LEAN OIL AND GAS

BACKGROUND

The oil and gas sector is one of the largest in the world in terms of dollar value, generating an estimated $3.3 trillion in revenue annually and often contributes a significant amount to the national GDP of the largest producers: the United States, Saudi Arabia, Russia, Canada and China.

The oil and gas supply chain is broken down into three key areas: upstream, midstream and downstream

- Upstream: also known as E&P (Exploration & Production), upstream includes all companies involved in the search for underground (onshore) and underwater (offshore) natural crude oil fields or gas fields, the drilling of exploration wells and the production of oil and gas. Upstream involves high technological investment and high risks to locate a field. It is highly regulated and affected by geopolitical factors, however, it can provide substantial returns.

- Midstream: includes the transportation, storage and processing of oil and gas. Transportation can be achieved through different means such as trucking, pipelines, tanker ships etc. The storage of raw materials can be achieved either during transportation or through dedicated storage facilities either underground, above-ground or at sea. Midstream involves low capital risk, however, it may be affected by geopolitical factors and by regional regulations.

- Downstream: refers to the process of filtering and refining raw materials into derivate products that can be sold to consumers. Downstream also includes the marketing and commercial distribution of these products. Examples of the end products include natural gas, petrol, gasoline, diesel oil, kerosene, jet fuel, heating oil, LPG (liquefied petroleum gas), lubricants, asphalt and many other types of petrochemicals.

CHALLENGES

Complex supply chains, political instability of many producing countries, continuous price volatility, trade wars and the rise of sustainable energy are among the most known challenges faced by industries operating in the oil and gas sector, however, other challenges should also be taken into account:

- Increasing productivity to minimize extraction and refining costs. This requires the enhancement of the production system on current existing sites and designing the new sites with a Lean mindset
- Increasing visibility into operations to control costs and optimize the performance of employees, facilities, assets and contractors, particularly when these are frequently relocated. Great investments are being poured into digitalizing the industry (e.g. 'Smart-Oilfield') and analyzing real time data, however, the digitalization alone may be insufficient if not focused on collecting the right data and implementing the right decision making processes
- Increasing equipment reliability in order to decrease downtime, especially unplanned downtime. Running the equipment within the parameters and maintenance schedule recommended by the manufacturer is not enough to achieve maximum reliability, hence, the need to install a more advanced approach such as OEE (Overall Equipment Effectiveness)
- Performing inspection in an economically viable way: facility and equipment inspections are needed on a regular basis and often require moving equipment, performing measurements, relocation of personnel etc. which can be poorly planned and therefore result in utilizing resources inefficiently
- Improving collaboration with oilfield services to improve logistics: even though oil and gas companies are some of the largest in the world, they still need to rely on 3rd party suppliers to support providing services, equipment, workforce etc. which drives the need of integration along the supply chain
- Managing large scale events such as shutdowns, equipment breakdown, equipment turnaround, equipment recommissioning etc. is challenging and often results in delays or accidents driven by poor planning
- Managing spills and leaks promptly: these events may have a devastating impact on the environment where they occur, as well as on the public image of the company responsible for it, hence, the need to prevent them as much as possible by improving the equipment reliability and to effectively respond if such an event were to occur
- Many oil and gas companies have large segments of their workforce who are aging and will soon retire, taking away their experience. This drives the need for standardization and process automation so that the transition to new, less experienced employees is less disruptive
- The oil and gas industry consume a great amount of energy and water during production, which is becoming challenging in countries where these resources are scarce and highly regulated, therefore there is a need to improve process efficiency in order to minimize the consumption of these resources

FOCUS AREAS

The wide amount of challenges and the high complexity affecting the oil and gas industry, drives the need to increase competitiveness by continuously improving processes across the supply chain, from the Upstream Exploration and Production processes all the way through the Midstream transportation and the Downstream refining of products. Continuous improvement initiatives should begin with the identification of major areas of improvement, in order to derive a structured implementation plan prioritizing high return projects that can be implemented easily.

AREAS OF WASTE OFTEN IDENTIFIED IN THE OIL AND GAS SECTOR:

TRANSPORTATION & HANDLING

Upstream: excess delivery of equipment or resources not required, delivery of equipment or resources under requirement, wrong equipment delivered thus requiring additional transportation, sub-optimal layout

Midstream: overcapacity or under capacity of pipelines, vehicle breakdown, unavailability of vehicles, remote storage

Downstream: Unnecessary transportation of materials or equipment driven by poor planning, poor factory layout or sub-optimal geographic location of facilities

INVENTORY

Upstream & Midstream: excess or insufficient equipment or spare parts, poor location tracking of material, equipment and spare parts, requirement for excess or third-party storage

Downstream: Excess or wrong mix ordering of packaging, chemicals or other materials, excess or wrong mix production of processed products

MOVEMENT

Upstream & Midstream: Unnecessary movement of people, such as walking, reaching or stretching e.g. due to un-optimised equipment design

Downstream: Excess movement (e.g. due to poor workplace ergonomics with unnecessary reaching, twisting, bending and walking, repetitive work in strained position, walking between equipment etc.)

