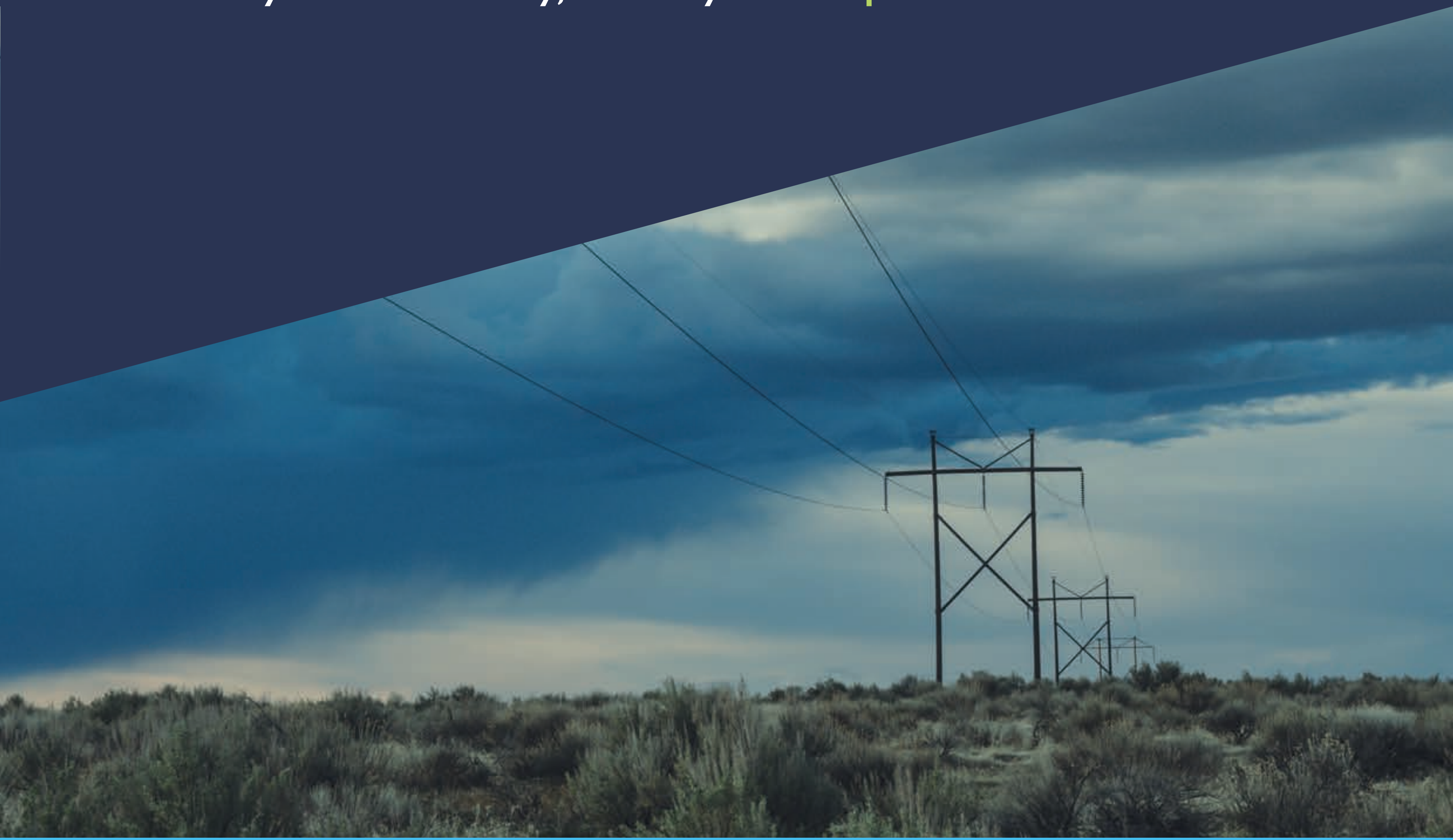
Data's journey in shaping digital transformation in Utilities, and what it all means

The roll-out of widespread internet access in the 1990s paved the way for digitalisation to permeate throughout the industrial world. Following the introduction of high-speed, reliable connectivity, traditional manual data collection methods are now almost obsolete. New methods of data monitoring and collection have culminated in vast increases in data volume, now presenting utility suppliers with an unrivalled opportunity to streamline and improve business performance. Empowering providers to deliver better, more consistent utility supply to consumers, despite ever increasing demand.

