



OIL AND GAS INDUSTRY - BLOCKCHAIN, THE DISRUPTIVE FORCE OF THE 21ST CENTURY

PREAMBLE

The potential for disruption in energy is vast.

An energy blockchain can be a catalyst for business model and process change across the enterprise. It could be instrumental in managing the sector's growing complexity, data security, and ownership. It is essential, therefore, that CIOs and business leaders understand the role that blockchain can play.

A new ecosystem of energy blockchain startups is emerging, and venture capital, has so far raised over US\$ 1 billion to scale business models of the future.

As the demand for efficiency and transparency continues to grow, the oil industry is at the crossroads. Still using paper contracts and outdated trading platforms, the implementation of distributed ledgers and smart contracts could advance the industry into the digital

age. While it may not seem as exciting as submerged oil rigs or robot-controlled power grids, revamping Big Oil's back office stands to save the industry substantial money.

The energy industry will have to digitalize more and more in oil production, refining, shipping. So traders will also have to participate. It is a pre-archaic process. So introducing blockchain will allow the passing of title from buyer to shipper to seller without going through the massive paperwork of bills of lading.

In the oil and gas industry, with its global reach, complexity, and diverse regulations, simplifying and improving the paperwork and processes of global product movement is a business imperative. With a compelling value proposition, many oil and gas companies may look to explore, invest in, and collaborate with partners on developing blockchain initiatives.



Introduction

Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, provides a summary in his book, *The Fourth Industrial Revolution*: "In essence, the blockchain is a shared, programmable, cryptographically secure and therefore trusted ledger which no single user controls and which can be inspected by anyone." A survey of 800 executives, featured in the same book, suggests 58% believe that up to 10% of the global GDP

will be stored using blockchain technology, which is a significant number considering the footprint of a nascent technology.

The overall market size of blockchain is estimated to be around US\$ 2.3 billion by 2021, according to a report by Markets and Markets. The cryptocurrency world is on the horizon and "Blockchain, distributed ledgers are in the disruptive stage of growth potential and will create new markets and / or upend existing markets for poised growth."

Blockchain in the energy sector can be viewed across business boundaries with emphasis on innovation:

Innovation as a factor in energy operations: Service providers are expected to incorporate innovation in services and constantly adopt cutting edge technology as the focus shifts to the capabilities that truly extend clients' operations. Distributed ledger technology seems promising for energy clients' business growth and long-term success.



Key industry challenges in oil and gas



Challenges to be addressed by energy companies – Large capex information technology projects, increasing sophistication and frequency of cyberattacks, and accelerating adoption of connected sensors are effecting shifts in how data is structured, validated, protected, and transmitted.

Transacting in energy commodities is currently inefficient. Intermediaries and complex processes affect the speed of exchanging critical data in real-time business. Issues that blockchain-enabled applications could address include:

- Removal or reduction of fractional costs (e.g. broker fees) that make existing transactions slower and more expensive
- Facilitating regulatory reporting requirements (i.e., EMIR, MiFID II)
- Increasing efficiency by standardizing data formats across multiple organizations, enabling interoperability and ensuring process integrity
- Reducing risk of fraud, error, and invalid transactions
- Reducing credit risk and transacting capital requirements

Technology appreciation of blockchain (distributed ledgers) in oil and gas

In 2017, Natixis, pioneered the first blockchain solution in commodity trade finance for US crude oil transactions. The distributed ledger platform, built on the Linux Hyperledger, helps digitization of crude oil transactions using blockchain and ensures enhanced security, improved transparency, and optimized efficiency.

With both the trading parties (buyer and seller) along with their respective banks on the same ledger, sharing of data and the status of a transaction from trade initiation to its final delivery is simultaneously visible to all parties, resulting in transparent transactions by using shared processes and record keeping. It will also reduce threat due to fraud, tampering, and cybercrime. Additional benefits would include lower overhead cost, reduced cash cycle times, and fewer cost intermediaries.

This effort will modernize trading in the global crude oil industry, which today is predominantly a non-digital and manual process.