WAITING

Upstream: Waiting for equipment, people, decisions, supplies

Midstream: People and material delays due to poor planning (e.g. delays in transportation, waiting for documentation approvals or goods that are not ready to be loaded in shipping areas)

Downstream: Waiting for material, IT systems and tools (e.g. due to line stoppages, batch processing leading to excessive work-in-process, waiting for quality approvals, waiting for data, clarification or correction of work received from upstream processes, production schedule not clear, system downtime, sub-optimal cleaning processes etc.)

OVER-PRODUCTION

Upstream: Excess production of crude oil, poor planning of exploration, lengthy authorization request processes

Midstream: Deployment of excessive over-capacity along the transportation network, duplicate data recording, introducing a product with poor demand from the market

Downstream: Production of wrong volume mix of derivate products, producing above market demand, making more products than required to save setup time

OVER-PROCESSING

Upstream: Recording too much information or duplicating paperwork

Midstream: Excess paperwork, inefficient truck loading process

Downstream: Duplicated paperwork, excess number of approvals required, double checking work, developing new products that have poor market demand

DEFECTS

Upstream: Equipment breakdown, inefficiencies, sub-standard designs, contamination, poor storage conditions, ordering the wrong supplies, health hazards and accidents

Midstream: Poor storage and transportation conditions, mislabeled items, leakages and spillages, deliveries to a wrong location or at a wrong time

Downstream: Producing products not meeting specifications, adding the wrong ingredient, setting the wrong temperature in a process, mistakes made when reporting orders in the business system, ordering the wrong supplies, health hazards and accidents

LEAN SOLUTIONS

The application of Lean in the oil and gas industry eliminates wasted time and resources, thus increasing the efficiency of the people, equipment and processes involved. This results in achieving minimal waste, more satisfied customers and higher quality output at a lower cost, which in turn results in increased profits. The benefits of Lean in oil and gas are significant and go well beyond financial rewards.

LEAN OIL & GAS CAN BE APPLIED THROUGH THE WHOLE VALUE CHAIN:

UPSTREAM

Lean Manufacturing techniques can be easily applied to well construction and well management. Lean solutions can help reduce variability in the drilling process thanks to process improvement, standardization and structured maintenance programs. Well operators should also look into the 'flat time' (activities that do not result in the hole being deepened but are required to drill the well, mostly the time needed for constructing a well): on average, the time to drill an onshore well is comprised of 35-50% on-bottom drilling time, the rest is flat time. The concepts embedded in Lean Construction can be adopted by flat time activities in order to minimize the building/assembly time of 'Engineered to Order' items through proper planning and by removing inefficiencies. Last but not least, an improved service level can be achieved from suppliers of equipment and services by integrating their planning system and by streamlining their processes

MIDSTREAM

The principles developed in Lean Construction can be applied to ensure that a pipeline is built on time by using the available resources in an efficient and effective way. Pipeline maintenance and fleet maintenance can be largely improved by implementing the Lean concept of TPM (Total Productive Maintenance), developed in the automotive industry to drive down the risk of spillage or equipment breakdown by improving the approach to maintenance. Furthermore, oil and gas Midstream can benefit from improved control over their transportation assets by introducing Lean Digital solutions

DOWNSTREAM

Refining processes can also benefit from the implementation of Lean solutions already applied in a wide array of processing industries. The starting point is a Value Stream Analysis to map material and information flow in order to better understand how each process along the processing line contributes to building value add or waste. The main areas of improvement are:

Layout – streamlining the layout of refining, processing and packaging results in connecting processes and hence reduces unnecessary transportation of material and movement of people

Autonomation (Jidoka in Japanese) – with more and more processes being automated, the oil and gas downstream industry can benefit from Autonomation or intelligent automation by using sensors to improve the ability to detect issues during the production process and thus reduce waste

Equipment effectiveness – the measure of OEE (Overall Equipment Effectiveness) improves process control and triggers improvement initiatives across the value chain

Planning – Smaller production batches driven by reduced changeover time, accurately forecasting demand and shorter lead times enables more accurate planning and hence, avoids overproduction

TANGIBLE IMPROVEMENTS

LEAD TIME

- Production lead time reduction by 25-30% in downstream by streamlining the production process
- Production lead time reduction by 50% at upstream supplier of parts by streamlining the production process
- Drilling times reduced by 40% by improving well construction lead time

QUALITY

- Returns to supplier reduced by 95% by integrating suppliers planning system
- Waste of product due to process setup errors reduced by 78% by standardizing processes and introducing error avoidance tools (Poka Yoke in Japanese)
- 43% improvement in HSE (Health, Safety and Environment) metrics by improving operating procedures

COSTS

- 20% reduction in working capital by reducing raw material, work in progress and account receivables
- Output quantity in Crossover & PUP joints +45% by streamlining processes and improving equipment availability
- Equipment availability increased by 32% by implementing TPM (Total Productive Maintenance)

Should you be interested to know more about our Lean services regarding this topic, then please contact us:

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