The journey of data has been long, resulting in less reliance on human interfaces and more on automation. Big data, machine-to-machine technology, and dependable connectivity provide the means to understand consumer trends and predict future utility usage. Companies failing to incorporate a robust data strategy into their business plan, are likely to find themselves at a major competitive disadvantage, if not already, in the very near future.

This paper looks at how far Utilities companies have come in terms of collecting and analysing data, streamlining operations, and casts an eye on how technology, and crucially connectivity, is likely to shape the future.



Traditional utility data collection methods

The Utilities sector has always made a significant effort to collect utility data, most frequently capturing pole data and meter readings.

Pole data

Historically, pole data was collected manually by an experienced technician wielding a hot stick, an extendable fibreglass pole used to measure voltage and conduct repairs on live electrical lines or communication cables. Adding to this process, digital cameras were used to record hot stick readings, along with images of the poles and their attachments.

One of the main limitations of manual data collection, particularly evident in pole data, is speed (or lack thereof). Data collection is slow and the information often obsolete by the time it is collated. For companies with a high number of poles ***(some exceed one million)***, extensive resources are tied up attending pole readings – it is simply not feasible (or financially viable) to collect enough data to provide meaningful insight to grid activity this way. Attending poles located at remote sites is even more time-consuming and contact with live electrical lines potentially hazardous to employees in the event of hot stick malfunction.

Spreadsheets have of course replaced paper records, but larger diverse data sets are driving the need for more sophisticated databases. As telecommunications continue to improve, Utilities are likely to receive more requests for space on poles or face unauthorised attachments; for example, a cable company fixing an attachment without permission, or before the necessary permits have been approved.

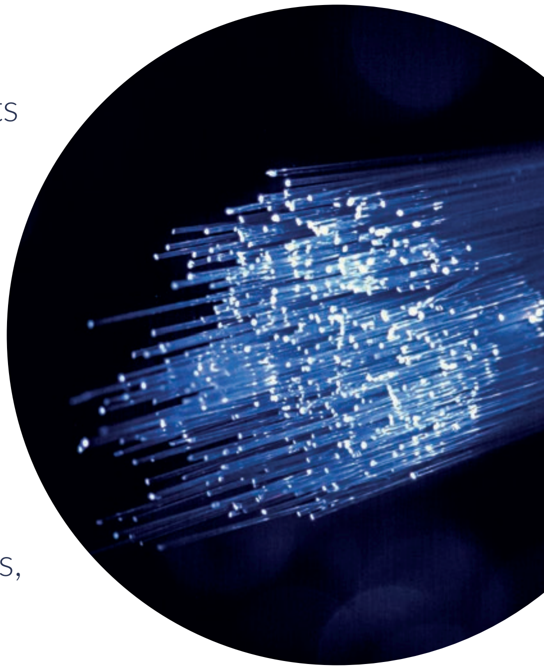
This can be a problem due to potential overloading and loss of rental revenue. So timely data will promote effective management of utility space.

Meter readings: from manual to smart

As we are well aware, most properties receiving a gas and electricity supply are fitted with meters that record consumption, usually located outside where the supply enters the property. In the past, utility companies relied on employees attending sites to read meters manually, or on customers to provide interim readings themselves. Advances in technology led first to automated readers that report usage from mechanical meters using an electronic signal, then to smart meters that connect wirelessly reporting usage in real-time and empowering users with better utility control.

