How IoT and cloud-based data is changing the Oil & Gas Industry

The Internet of Things (IoT) is poised to change the capability of businesses to monitor and measure an almost unlimited number of different objects. Deploying this capability will be crucial for the Oil & Gas Industry over the coming decades, particularly as it relates to flaring and cold flaring (venting).

1. Introduction

The scale of emissions

Flaring and cold flaring of gas contributes to climate change and impacts the environment through a variety of pollutants, including methane and CO2 emissions.

The majority of flared and vented gas is emitted by Russia and Nigeria, along with smaller proportions in countries like Iraq and Iran. In recent years the United States has increased flaring, though this increase is due to the country’s explosive growth in the national Oil and Gas industry.

The combination of high infrastructure costs and low gas prices in the United States has discouraged investment in on-site capture technology, and flaring is considered the lesser of two evils when compared to venting methane directly into the atmosphere.

Based on satellite data, more than 150 billion cubic metres (or 5.3 trillion cubic feet) of natural gas is released into the atmosphere each year through flaring and
cold flaring operations. To put this figure into perspective, annual gas flaring equates to one quarter of annual gas consumption in the United States, 30 per cent of the European Union’s annual gas consumption, and three quarters of Russia’s total annual gas exports. 150 billion cubic meters also represents more than the gas consumption of Central and South America combined. In Africa, one of the most predominant gas flaring continents, the annual 35 billion cubic metres (or 1.2 trillion cubic feet) of gas flared is equivalent to half of the continent’s total power consumption.

Energy lost as CO2
Flared natural gas from the oil extraction process, also called associated gas, produces more than 300 million tons of CO2 emissions. This equates to the combined annual emissions of approximately 77 million cars, and if the gas was captured and used to generate power, it would provide more electricity (750 billion kWh) than the annual consumption of the African continent.

A 2015 report released by the Western Values Project (WVP), a non-profit organisation focused on sustainable land development, estimates that federal royalties lost from gas flaring in the United States amounted to more than $50 million in 2013. According to the report, the lost gas in this period could have powered all the homes in Chicago for a year.

Flaring has long been recognised as a leading contributor to greenhouse gas emissions, and consequently global warming. While the Oil & Gas industry has come a long way in its recognition and reduction of the emissions problem, increasing regulatory focus, as well as the additional public and media attention, means that the industry still has a lot further to go.

IoT’s place in the Oil & Gas Industry
With the growth of the IoT, it is expected that the next generation of internet users will be machines not people. While there are a number of consumer applications emerging, the major
benefits are likely to be experienced by business and industry, where remote monitoring and measurement can help to vastly reduce cost, enabling passive monitoring on an ongoing basis until intervention is required.

The most significant use of data will be to businesses employing remote monitoring and measurement technology, which can enable more informed strategic decisions through access to improved information in real time. IoT applications can not only support measurement, but enable businesses to manage more effectively in hostile and hazardous locations. For the Oil & Gas Industry, IoT connectivity will enable organisations to control risk more effectively, and support the necessary transition from measurement to management of greenhouse gasses as the industry addresses the problem of emissions.

2. Challenging environments
Due to the nature of fossil fuel location and extraction, critical infrastructure for the Oil & Gas Industry is often located in remote environments. As a consequence, the necessary maintenance and management of plants located in these dangerous and extreme environments has traditionally been provided by a large and expensive workforce. For example, a North Sea Oil rig typically stations between 50 and 100 permanent staff on board who work 12 hour shifts. When you consider that access is only possible by helicopter, it becomes increasingly clear that the cost associated with maintaining and managing remote assets in dangerous environments is significant.

No place for complacency
In August 2015 an explosion at a gas treatment plant on the west coast of Venezuela demonstrated the need for the highest levels of safety in Oil & Gas operations. The explosion took place at a processing plant in the Cardon IV Block of the Perla gas field, around 50km offshore of the North West of the Gulf of Venezuela, at one of the biggest offshore gas fields in Latin America. Fortunately the explosion did not cause any fatalities, yet these kinds of incidents often lead to the loss of life.

There are many potential causes of on-site explosions: the sudden release of gas under pressure, which can often result from normal extraction operations and other on-site activities, or the introduction of an ignition source into an explosive or flammable environment. The Hydrocarbon Releases (HCRs) that cause explosions like these are in simple terms, leaks. It is inevitable that leaks will happen during operations, and while significant efforts have been made to reduce these, innovations in remote monitoring technology can be exploited to reduce the associated risk further.

