There are more than 2mn miles of transmission pipeline infrastructure globally, and that amount will grow in the next few years. In the US, for example, oil production is currently at a 27-year high of 8.5mn b/d and is expected to touch a 43-year high of more than 9mn b/d in 2015 as more production comes online from the Marcellus and Utica shale plays and elsewhere. Industry analyst IHS estimates that in the US alone, there will be an average of $80bn invested annually in petroleum infrastructure between 2014 and 2020.

Significant finance is flowing into the midstream segment of the industry as operators are investing considerably in expansion projects to connect new oil and gas supplies with markets. Another part of the surge in investment is a result of the maintenance required to upgrade or replace ageing assets that present the industry with risks as well as lost productivity. Much of the pipeline infrastructure around the world is more than 20 years old, causing pipeline operators to take added precautions to ensure safety when transporting increased production volumes.

While oil and gas pipeline operators are investing heavily in new technologies for better control, inspection and maintenance of assets, an estimated 10bn devices are linked to the industrial internet, the global network connecting people, data and machines. These trends foreshadow the future for the pipeline industry. Given the capital investments the industry is making to expand or upgrade pipeline networks, a challenge for operators is to take advantage of emerging technologies that make pipelines safer, more efficient and more agile in terms of routing production where and when needed.

New opportunities
Three broad trends are converging to create these new opportunities. First, development of intelligent machines employing advanced sensors and controls; second, advanced analytics for making deeper business insights; and third, sophisticated visualisation tools for sharing data across entire companies. Some of these technologies are already in use, such as fibre-optic cables and radio frequency identification devices (RFID) that connect to the internet and provide operators with an understanding of the operating condition of their assets in as near real-time as possible. Others, including Big Data (see p14) analytics to identify otherwise unrecognisable trends and conditions to support safety, risk and commercial optimisation, are being deployed or are on the very near horizon.

Other technologies are further down the road, but show significant potential for increasing safety, reducing costs and delivering greater efficiency. These include:

- **Wearable computer devices** that provide on-site visualisation of maintenance information, asset detail, and 3D images for collaboration with experts at offsite locations. This helps resolve problems more quickly and helps operators be more effective with limited resources.
- **Wearable safety devices** to monitor for hazardous atmosphere, pinpoint employee location and provide alerts.
- **Industrial automation security**
Intelligent Pipeline Solution in action
Source: GE

The benefits of using the industrial ‘Internet of Things’ include helping pipeline operators make better, faster decisions to improve safety and prevent costly downtime.

- Leak detection tools ranging from robotics to industrial drones, acoustic sensors and satellite monitoring, help spot leaks and also support perimeter surveillance and right-of-way monitoring.

Meanwhile, the technology transformation represented by solutions such the Intelligent Pipeline Solution by GE and Accenture has vast potential for the industry. By integrating and digitising large quantities of data, management and operations can share a common view of situations in near real-time, with analytics available at the level of individual assets. The benefits of using the industrial ‘Internet of Things’ include helping pipeline operators make better, faster decisions to improve safety and prevent costly downtime. It will also provide a more real-time view of pipeline integrity across vast networks of interstate natural gas pipelines.

Pipeline operators using geospatial visualisation tools coupled with real-time analytics on computers and mobile devices can review the integrity of operations in their entirety. These tools let management see the status of different risks and generate key performance indicators (KPIs) for use in a range of dashboards. With a clear picture of the health of various assets, decisions on maintenance and capital allocation are easier to make. Organisations can achieve more with the same budgets, eliminating inefficiencies and establishing priorities more accurately. Manpower and capital can be sent where and when it is needed most.

Benefits beyond safety
The continuing volatility of the oil market may push prices down and put added pressure on pipeline operators to reduce costs and operate assets efficiently. Innovative technology can help keep costs down. Operators increasingly require more robust data, real-time workforce planning and information to optimise the safe performance of these networks and relevant systems. This will be a digital journey moving along the path from being predominantly reactive to becoming more proactive, predictive and optimised.

In the process, companies will need to adjust their cultures from often making gut-based decisions based on the experience of individuals to relying on solid, analysed data to gain business insights in near real-time for optimising safety, maintenance, operations and customer service.

Ongoing challenges
Solutions related to the industrial internet hold great promise for oil and gas pipeline companies, despite the problems posed by the high costs of investment, proliferating regulatory initiatives and an ageing workforce. Indeed, for digital and technology solutions to deliver optimal returns on the investment they represent, companies need to have control of three key success factors:

Data management and quality – Pipeline operations generate considerable amounts of data, and new technologies will continue to generate much more. Many companies, however, tend to keep data in organisational silos, where it can be difficult to rapidly share information. Data that might be useful to asset performance might stay with operations, while information on customer demand stays with marketing when it could be shared with operations. To make the most of intelligent solutions harnessing the industrial internet, companies need to take a hard look at data governance as well as their overall IT architecture. For some, this will mean switching from the use of paper-based systems, such as for internal reports, to an integrated digital platform.

Knowledge management and transfer – As is the case in many other industries, the oil and gas pipeline workforce tends to be over 45 and heading for retirement. Companies need to be thinking about how to attract and retain the best workers, but also about how to transfer the knowledge acquired by the current workforce to the newcomers. With so much at stake — in terms of both investment and potential risk — companies can no longer rely upon informal, on-the-job training. Capturing safety, operational, financial and other historical data into a digital system that can be easily accessed and used by the next generation will be a vital asset.

Understanding the ‘big picture’ – It is easy to defer or delay investment in new technologies, adopting a ‘wait and see’ attitude to determine what works and what fails to deliver. The oil and gas pipeline industry, however, is at a critical juncture both in terms of its financial performance and in terms of its reputation. Companies should be wondering if they are doing all they can to minimise risks, but also to establish a reputation for being forward-looking and cognizant of the interests of all stakeholders.

Overall, the success of the pipeline industry is critical to the global energy market. Companies need to improve, not only their infrastructure, but how that infrastructure is managed and operated. Reliability and sophistication of a company’s visualisation and data management capabilities are just as important to that company’s future as changes in transportation demand. Companies that scale both will take the lead in this time of tremendous opportunity.

Challenges including asset integrity, shifts in flow dynamics and a changing workforce call for digitally enabled, integrated programmes both inside and outside the pipelines themselves. The companies that get this right can distinguish themselves in terms of improved safety, better economic returns and an enhanced reputation among customers and shareholders, and also among government and regulatory bodies.

1. PII Pipeline Database (summary of Infield Systems, Global Data DOT and CIA world fact book databases)
2. ‘US crude oil production in July highest in 27 years: EIA, Reuters, 12 August 2014 [http://www.reuters.com/article/2014/08/12/us-eia-oil-outlook-idUSKBN0GC1QE20140812]