GuildOne

aws   r3.

New Standards of Measurement: *A Distributed Ledger for Hydrocarbon Volume Measurement and Real-Time Value Exchange*

Ever since the severe downturn in oil prices in 2014, oil and gas companies have been seeking new operating models to drive efficiencies that could reduce costs and increase profits. These initiatives have led to fundamental changes in conventional ways of extracting, processing, transporting and selling hydrocarbons. They have also forced companies to drastically rethink how they operate and to identify innovative ways to improve transactions with business partners and suppliers.[1] This includes adopting digital technologies to optimize data-driven processes that have traditionally been performed internally, in isolation, within each counterparty and that have, therefore, led to high levels of dispute and rework.

1 Deloitte, "Is Blockchain's Future in Oil and Gas Transformative or Transient?" https://www2.deloitte.com/global/en/pages/energy-and-resources/articles/role-of-blockchain-in-the-energy-and-resources-industry.html (accessed August 1, 2018) p 3

In energy companies, conflicting information has been at the root of many long-standing and costly friction points. The use of disparate systems and data, and the lack of a common interpretation of shared contracts, have driven high levels of dispute between contractual counterparties, causing dramatic business impacts. The convergence of key technologies – including distributed ledgers and machine learning – promises higher trust between partners who embrace them. Doing so not only increases operational efficiencies, it also has the potential to remove a number of commercial friction points.

THE SHIFTING FOCUS: FROM ROYALTIES TO MEASUREMENT

GuildOne is a recognized pioneer in applying blockchain technology to oil and gas business problems. In Feb 2018, the company conducted the first proof-of-concept (PoC) royalty payment using its blockchain-based Royalty Ledger™ application. This was the first successfully executed smart contract transaction in the oil and gas sector using blockchain and was executed with oil and gas operator NAL Resources and royalty company PrairieSky Royalty.

Royalty Ledger allows producers, land owners and royalty holders to reach consensus on the calculation and settlement of royalties by sharing key information via distributed ledger technology (DLT). It then uses this newly minted consensus to enable real-time settlement of contracts through blockchain-based execution and value exchange.

However, while settling one set of data-related contract problems, this new shared operating model has shifted the focus to another cause of contract dispute. Providing access to aligned and valid information on contract terms has allowed stakeholders to dive deeper into the transaction. And shared information regarding key variables and calculations has enabled a new "frictionless" transaction model. In light of these improvements, one of the main causes of dispute is operator-reported volumes, the hydrocarbon measurement used as input into all contractual calculations and settlements.

Foremost amongst the causes of measurement-related dispute are the processes used to record, share, and reach agreement on hydrocarbon volumes along the value chain. GuildOne's Measurement Ledger™ has the power to change this. It will allow different parties to reach "consensus" on volume by using the blockchain platform to measure and track measurement information regarding hydrocarbon volume on an open, shared "trustless" ledger, from wellhead to sale point, recording the volume and ownership at each custody transfer point and executing settlement immediately upon custody transfer.

MEASUREMENT LEDGER AND THE CUSTODY TRANSFER PROTOCOL

"Three and a half years ago, we started paying close attention to the emergence of blockchain," says GuildOne President and CEO, James Graham. "We asked ourselves, 'What if companies could express contract terms on a distributed ledger, and replicate and reach consensus on the terms between parties?' That could mitigate the possibility of dispute going forward and eliminate a large chunk of the G&A that goes into contract administration." With that concept in mind, Measurement Ledger was born.

Now, GuildOne is moving forward with a group of pioneering partners to explore blockchain's potential

Guild1ne

to automate the provision of valid production measurement data to increase the efficiency and validity of reporting systems and downstream process. This progressive group is embarking on a PoC for Measurement Ledger and the creation of a new set of standards for ecosystem adoption, GuildOne's proprietary Custody Transfer Protocol. By defining a standard protocol to provide and share value throughout the hydrocarbon ecosystem, the PoC group is hoping to lower the barriers to adoption of efficiency-driving digitized technologies for oil and gas operators, vendors, suppliers and regulators.