Big data and M2M technology:
Revolutions in data collection and processing

In 1990, ***Peter Denning*** acknowledged the exponential growth of data, and concluded that in order to process vast amounts of data, interpret it and make conclusions on the information therein, the development of software was essential. His projections were on point; the data available today has already reached such enormous quantities, that traditional processing software can struggle to keep up.



Big data is typically characterised by the three 'Vs' – volume, variety, and velocity. In essence, it is huge amounts of complex data that constantly evolves and is available at high speed – often in real-time. In 2022, the amount of data generated worldwide is estimated to be an incredible ***97 zettabytes*** (97 followed by 100 zeros). In Utilities, the most relevant big data is collected by the millions of smart meters in the homes and businesses of customers, and from transmission lines on the grid.

The exploitation of big data is only possible through innovations in connectivity; the development of computers, smart phones, the internet, and internet of things have provided a means to access more data than ever before.

The internet of things (IoT) emerged during the 1990s. The term, coined by the British computer scientist Kevin Ashton in 1999, refers to interconnected network-enabled (internet, wi-fi, cellular network - 3G, LTE, 4G, 5G - near-field communication and Bluetooth) technologies. Devices use internet protocol (IP) to communicate to each other (machine-to-machine, or M2M communications) in real-time without the need for human input. They collect and transmit information to a network for delivery to a data integration point. Accurate, relevant data can be collected at a rate that simply would overwhelm the human brain.

But M2M communications are not new, in fact, they have been in use for almost two centuries. A very basic wired network used by the Russian army in 1845, is believed to be the first example of M2M communications. Cabled networks gave way to radio, which evolved into more sophisticated telecommunications, and eventually cloud computing (offering data storage without the expense of buying and maintaining computer systems, and incredible scalability), which paved the way for many IoT solutions.

Today, M2M technology and IoT are such an integral part of our everyday lives that they often go unnoticed. For Utilities, they present an excellent opportunity to capitalise on a vast array of information that, when turned into actionable insights, revolutionises customer services, streamlines operations, and increases productivity and safety.

Data driving digital transformation in the utility sector

Electrical grids and gas distribution systems are critical infrastructure. Outages and supply interruptions result in huge financial burden and penalties for the supplier, and severe (often prolonged) disruption for consumers. With increasing pressure for renewable energy and from customers seeking to generate their own power, digital transformation could be the catalyst Utilities need to bolster consumer interest.

The smart grid: predicting usage trends and reducing disruption caused by power outages

Consumer usage trends

The UK Department of Energy and Climate Change has invested billions of dollars into its national policy goal - building a smart grid across the UK. The smart grid comprises a suite of technologies that connect Utilities to their customers, enabling two-way communications and providing a means of monitoring conduction along transmission lines.

Smart meters and sensors along grid lines transmit usage data to utilities, enabling them to match supply with demand. Smart appliances can alter the times of electricity usage, avoiding peak times when pressure on the grid is high, resulting in lower costs and reduced risk of outage. The rising popularity of sensor-based technology, such as smart thermostats, is increasing customer engagement with smart-grid technology. At the end of 2021, there were ***27.8 million smart and advanced meters*** in homes and small businesses across the UK. But reports show ***8% of the UK's landmass remains uncovered by mobile networks*** - so connectivity considerations are essential.

Information is power: detailed insight into customer habits allow Utilities to achieve maximum efficiency and customer satisfaction. And at a time when Utilities face expensive grid updates, usage trends could prove invaluable to planning and prioritising engineering work, and most effectively distributing utility supply.

Reducing the risk of outages

The ***UK electrical grid*** consists of over 7000 kilometers of overhead line, 2800 kilometers of underground cable and 350 substations on to the distribution system, so it can reach homes and businesses. This exposure translates to a higher risk of physical damage and difficulty accessing pole sites for repair.
Data collection and interpretation play a crucial role in minimising service disruption; early recognition of anomalies in these areas provides an opportunity to correct issues before catastrophic failure.

