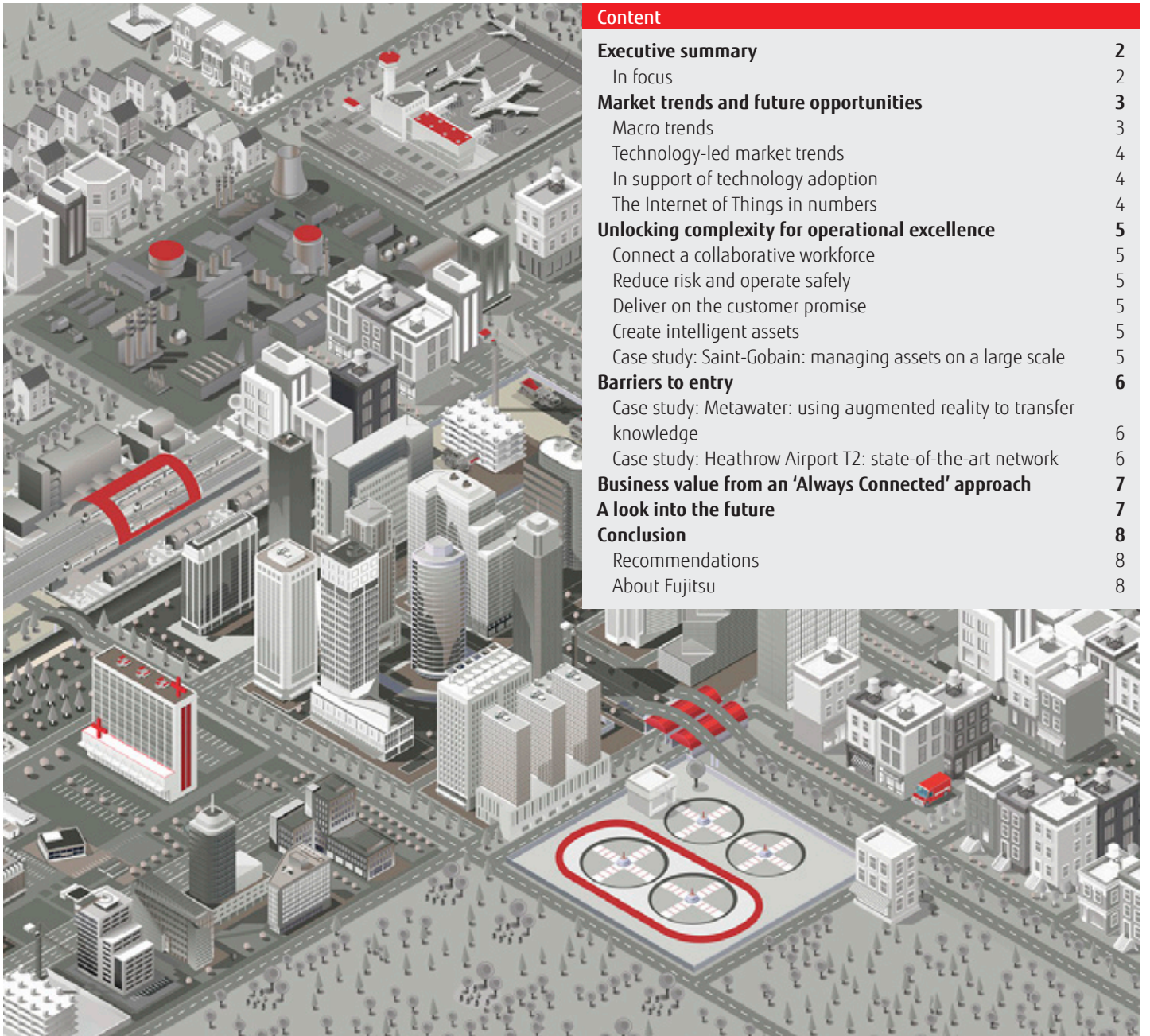


White Paper Always Connected



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Executive summary



In asset-intensive industry sectors, the promise of connectivity should be difficult to ignore. In sectors where project-based working – long-term and ad hoc – is the norm, there is significant potential value to be derived from an ‘Always Connected’ approach. And in industries where partnerships with other organisations are essential to delivery, connectivity is proven to create efficiency and effectiveness.

The opportunities, while great, come at a time of significant upheaval – economic volatility, dramatic demographic change and increased pressure on natural resources to name but three challenges faced.

It is in this context that this paper sets out to make the case for an ‘Always Connected’ approach to business. It is through this approach that infrastructure is connected; assets such as devices, plant, machinery, parts and appliances interact; information sharing across employees unlocks complexity; and intelligent data insight drives decision-making.

Traditionally, the two sectors that are the focus of this white paper have spent modestly on technology. They have been reluctant – or remain unconvinced of the case – to merge operational technology with information technology. The ‘Always Connected’ model makes the strongest case yet to reconsider this approach.

Enabling this is a technology issue but the case for it is the political, environmental and societal pressures that these organisations face. An intense burden on margins, coupled with environmental and regulatory imperatives, are the norm. In the realm of utility and built environment sectors, companies remain stubbornly low-tech, and skills, experience and advocacy of digital are thin on the ground. Yet rather than present an obstacle for action – or an excuse for inertia – these pressures should provide the impetus for change. In an ‘Always Connected’ model, the goals should be falling operational costs, rising customer expectations, greater back-office

efficiency and increased opportunity to explore new business models. ‘Always Connected’ also means a better engaged workforce and an environment to attract and meet the expectations of the millennial generation. For the organisation, its employees, partners and customers, there is much to gain.