Measurement Ledger is the first hydrocarbon volume measurement platform that integrates blockchain, machine learning and smart contracts using the nascent Custody Transfer Protocol. The PoC will demonstrate that Measurement Ledger seamlessly captures source data from different meter types along the hydrocarbon value chain, in full compliance with Alberta's statutory measurement requirements.

Once the data is gathered, Measurement Ledger then processes the data through smart contracts to calculate flowing hydrocarbon volume information from validated measurement data. Smart production contracts will then share that data with other smart contracts, triggering the commercial transactions outlined in the smart royalty contracts (and others) to execute the value exchange immediately upon receipt and validation of the data.

Through this distributed, autonomous and organized process – which is defined by the Custody Transfer Protocol - Measurement Ledger will eliminate costly delays caused by disputes over data, allow automated demonstration of compliance with the regulatory regime and drastically reduce transaction times and costs.

CONVENTIONAL HYDROCARBON MEASUREMENT: DIRECTIVE 17

Current hydrocarbon measurement and tracking in Alberta – and a growing number of other jurisdictions – is governed by the Alberta Energy Regulator's Directive 17 (D17).[2] D17 provides a standard set of practices and regulations governing the flow of data and hydrocarbons. Production and state data is measured at all stages of the value chain—from upstream production through midstream processing and on to downstream distribution—at measurement points placed according to D17 requirements and best practices. D17 is applicable to all custody transfer points along the value chain and, as such, has a determinate effect on payments dictated by contracts throughout the chain.

D17 includes "standards of accuracy for gas and liquid measurement that take into account such concerns as royalty, equity, reservoir engineering, declining production rates, and aging equipment." These varying concerns mean that different measurement points along the flow regime, often consist of different types of meters that produce multiple distinct data points. The data gathering and analysis process is unique to a given company and susceptible to discrepancies in data that frequently lead to costly delays and disputes.

---

2 https://www.aer.ca/regulating-development/rules-and-directives/directives/directive-017

Guild1ne

D17: MEASUREMENT STANDARD GOING GLOBAL

Enacted in 2013, D17 is the best regulatory model for the Measurement Ledger PoC, as it is most rigorous hydrocarbon measurement and tracking standard in the world. Numerous jurisdictions are looking to it for guidance, as regulators seek to ensure that the entitlements of production and royalty stakeholders are met.

For instance, the Measurement Guideline for Upstream Oil and Gas Operations released by the BC British Columbia) Oil & Gas Commission is based on D17, and it is expected that the Government of Saskatchewan will also adopt D17 principles in its Directive PHGO17: Measurement Requirements for Oil and Gas Operations.[3] Internationally, countries such as Norway, Nigeria and others, where petroleum resources are owned, extracted and sold by state-owned entities, are developing similar regulations to ensure that their citizen stakeholders receive their full share of royalties.

Oil and gas firms in those jurisdictions will benefit from the experience of Alberta companies in optimizing transactional efficiencies while complying with D17. Digital technologies are expected to make a significant contribution to those gains. "In navigating an often dizzying array of national regulations and restrictions, simplifying and making more robust the paperwork and processes of global product movement is essential."[4] Blockchain-enabled technologies, such as Measurement Ledger, are expected to drastically streamline these complex processes.

THE COST OF DOING BUSINESS THE CONVENTIONAL WAY

The process of extracting hydrocarbons and moving them along the value chain to market involves many stakeholders, including landowners, royalty managers, regulators, oil and gas company operators and financial institutions. The complexity of the value chain brings with it significant costs. Keith Steeves, CFO of NAL Resources, states, "We have 800 partners. That is just oil and gas producers. We have 800 oil and gas producers with interest in wells. We have 10,000 wells, of which 4,500 are active. The average production is 10 barrels a day. As you can imagine, we're interested in reducing the costs associated with that."