Recently, energy majors BP and Shell led a plan for a blockchain-based platform for energy trading, expected to start by end-

2018. It is a significant shift in the oil and gas industry. Norwegian oil firm Statoil, trading houses Gunvor, Koch Supply & Trading, Mercuria, ABN Amro, ING and Société Générale are consortium partners.



Blocks of paper barrels	<p>Bridging the gap between paper trades and the real-world movement of barrels is often a laborious task. The adoption of a blockchain system for payment could speed up the process significantly and cut costs at the same time.</p> <p>In addition, with blockchain, there is a significant increase in the transparency of data. Finality is maintained between the parties in the futures trade as only a single source of truth will be presented to all participating traders.</p>
Oil-based digital currency	<p>In addition to the improvements that blockchain could make to traditional oil and gas operations, some are looking to the world's most important commodity as a baseline for digital money.</p> <p>A cryptocurrency based on the commodity can be introduced to make payments even faster.</p>
Enhancing compliance	<p>Whether onshore or offshore, the oil and gas industry is heavily regulated, with protocols deriving from multiple sources and covering everything from the environment to tax. Data contained in a blockchain can be shared with regulators in real time to maximize visibility and eliminate the fines meted out for non-compliance.</p> <p>Collaborative interactions can also be improved through blockchain. Joint venture partnerships, which may involve several companies collaborating on the same project, are common within the oil and gas marketplace.</p> <p>With blockchain, every transaction is replicated to all nodes in an immutable way for regulators to monitor.</p>
Transparency in operations	<p>In the energy trading operation of natural gas, there are multiple parties involved in operations from upstream to downstream, such as energy producer, shipper, supplier, transporter, regulator and settlement provider. So there is a lack of trust between these stakeholders, lack of visibility or data, and legal disputes and settlement delays.</p> <p>Using blockchain, all these groups can be brought on to a single platform for enhanced visibility. Also, by using smart contracts, a majority of the operations can be automated. Integrity of data will be maintained throughout the supply chain of natural gas.</p>

Land records management and equipment – empowered with distributed ledgers

For oil and gas companies, one of the most important aspects is the proper management of land sale records. For these companies, millions of dollars' worth of investments and profits depend on the maintenance of proper and unambiguous records related to who owns these large parcels of land.

The traditional process is simple enough - the sale is agreed, the documentation changes hands along with money. But in the real world, there are a multitude of issues such as who actually owns the property, contract issues, forgery, and many other illegal activities. The distributed ledger system can help eliminate these problems.

Blockchain technology is being explored in Georgia and Ghana, which experience high levels of disputed land ownership and land seizures. Leveraging this technology in the oil and gas industry to record sale and

transfer of land, will create an Immutable audit trail of land movement, ownership, and value. It will reduce ownership disputes, title mismatches, and provide tax authorities with accurate land transfer information along with value as they occur in real time.

Blockchain is not going to replace government process concerning how land is registered and monitored. It will make governance of land registration simpler and corruption-resistant.