Real-time flow of electricity through the grid is monitored using measurements called ynchrophasors. These are recorded and time-stamped using GPS by devices - phasor measurement units (PMUs). In combination with smart meter data, such timely information provides an opportunity for power suppliers to identify necessary maintenance before it culminates in a full-scale power outage.
When outages do occur, knowing the exact location and nature of the issue without having to wait for technicians to manually investigate significantly reduces the time to restoration.

According to ***our survey*** of utility users in February and March 2022 (Empowering Utility providers to better align with consumer priorities), almost one third of respondents experience more service interruptions now than they did 10 years ago. In 2021, the average electricity customer in the UK experienced more than ***30 minutes*** without power and while this is relatively minimal, this figure is only ***set to increase.***

"If we know the kind of disturbances to expect, or the accompanying phenomena during a disturbance, we can design control systems to quickly mitigate the disturbance." Said Robert Nyiredy, VP Risk Management Consulting at Vysus. "We can ensure a high reliability and security in a grid using innovative control strategies and systems."

Extreme weather events contribute heavily to grid vulnerability. When a lightning strike caused blackouts in 2019, leaving more than one million UK customers without electricity with two power plants disconnected from the grid, the two energy firms in question were fined in excess of ***£10.5 million.***

Smart grids create a role for artificial intelligence

The full potential of data can only be realised once it has been processed and applied to decision-making. Humans are fallible, and our brains are not equipped to deal with the volumes of data transmitted through the smart grid.

Devices are already communicating with one another; the next step is learning to make decisions based on the data they collect. Automation entails minimum human input and is therefore more accurate and much faster than human-led processes. Algorithms can enable software to learn from other devices and their own past decisions and incorporate this knowledge into future actions.

Possible applications include automatic dispatch of repair teams to outages, automatic scaling of supply during demand variations, and generation of utility bills based on data from individual customer smart meters.

Optimising connectivity facilitates the roll-out of IoT applications

Connectivity has been identified as a common barrier to full exploitation of the IoT. ***Inmarsat's 2021 report*** states that 58% of electrical utility providers are unable to implement IoT projects due to unavailability of reliable connectivity in the areas they need it. Huge variations in terrain and the disparate nature of remote assets can limit the usefulness of some terrestrial connectivity options.

5G is the fifth generation of broadband cellular network. With speeds up to ***20 times faster*** than its predecessor – 4G – and ***network connection density 10 times higher***; it is expected to boost Utilities' application of the IoT and artificial intelligence. A ***2022 survey published by Deloitte*** reported that 26% of respondents within the power and utilities sector included 5G in their strategy, and a further 36% planned to.

Only ***one third of companies within the utility sector currently use satellite*** in their communication strategies, compared to almost half in other sectors. Satellite can be used as a primary connectivity option, or as a failover in the event of terrestrial network interruption, creating a more resilient, future-proof grid.

The future is bright

Data occupies a central role in resource planning, modernising business processes and optimising productivity in the utilities sector. As the amount and diversity of data, and the speed it is received continues to increase, the opportunities for utility companies to convert data into actionable insights within their operations becomes endless.

Connectivity is becoming more reliable than ever, and myriad options are available to create a bespoke network to support big data collection and M2M interactions across entire networks. But despite availability, optimal connectivity solutions are not always implemented. This increases risk of network failure, hindering the usefulness of data strategies. Solid connectivity networks, with additional failover solutions, not only promote digital transformation by ensuring critical data is available uninterrupted and in real-time, they are a ***prerequisite***.

There still exists some scepticism around the complete value of data, and analysing it has, to some extent, become a box-ticking exercise to some. So, arguably, further education is needed in the sector to optimise connectivity. Regardless, with the vast and disparate nature of Utilities and its infrastructure, connectivity will be the key to unlocking the power of big data in this sector.

As the utility sector faces an ageing grid susceptible to physical and cyber threats, and the popularity of greener energy soars, effective use of data could be critical to customer retention and cost reduction.

While advances in connectivity are revolutionising the information available to utilities, there are still obstacles to overcome before big data can be used to its full potential.

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