With the many parties involved in the process, contract disputes are prevalent and are a major drain on resources. Most of these disputes are borne of simple administrative errors, missing or incomplete data and/or data incongruity. Complicating contract matters further is the "prevalence of joint venture partners, buy-outs, farm-ins, the occasional freehold landowner (in a majority leasehold mineral right Canada), and the list goes on."[5]

Furthermore, in conventional measurement schemes, all transactional parties are responsible for validating, maintaining and updating all data that is relevant to their operations, which is then required to be reconciled with the data of other transactional partners. Discrepancies in data often lead to costly delays and disputes, and require reconciliation. "This time-consuming, manual reconciliation process is

3 https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/oil-and-gas/oil-and-gas-licensing-operations-and-requirements/oil-and-gas-drilling-and-operations/measurement-requirements

4 Deloitte

5 BOE Report: "Oil and gas leaders collaborate using blockchain technology to help cut costs" https://boereport.com/2018/02/14/oil-and-gas-leaders-collaborate-using-blockchain-technology-to-help-cut-costs/ (accessed August 1, 2018)

Guild1ne

susceptible to errors or manipulation of transactions. As a result, all participants in the supply chain incur costs and delays associated with this reconciliation."[6]

Payments are required wherever hydrocarbon custody transfer points exist along the value chain. These payments are determined by the volume of hydrocarbon being delivered from one party to the next. However, the data on which those volumes are determined may be interpreted differently depending on the metering systems each stakeholder uses, the human resources available to verify accuracy and the information available.

Custody transfer payments are thus the subject of frequent and costly disputes that entail significant costs for all parties involved, in terms of human resources and delayed payments. Keith Steeves states that in order to produce information that counterparties need to check and, in turn, to check data that is provided by counterparties, NAL employs 45 people in finance, most of whom are production accountants. That number, he says, "could easily be 15 to 20." He also estimates that 30-50% of his company's workload is "due to disputes." This PoC will demonstrate that blockchain-enabled technologies can significantly reduce those disputes by exchanging data on open, shared, immutable, distributed ledgers that are enabled by blockchain.

PROJECT PARTNERS

James Graham posits that Measurement Ledger introduces a new layer to the D17 measurement schemata, the blockchain layer. However, blockchain represents only a part of the technology toolbox that is deployed. It is the platform that facilitates the integration of a number of other technologies. As Graham is fond of saying, "Blockchain is not about individuals. It's a team sport." As such, the Measurement Ledger PoC will include a number of energy-sector and technology partners to make it work. They, and the role they play in the PoC, are described in the sections that follow.

ENERGY SECTOR PARTNERS

GuildOne: For more than two decades, GuildOne has supplied advanced database solutions and business intelligence to oil and gas companies so they can better understand and use data to enhance business performance. In this PoC, GuildOne will be providing the Measurement Ledger technology that underlies the measurement and tracking of data along the hydrocarbon value chain.

NAL Resources: NAL Resources produces approximately 38,000 barrels of oil per day. With more than 300 dedicated team members working in Western Canada, NAL brings expertise in all areas of finding, developing and managing oil and gas assets. Within this PoC, NAL Resources will serve as the producer and out-of-the-ground owner of the hydrocarbon.

Tidewater Midstream: Tidewater was incorporated in February 2015 to pursue the purchase, sale and transportation of natural gas liquids (NGLs) throughout North America and to export markets overseas. They continue to investigate numerous opportunities with North American producers and mid-streamers for the acquisition and operation of such infrastructure projects. With this PoC, Tidewater will be the midstream (or pipeline) off-taker of the hydrocarbon as it enters the transport phase of the value chain.

---

6 IBM "Blockchain can help transform supply chain networks in the chemicals and petroleum industry" https://www-01.ibm.com/common/ssi/cgi-bin/ssial-ias?htmlfid=CHJ12351USEN (accessed August 1, 2018)

Guild1ne

TECHNOLOGY PARTNERS

R3: R3 builds blockchain technology to transform the way the world does business. R3 built its Corda blockchain platform in close collaboration with global financial institutions to meet the highest standards of one of the most complex and highly regulated industries in the world. It can be applied seamlessly to all other areas of commerce.