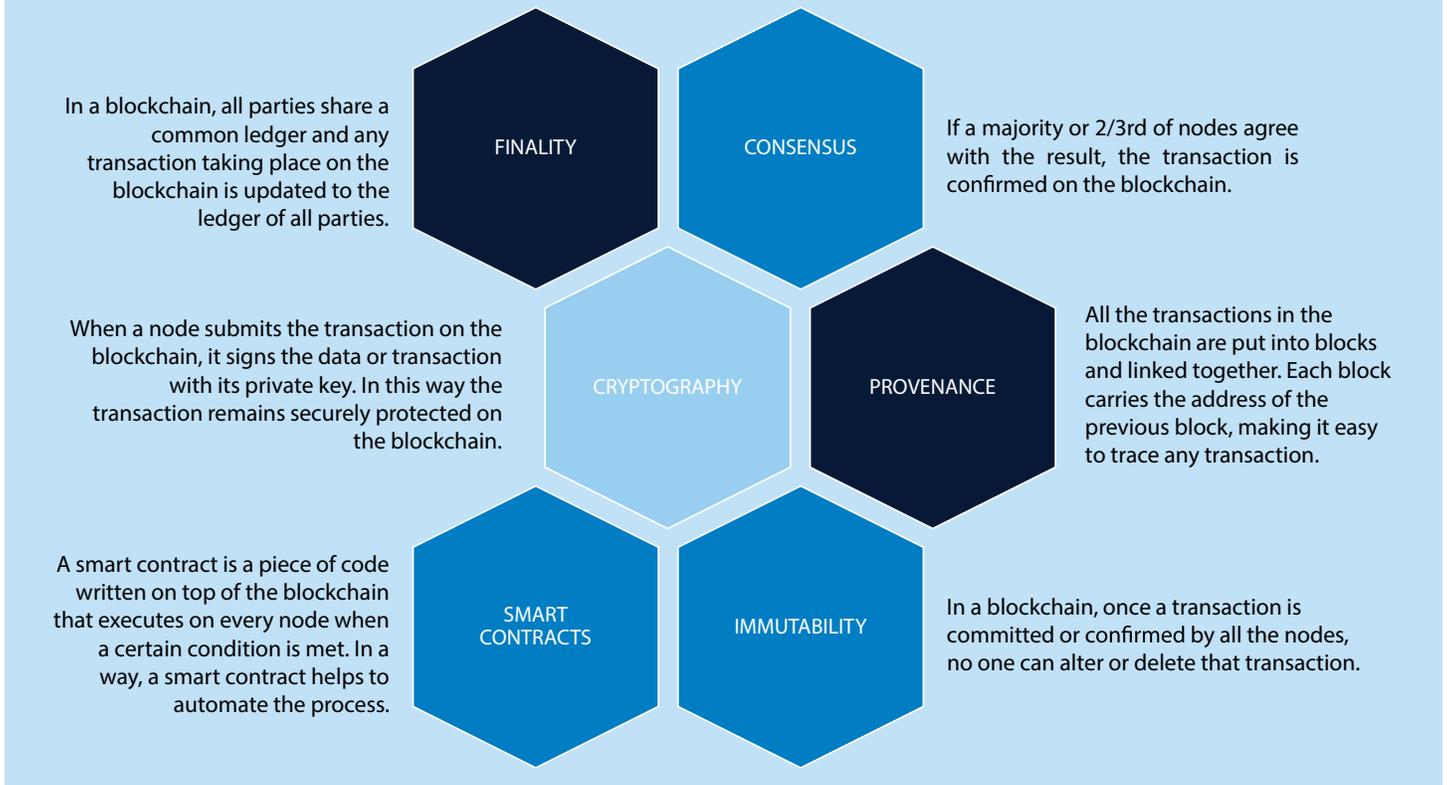
Equipment history records – general maintenance powered by distributed ledgers

The current Internet of Things (IoT) ecosystem in oil and gas organizations currently relies on centralized, brokered communication models. The communication is primarily through server / client model with huge dependency on storage capacity. Though the devices are in close proximity, the connection between them must go through the Internet. This

