



DIGITAL TRANSFORMS PHYSICAL

Digital Transforms The Oil & Gas Industry

Hamza Nahid
Digital Thread Value Specialist, EMEI

WHITE PAPER





Contents

- 3** Executive Summary
- 4** Oil & Gas Value Chain & Key Definitions
- 5** Increasing demand for Oil & Gas
- 6** Smarter Capital Projects, Operations & Infrastructure
- 7** Capital Projects & Infrastructure Monitoring
- 10** Conclusion

Executive Summary

The **growing need** for oil and gas worldwide is putting pressure on the upstream, midstream and downstream sectors to produce more, be **more efficient** and meet their customers' demand for natural gas, fossil fuels, biochemicals and other raw and finished petrochemical products.

This creates a real dilemma: expectations are that production and **investment** are planned to be **curtailed** due to the **climate change movement** and a desire to mitigate greenhouse gas emissions, while market **demand** for fossil fuels and natural gas continues to **grow**.

Hence, it is vital to **reassess a company's** overall **efficiency** of throughout across the whole **value chain**. We think that starting with the following three questions would help begin this improvement process:

1. Does my company use tools to **predict** equipment **failure** through **connectivity** in order to optimize the duration of turnarounds and **maintenance** operations?
2. Are we offering the right **collaborative** solutions for our field **workers** to communicate **remotely and efficiently** while ensuring **traceability** of operations?
3. Do we have the tools to **optimize** the design of machine processes and pace of **operations** to meet our **sustainability** goals?



Oil & Gas Value Chain & Key Definitions



Upstream

Companies that explore, develop and produce petrochemical resources consist of the upstream sector. Also known as "E & P" –exploration and production.

Midstream

The processing, storage and transportation (primarily pipelines) sector of the petroleum industry

Downstream

The refining and marketing sector of the petroleum industry. (E.g., refineries, gas stations).

Digital Thread

A digital thread creates a closed loop between digital and physical worlds to optimize products, people, processes, and places.

Sustainable Investing

Sustainable investing is about investing in progress and recognizing that companies solving the world's biggest challenges can be best positioned to grow. It is about pioneering better ways of doing business, and creating the momentum to encourage more and more people to opt in to the future we're working to create.



Turnarounds

A turnaround or a "TAR" is an expensive process in which an industrial plant or refinery goes through a scheduled shutdown in order to perform maintenance on the facility. During this time, production must come to a complete stop.

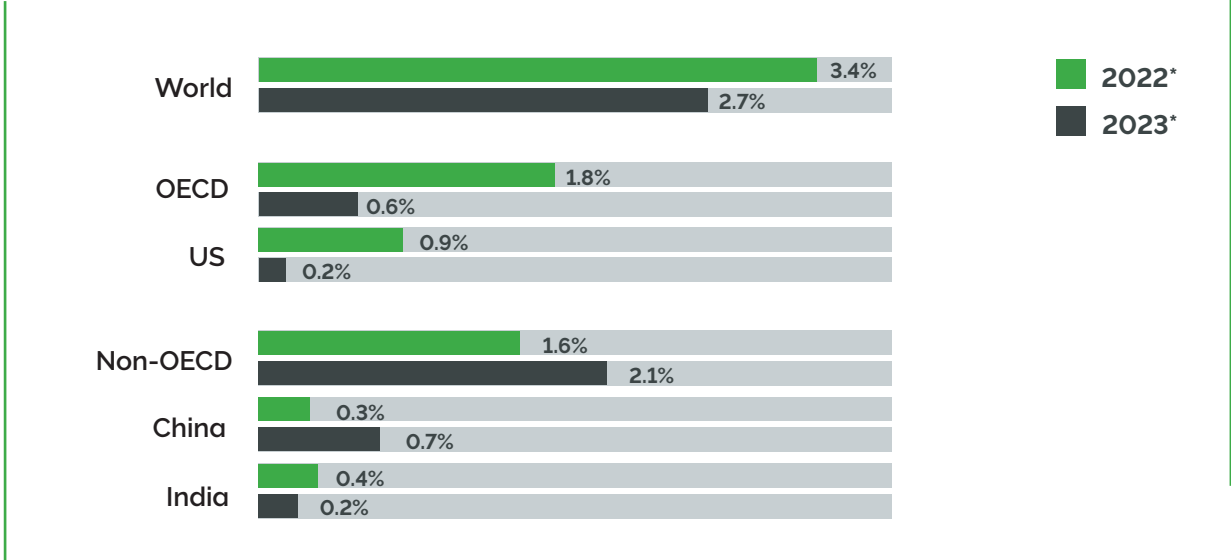
Increasing demand for oil and gas drives an increasing need for efficiency

The Oil & Gas sector is going through a real dilemma in which the production and investments are supposed to be reduced due to climate change and reduction of GHG emissions, and at the same time the growing market demand for fossil fuels as well as natural gas. This is resulting in two major consequences:

1. Demand exceeds available supply. Which implies price increases affecting every aspect of our lives : Transportation, electricity and other vital services. This is happening as of this writing in 2024.
2. Pressure on O&G players to produce more with greater efficiency while making progress on publicly stated sustainability commitments.