A recent campaign called Step Change in Safety which was supported by all of the stakeholders in the UK offshore industry, neatly demonstrates what can be achieved. In 2010 the total number of HCRs was 187. The Step Change in Safety campaign aimed to reduce this by 50% over a three year period. Whilst the campaign came up short – it only reduced the number by 49% - the approach demonstrates what is possible when more focus and attention is given to safety issues.

Monitoring potentially explosive environments for the presence of flammable vapours is an important health and safety practice and should be supported by the use of accurate measuring equipment. By combining IoT advances in remote connectivity and innovations in monitoring technology, the success that has already been achieved in this area can be increased significantly.
3. IoT for remote monitoring
When applied effectively, remote asset management through connected infrastructure will revolutionise Oil & Gas operations. While the ability to operate oil rigs without any personnel on-board is still some way off, any reduction in the number of personnel needed is likely to quickly add up to a considerable cost saving and inherently reduces the risk of casualties during emergency incidents.

The capability to access diagnostic information remotely is already widely used in the utilities sector where, for example, remote assets have been controlled by telemetry for many years to manage a number of tasks. Typical examples are regular reporting of asset well-being and diagnostics when an asset may be malfunctioning. Historically it has been necessary for personnel to check whether assets were working or not, costing time and money, and at its core, inserting a human being and employee into a dangerous environment. Not only does remote measurement and polling of these assets significantly reduce cost, but inherent risk.

Cloud technology and internet everywhere
It is cloud technology and the ubiquity of internet connectivity that fundamentally brings significant change to remote asset management. Cloud is the infrastructure or network over which an application or programme can run on many different computers simultaneously, and with remote asset monitoring relates specifically to the internet. Monitoring equipment installed on local assets transmits information in real-time to software that is stored on central servers, rather than physically on-site. When real-time data is fed into software such as continuous emission monitoring system (CEMS), organisations can continuously collect, record and report data remotely.

This method has several benefits. The software is run on the central server of the business and it is therefore not necessary to store and run the software on a machine on-site, reducing cost and the necessity of having a human operator on-site to manage the hardware and associated data. Additionally, the data is stored securely on a remote server and is not dependent on the health and reliability of an on-site machine.

The business can then access and analyse the data using a variety of devices, providing they are connected to the internet. With internet connectivity available almost everywhere, businesses can access the real-time data feeds of remote assets from multiple devices, anywhere in the world. Information is gained quickly, and action can be taken immediately to update software, shut down failing or faulty systems, and if there is a danger of explosion, extract on-site personnel immediately.

Asset monitoring
At any time during an Oil & Gas operation there is an assortment of different systems that need to be accurately monitored, providing a variety of data streams that need to be analysed and evaluated during decision making processes.

When infrastructure is monitored remotely and information transmitted to a cloud platform the monitoring of diverse assets can be simplified. A flexible platform can run numerous applications that monitored the asset range in parallel, enabling trends and impacts to be measured. If one particular asset is failing, the impact on others can be assessed.

A business’ predictive analytics capability for asset management comes from comparing
accurate real-time data feeds with vast amounts of stored historical data. This gives an organisation the ability to recognise potentially dangerous trends and take action immediately. Storing data on-site, however, is costly. Storing this data in the cloud enables more information to be stored and recorded, and also offers multiple layers of security and redundancy.

4. Better management through measurement

The combination of accurate, real-time information on remote assets and cloud technology can have a significant positive impact on moving an Oil & Gas operation from a monitoring approach to a management approach. It enables companies to access information on extreme events, and make strategic decisions based on historic data.

A practical example

Taking the example of an oil rig operation again, a business can utilise remote management to understand how the platform performs at different times of year and how seasonal weather impacts this performance. For an accurate analysis, this requires access to long term data trends from both the company’s on-site assets, and weather data. An extreme weather storm may, for example, only happen every five years, and access to data about a previous extreme storm will be useful in ensuring that the correct precautions are taken in the future. This kind of historical information demonstrates why it is important for a company to be consistently harvesting all of its data, even if it cannot currently see a practical application for it.