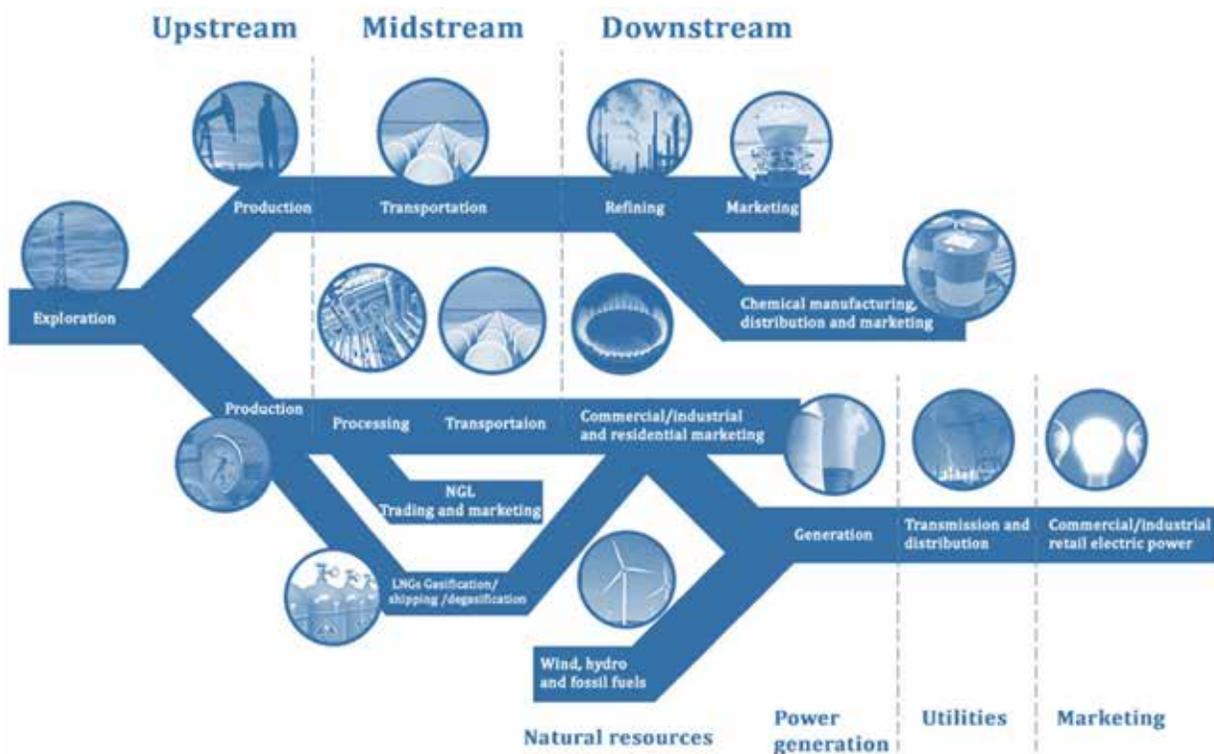
model is in use for decades, connecting generic computing devices and supporting small IoT networks. But it will not be able to respond to the growing needs of the IoT ecosystems of tomorrow.

A simple solution for equipment history records management is blockchain. Traditionally, the entire record of the equipment is stored on a central server. With a blockchain solution, a distributed digital ledger is created which stores the transactions among the various nodes of the network. In order to make any changes to the record, one must first register on the blockchain. Only those nodes that are identified and authenticated by secure cryptographic methods will be allowed to add or make changes to the ledger. After this, the other nodes on the network must confirm this transaction for the change to be accepted. It eliminates the need for a central authority.

Blockchain characteristics – the aura of “distributed ledgers”



Domain appreciation of blockchain in oil and gas - the energy value chain



Blockchain has emerged as an elegant, secure, and scalable solution that is applicable across the enterprise, from gas field to end customer.

The context in which blockchain applies – with its immutable record, reliability derived from consensus, and potential to automate processes – are infinite.

Several blockchain pilot projects are exploring configurations and measuring value across the entire energy enterprise, from supply chain to security.

Exploration and production – upstream

Given the synthesis of the distributed ledger and digital transactions empowered by cryptocurrencies, in the upstream value chain, the potential for disruption using blockchain is in areas related to:

- Design and construction of wells and facilities, especially in the sub-processes of well drilling and drilling optimization areas
- Tracking equipment history, both maintenance history as well as the history of the equipment's operating conditions

BHP Billiton, one of the world's largest mining and energy companies, is developing a proof of concept on its Project Rai Stones in collaboration with ConsenSys and Block Apps, using the Ethereum public blockchain. This project aims to track wellbore samples through a blockchain-based tracking application. Wellbore samples are extremely expensive and cannot be replaced. They go through several custodians, usually all BHP vendors; and are currently tracked manually using spreadsheets and e-mail. This may lead to human error, resulting in huge regulatory fines, lack of transparency to business stakeholders, and lack of efficiency in finding metadata about these samples.