These represent a “perfect storm” of business pressures. The response should correspond to these environmental, economic and geopolitical challenges.

WORLD OIL DEMAND GROWTH FORECAST,
Y-o-y Changes, Mb/D - Thousand barrels per day



Source OPEC. * 2022-2023 = Forecast.

Smarter Capital Projects, Operations & Infrastructure

From our perspective, the most significant Oil & Gas industry challenges are capital projects and infrastructure exploitation across the whole value chain: upstream, midstream and downstream – see the illustration below. In the upcoming paragraphs, we will define these challenges and ask questions that will help solve them.



Upstream



Midstream



Downstream

#1: Capital Projects

Capital Intensive Activities: projects across the upstream, midstream and downstream are complex. This complexity increases as the number of stakeholders multiplies as well as the location, regulatory, and environmental realities which exist where the project takes place.



#2: Equipment & Product Health Monitoring

Equipment & Infrastructure Management: Equipment maintenance, pipeline health monitoring and turnarounds are central to the continuity of reliable operations. Improving these aspects will result in significant business impact for oil and gas players.



Capital Projects & Infrastructure Monitoring: People & Data at the heart of the puzzle

1. Capital Projects

Capital projects across the upstream, midstream and downstream are typically challenging, full of risk, and complex. This complexity increases as the number of stakeholders increases as well as the location and regulatory environment where the project takes place.



Upstream



Midstream



Downstream



New Team & Location

Capital projects need diverse and interdisciplinary teams to collaborate and work together. Each project has unique challenges in terms of skills required and in upskilling new workers to manage the increasing complexity of interdependent infrastructures - hence the following questions:

1. Are we, as a company, able to train new workers and employees on new construction methods and technologies?
2. Are we offering the right collaborative tools for our field workers to communicate – remotely - easily and ensure traceability of operations?
3. Are we able to securely and digitally store data exchanged and generated during the project life cycle?



New EPC Contractors

As highlighted before, the nature of O&G capital projects involves many stakeholders, from facility engineering to procurement and construction contractors. During the execution of such projects, a lot of problems might arise which would lead to legal pursuits and unwanted conflict. So,

1. How do we make sure, in advance, that choices of machines/equipment and facility/ infrastructure design are coherent?
2. How do we make sure that we have all needed equipment on site at the right time?
3. How do we make sure that all stakeholders are aware of the engineering, construction or procurement changes?



Regulatory constraints

Each continent, country or region has its unique regulatory requirements when it comes to capital projects. The major ones are related to safety and sustainability. Measuring carbon footprint for example during construction phase can be a real challenge.

1. Do we have today the tools and methods in place to measure our carbon footprint during construction?
2. Do we have the capacity to optimize the design of machines/parts to meet our sustainability goals?
3. Do we have safety training programs in place? How efficient are they?
4. Do we possess reliable data for risk and safety integrity level analysis?

2. Equipment & Product Health Monitoring

Equipment & Infrastructure Management : Equipment maintenance, pipeline health monitoring, and turnarounds are central to the continuity of efficient operations. Improving these aspects can result in significant business impact for oil and gas players.



Upstream



Remote Equipment Monitoring

As mentioned before, O&G capital projects are risky and complex. In the upstream sector, expensive equipment is deployed to ensure maximized production with reduced downtime. This won't be possible without a well-designed and efficient equipment management capability.

1. How do we make sure that the equipment is in good health in real time?
2. How do we make sure that field workers have the correct up to date SOPs for operations?



Midstream



Distribution Infrastructure Management

In the U.S., 70% of crude oil and petroleum products are shipped by pipeline, [according to this article](#). This means that pipeline transportation is a (nationally) critical infrastructure that needs to be closely monitored. The health of a pipeline can be decomposed into the physical part of the pipeline and the physical state of product transported.

1. Are we capable of tracking and managing the health of our physical infrastructure – Temperature, humidity, pressure, and other properties - remotely?
2. Are we capable of localizing faults throughout the whole pipeline by tracking the physical properties of transported product (its pressure, temperature and flow)?



Downstream



Turnarounds & MRO

Turnarounds are one of the most important activities in the O&G sector that concern mainly refineries, where production must stop in order to perform a certain number of necessary maintenance operations. Their cost can be reduced massively by having a solid preparation, which includes people, parts and tools necessary to optimize the time required as well as avoiding rework and other problems.

1. Does my company have a solid methodology to prepare for turnarounds?
2. Does my company offer adequate training to the turnaround team?
3. Does my company use tools to predict equipment failure through connectivity in order to optimize the duration of a turnaround?

Conclusion

The oil and gas industry is a major industrial sector that will benefit significantly from technology advances, particularly mature Industry 4.0 solutions, to increase efficiency, modernize operations and upskill employees. To realize the full potential of digital transformation, companies in the oil and gas sector must first identify their biggest challenges and bring in the right tools and vision to achieve the desired value at scale.

Additional Information

For additional information on Digital Transformation opportunities and insights read more [here](#) or contact us [here](#).



DIGITAL TRANSFORMS PHYSICAL

PTC, Inc.

May 2024 Copyright © PTC Inc.

www.ptc.com