination area inspections
- Tank roof inspections
- Vessel inspections
- Tower inspections
- Flare stack inspections
- Contamination area inspections
- Flare re-ignition
Drone Usage at Refineries
Drone Usage at Refineries
Drone Technologies

Unmanned Aerial Vehicles (UAVs) usage expanding exponentially

Visually inspect:
- Flares
- Electrical Apparatus
- Tanks
- Pipelines
- Facilities Inspections

Visually inspect flares tips – Tough locations such as the North Sea – safer than climbing, much less costly than helicopters.

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Major players marrying drone technology to AI

- General Electric, Siemens, IBM, ABB, others

$100B USD by 2020

• UAVs
• Pipeline Leakage Sensors
• Laser Measurements
• Thermal Scanning & Imaging
• Robot Crawlers
• Taxis
• Ambulance
• Electromagnetic Interference

Major players marrying drone technology to AI
DRONE AMBULANCE
Common Mode Failure: Human Factors

- Technology is only effective, safe, and useful if it is managed properly.

Human Factor Engineering – Improve technology to prevent human error as a causal factor.
Corporate cost cutting

Failure to invest in plant infrastructure

Lack of corporate oversight

Lack of process safety

Lack of corporate oversight

Inadequate training

Incompetent supervision

Poor communications

Poor decision making

Poor decision making

Aged, broken, or inop plant instruments, gauges, indicators

Lack of maintenance spending, repair & replacement

Andrew Hopkins (Failure To Learn) "Awful Sameness"
FLASH FLOOD TO OCEAN

LANDSLIDE
CAR BLOWN OFF MOUNTAINSIDE
DESMONE

CALM AFTER THE STORM
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March 19, 2018