Midstream activities

In midstream, the potential for distributed ledger use is applicable in areas related to:

- Energy trading and risk management
 - Following successful trials, two major oil corporations, BP and Eni are incorporating distributed ledgers into their energy trading platform
- Land management – smart contracts
- Contracts – joint ventures and revenue accounting - calculation and payments of interest (joint interest billing)
- Quote to cash - services / equipment procurement – reduce daily sales outstanding (DSO)

- Asset maintenance – asset maintenance contracts
- Health, safety, environment (HSE) - equipment safety-related inspections, maintenance activities
- Regulatory – reporting to authorities

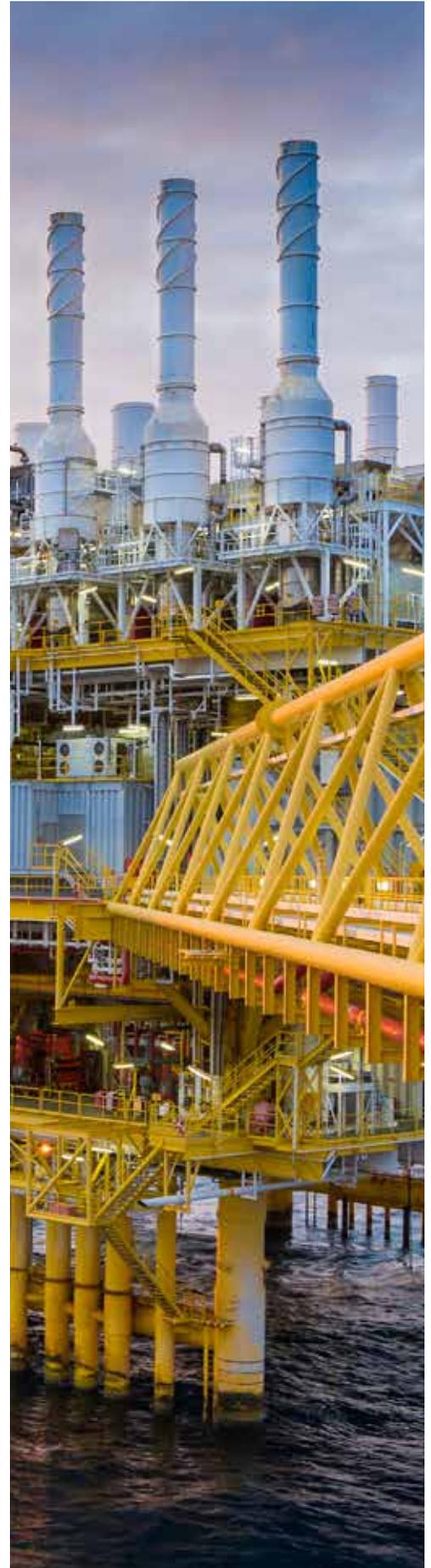
All of the above will contribute towards a consortiums and shared ledgers system that harnesses its potential for oil and gas companies.