Corda: is the blockchain platform upon which Measurement Ledger operates. The strict standards R3 used to build its platform were a key differentiator for the GuildOne team as they chose a platform on which to build out their pioneering vision, including the Measurement Ledger.

AWS - Amazon Web Services: AWS IoT improves operational efficiencies by connecting sensors at scale, such as with predictive maintenance of pumps in the oilfield and in retail gas stations. And with nearly limitless high performance computing resources, AWS solutions can quickly process and visualize this growing set of data to generate insights to improve profitability and competitive differentiation.

AWS can help oil and gas companies across the value chain optimize sites like oil fields and refineries by providing the tools to digitize and manage heterogeneous assets such as equipment and personnel without connectivity. With tools to extract deeper insights from devices and to control devices at scale, AWS can help maximize production, increase productivity, and improve safety outcomes.

BLOCKCHAIN: REMOVING POINTS OF DATA DISPUTE

Blockchain is widely expected to have a transformative effect on the oil and gas sector, as it is on the economy as a whole.[7] Blockchain adoption can "at once impact operational costs, capital expenditure, risk management, and security."[8] It will enable "faster payment and settlement times, larger trading volumes, and an immutable audit trail,"[9] thereby creating huge efficiency improvements, particularly as "data entry errors are eliminated, as entries inconsistent with information held by counterparties will not be validated and added to the record."[10]

Blockchain is an open, shared distributed ledger that allows all parties with permission to view relevant transaction data. All entries are validated by counterparties before execution and an immutable (unchangeable) source of truth for transaction data is thus maintained for all contracted parties.

As all transactions are tracked and verified by all counterparties, no one party is able to make any entries without the knowledge and consent of all other parties. In this way, blockchain creates an open, shared and immutable ledger that removes trust as an issue and is, therefore, considered to operate in a "trustless" state. As a result, it vastly reduces the potential for disputes over the accuracy and/or integrity of the data on the ledger.

Distributed ledgers have the potential to eliminate the need for data reconciliations because all parties

---

7 For further discussion, see World Economic Forum: Digital Transformation Initiative: Oil and Gas Industry, http:// reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-oil-and-gas-industry-white-paper.pdf (accessed August 1, 2018)

8 BTL" Powered by Blockchain: Reinventing Information Management in the Energy Enterprise"
http://btl.co/powered_by_blockchain/ (accessed August 1, 2018)

9 Ibid

10 Ibid

Guild1ne

have signed off on its accuracy and integrity.[11] Blockchain will thus allow parties along the hydrocarbon value chain to establish and track an agreed-upon (or consensualized) data set, eliminating data-related disputes from the process. This PoC is intended to demonstrate this.

THE PROOF OF CONCEPT PROJECT: HYDROCARBON MEASUREMENT AND THE CUSTODY TRANSFER PROTOCOL

While Measurement Ledger utilizes GuildOne software and algorithms and operates on R3's Corda platform, it also works in conjunction with a number of other technologies to facilitate the frictionless, trustless exchange of data. For example, digitization and technology facilitate the gathering of data throughout the hydrocarbon value chain. At the wellhead and through various measurement points, production equipment and devices are connected to the Internet of Things (IoT), allowing production volumes to be digitized and tracked automatically, from the point of production and through to downstream markets.

Once the hydrocarbon is brought to the surface, it enters the value chain. Under the PoC project condition, meters will measure the volume of hydrocarbons at each of the measuring points required by D17 along the chain. The POC includes the architecture and data protocols (Custody Transfer Protocol) to connect to meters in the field, isolating meters at D17-designated measurement points. Measurement Ledger will upload relevant data from meters at D17 measurement points to a network of micro-ledgers that reside on AWS EC2 hosts. All data from field will be gathered and then recorded on the Measurement Ledger.