Reducing risk with data

Data enables insight and insight enables better management, and this in turn should lead to reduced risk. The oil and gas industry matches high risk against high reward, and any action that can be taken to reduce risk means that a higher proportion of the reward is accessible. In late 2015 dozens of oil workers were killed in a fire aboard a rig in the Caspian Sea. This was caused by a gas pipeline that was damaged in high winds. By recording critical data to the cloud, companies can understand the impact of extreme weather on oil rigs and implement procedures to reduce the risk of a similar incident. Had the owners of the rig been more aware of the likelihood of such an incident happening, they would have evacuated the site earlier.

Increased focus on emissions reduction

With increased regulatory scrutiny, it is crucial for the Oil & Gas Industry that the flaring of natural resources is strictly limited, only taking place when absolutely necessary. It is also necessary that gas released into the atmosphere is accurately measured, recorded, and reported.

In November 2015, the COP21 climate change conference in Paris saw a raft of Oil & Gas companies, oil-producing countries and other organisations join existing signatories in a pledge to reduce routine gas flaring to zero by the year 2030.

According to the World Bank though, momentum to reduce flaring appears to be levelling off, with only 10% cuts achieved by the world’s top 20 emitters since 2007, despite pledges to drastically reduce flaring. Figures from a World Bank GGFR Presentation in March 2015 show that flaring is being reduced, but suggest that by 2030, 80 billion metric tonnes will still be flared globally.

Reduction targets, known as Intended National Determined Contributions (INDCs), have been submitted by 187 countries, but these targets will need to be exceeded if temperature levels are to fall below two degrees – the current targets will still fall short of this decrease at 2.7.
Reducing emissions as a business strategy

Global regulations and targets mean that emissions need to be recorded and shared with regulators as well as health and safety authorities. Historically this involved recording the volume of gas flared locally and sharing this on a periodic basis. Connected measurement technology means that now this information can be monitored and measured in real time through secure hosting in the cloud.

To date most measurement of gas flaring has been regulatory – companies are obliged to report on gas flaring and often local regulation and taxation is applied to the practice. By using cloud technology to record gas flaring, companies can build a better picture of trends over time and utilise this information to derive valuable insight to inform business strategy. Consider a rig where flaring only happens after certain maintenance procedures. Real-time data from this can provide insight to more effectively manage the flaring process – reducing both the amount of wasted gas and also the taxation paid. Over an extended period of time organisations may begin to see patterns emerging that enable them to more effectively predict which rigs will flare more gas than others. In this case it is possible to consider the costs and benefits of gas capture technology, which would enable a cost (taxation) to be turned into revenue (natural gas sales).

Real-time data can also be used to create a competitive advantage. Data retrieved from different sites can be compared to more effectively manage the flaring process – site to site, country to country, or process to process – enabling continuous improvement over time. Best practice can be taken from top performing (low emission) sites and implemented across the entire business operation. For the Oil & Gas industry, publicising reductions in emissions and high-performance sites can have a significant impact on share prices.
A real change

Until now, apparatus for collecting and storing flare gas has been too expensive to make it an economic proposition for many operations, but this situation is changing as new technologies come to market that collect and store gas with minimal infrastructure requirements. With a depressed oil price, turning a resource that is normally wasted into a new revenue stream is a strong move from operators under pressure to create a higher return on investment from each production site. The convergence of technological advances and a change in thinking in the industry will mean that companies will be able to sell excess gas, rather than releasing it into the air.

5. Conclusion

Ironically the most critical aspect of deploying successful IoT communication systems for remote asset monitoring is human involvement. Connected infrastructure will report accurate information in real-time, but skilled humans still need to interpret and analyse the information, to turn it into actionable insight to make better decisions. IoT applications also need to be designed with fail safes, to ensure that immediate escalation for human intervention takes place when required and the monitoring systems are themselves monitored. Rather than taking the place of human beings, the best IoT applications will enhance people’s abilities to make accurate decisions, reducing cost, improving capability and, most important, reducing risk. More effective management of risk can be achieved by deploying cloud-based measurement tools that provide a snapshot of any issue in the short term but, in the long run, will help businesses identify trends that can not only improve business growth but help manage risk more effectively.

Nowhere will this be more applicable than in the high risk Oil & Gas Industry, but this is an industry that can experience a host of ancillary benefits through connected monitoring infrastructure. As regulations become increasingly targeted, complex, and legally enforceable, businesses in the Oil & Gas Industry need to harness the most innovative technology if they are to maximise the financial potential of their operations in an increasingly uncertain environment.

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