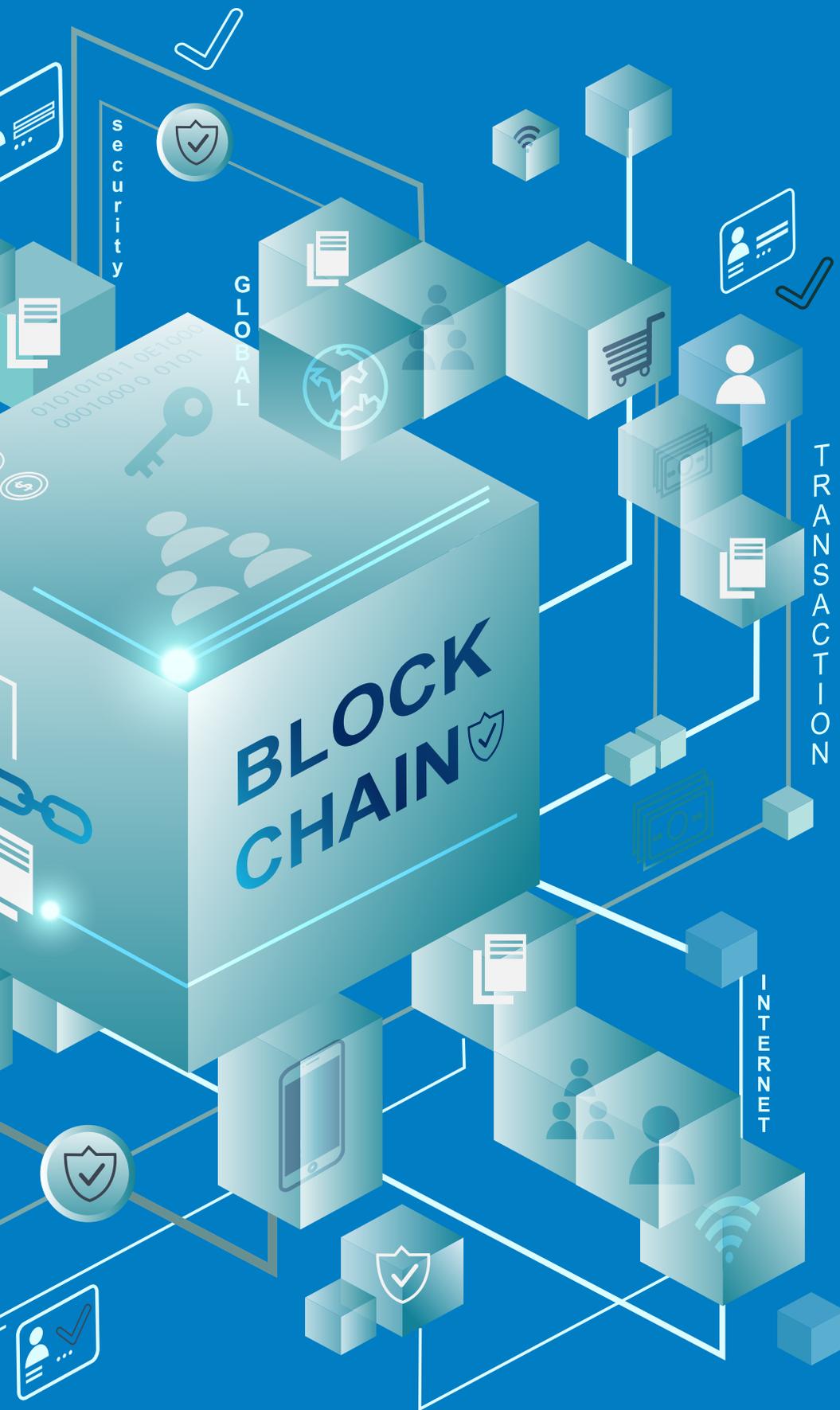
Refinery and petrochemicals - downstream

In downstream, most of the work revolves around petrochemical operations and in the product and distribution space.

By adopting consortiums and shared ledgers, the downstream business of oil and gas companies can be more efficient in taking to distributed ledger technologies, primarily in the areas related to:

- Exchange of products
 - From primary distribution hub to outlets
 - Reducing the dependency on refinery companies
 - From secondary distribution through terminals to individual pumping stations
 - Terminal automation through blockchain
- Demurrage and claims management
- Smart contracts adoption in downstream business process areas





Conclusion

Blockchain can influence everything, and not just in mature markets with heavy technology disruption (financial services, healthcare, and retail).

Blockchain technology in the energy sector inspires confidence, but it is impossible to overhaul the industry. Deploying small but significant changes to improve efficiency in the global oil business requires support from multiple stakeholders. Only time will tell how many companies will embrace blockchain technology at an early stage.

- Domain-led technological disruption is currently on the horizon in the areas of distributed ledgers and cryptocurrency
- For an energy company looking to adopt blockchain, select the right use case
- Join an existing initiative to learn the technology. Blockchain is a team sport, you cannot experiment on your own
- Blockchain is not complicated. It is 80% process modeling and 20% technology. Start small and onboard more parties later

The blockchain journey in the energy (oil and gas) sector has just begun. With the energy companies' focus on identification of right use cases and embracing change through technology and Internet of Things (IoT) for business growth, the journey is going to be fascinating.

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