Measurement Ledger will then calculate, convert and record the data as operator-reported volumes for every custody transfer point along the hydrocarbon value chain, as required by D17. Measurement Ledger then takes the volume data—which is processed manually under the conventional schematic and, therefore, subject to different data and interpretations—and inserts it into the blockchain level of the schematic, where all parties can see and agree upon (or consensualize) the data.

Each device along the chain represents a node on a secure prover network that transmits data over Custody Transfer Protocol. This produces a volume ledger that is not only shared, open and trustless, but is also transparently in compliance with D17 requirements. All parties can view the data throughout the chain, eliminating costly delays due to disputes over delivered volumes.

SMART CONTRACTS: TRIGGERING IMMEDIATE VALUE EXCHANGE

For the Measurement Ledger PoC, smart contracts that contain the commercial terms agreed upon by the parties to the contract will execute to report production volumes for use by downstream processes, including GuildOne's Royalty Ledger. The operator-reported volumes are the basis of the key commercial terms of the contract.

---

11 BTL" Powered by Blockchain: Reinventing Information Management in the Energy Enterprise"
http://btl.co/powered_by_blockchain/ (accessed August 1, 2018)

Guild1ne

The smart contract will automatically validate the data against contractual terms that are agreed upon, or consensualized, by all parties beforehand. When the data indicates that the specified terms are met, the smart contract executes the transaction immediately.

PROOF OF CONCEPT OUTCOME: A FRICTIONLESS, DISPUTE-FREE TRANSACTION MODE

Blockchain represents a "connective" technology that allows oil and gas companies to advance digitization into the realm of commercial transactions. Just as the Internet made "frictionless commerce" possible by connecting buyers and sellers in online marketplaces, blockchain could provide the frictionless fabric for value exchange within discrete digital business networks.[12]

This is particularly important given the current surge of digitization that the energy sector as a whole is undergoing in reaction to both technological advances and economic (and competitive) pressures. "Given the data-intensive opportunities available through the growth and expansion of the Internet of Things, blockchain could be an important vessel to carry the industry's data transformation forward."[13]

This PoC is intended to demonstrate that blockchain is the platform on which key digital technologies will be integrated to create efficiencies through automation and remove costly friction points. Using blockchain, transactions can be settled in a matter of hours, compared to days, weeks or months, as is currently the case. Further, by reducing data-driven disputes, blockchain-supported automation can reduce or eliminate costly delays. Some sources estimate that blockchain could reduce the cost of payment transactions by up to 30 percent.[14]

This PoC only scratches the surface of blockchain's transformative potential, in oil and gas and beyond. "We see the seedlings of a truly frictionless, dispute-free transactional mode," says GuildOne's James Graham. "If we're able to get to a dispute-free state of interaction, we believe we can drive revenue completeness for all parties involved in the oil and gas industry, regardless of the resources they may have at their disposal to complete transactions and settle contracts."

ABOUT GUILDONE LABS

GuildOne has been reducing churn and errors, fixing broken processes and ensuring revenue completion for Canadian corporations since 2001. The company has supplied advanced database solutions and business intelligence to the oil and gas industry so they can better understand and use data to enhance business performance. Starting in 2016, GuildOne has invested time and resources in the research of emerging technologies such as blockchain, machine learning, and artificial intelligence, culminating in the release of its Royalty Ledger, the first successfully executed smart contract using blockchain technology in the Oil and Gas industry.

12 IBM "Blockchain can help transform supply chain networks in the chemicals and petroleum industry" https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=CHJ12351USEN (accessed August 1, 2018)

13 Deloitte Is Blockchain's Future in Oil and Gas Transformative or Transient? https://www2.deloitte.com/global/en/pages/energy-and-resources/articles/role-of-blockchain-in-the-energy-and-resources-industry.html (accessed August 1, 2018)

14 IBM "Blockchain can help transform supply chain networks in the chemicals and petroleum industry" https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=CHJ12351USEN (accessed August 1, 2018)

Guild1ne