IN FOCUS

This white paper addresses the needs and opportunities of the following sectors:

Energy and utilities, including:

- Generation and transmission
- Distribution and supply
- Water organisations

The built environment, including:

- Engineering
- Construction
- Facilities management

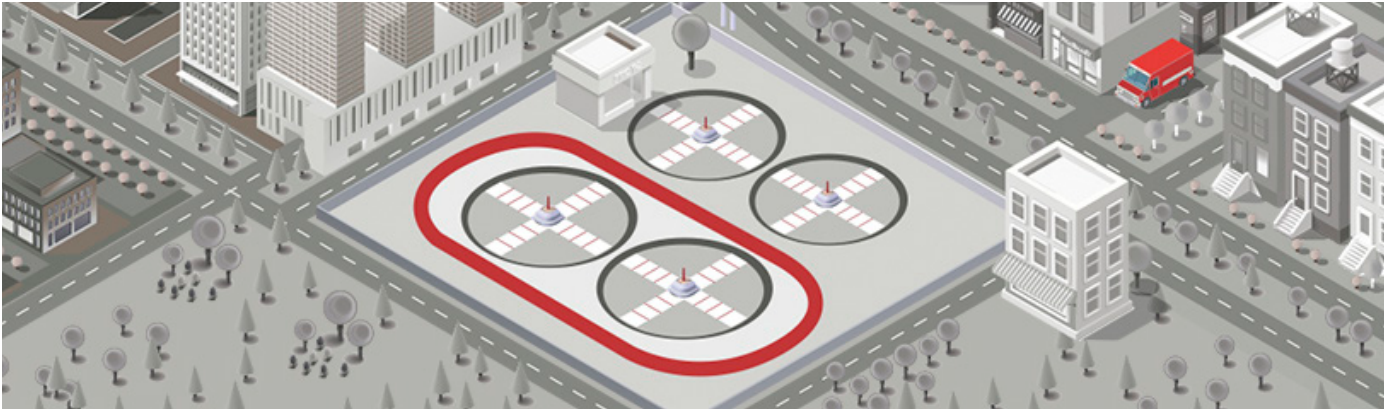
For broad societal benefit as well as that which directly affects individual businesses, it is worth exploring digital connectivity as a driver of change.

“Industry must embrace technological progress to meet the demands of a rapidly changing world. Innovations like Digital Engineering and Design for Manufacture and Assembly will be fundamental to delivering a higher quality, more sustainable built environment for future generations.”

Anna Stewart, Group Chief Executive, Laing O’Rourke

Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf

Market trends and future opportunities



Shifts in the economic, political and societal landscape are driving change in the way that built environments are evolving. In parallel, there is an emerging use of technology to respond to these trends.

Macro trends

As the make-up of our population changes – growing, ageing and becoming increasingly urban – so the challenge for utilities and built environment specialists intensifies. In the UK the proportion of the population over 65 continues to grow. It will increase by 12 percent in the next five years while the general population grows by 3 percent¹. Meanwhile, according to United Nations' estimates, the share of the world's population living in urban environments – just 13 percent at the turn of the last century – will hit 70 percent by 2050². All this means increased strain on water, transport and power infrastructure – and a search for new solutions and the creation of new business models.

Energy market reform. Security of supply, tackling climate change, and affordability underscored the government's stated intentions when it announced electricity market reforms in 2012.³ Among the objectives, the government's target of 15 percent energy generation from renewables by 2020 is making new demands on the electricity grid, with an increase in small scale (business and domestic) power generation. Designed for centralised generation, distribution and supply, the UK's energy infrastructure will need to adapt to accommodate a more distributed model.

Technology. Sensor technologies in particular will come to the fore in addressing this challenge.

The utilities industry will account for 67 percent of overall machine-to-machine device connections worldwide by 2023⁴.

As the history of technology dictates, the price of sensors will fall dramatically as adoption rates take off. In the last ten years, for example, the cost of compute has experienced a 60-fold reduction. Meanwhile, the popularity of sensors used in scientific equipments, automotive diagnostics and drone manufacture – among other applications – demonstrates the potential of sensors for utilities and the built environment sectors.

Climate change. The need for lower emissions targets in the UK is enshrined in the 2008 Climate Change Act⁵. It commits the UK to reduce carbon emissions by at least 80 percent in 2050 from 1990 levels. This goal has implications for energy and construction sectors alike, making additional demands on day-to-day operations, rethinking business processes and offering a potential opportunity for growth. According to the government's own figures, the low-carbon economy is worth £26.bn.⁶

Energy price volatility. The price of fossil fuels – oil, in particular – continues to fluctuate. After several years when prices stabilised at just over \$100 a barrel, sharp declines in the price of oil followed from June 2014. While this has had a largely benign affect on the construction and engineering sectors, it has added to the pressure of some within the energy sector.

This, in turn is acting as a stimulus to generate additional energy as well as optimise existing energy usage to reduce costs. The use of organic biomass and combined heat and power (CHP) plants are examples of both in action.

1. <http://www.parliament.uk/business/publications/research/key-issues-parliament-2015/social-change/ageing-population/>

2. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf

3. Electricity Market Reform, 2012 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48371/5349-electricity-market-reform-policy-overview.pdf

4. <http://utilityweek.co.uk/news/enabling-a-mobile-workforce/1058122#.VmVKNLlLSMB>

5. Climate Change Act, 2008 http://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf

6. Department for Business, Innovation and Skills, 2015: The size and performance of the UK low-carbon economy: Report for 2010-13

Technology-led market trends

IT/OT convergence. Information technology and operational technology have, until recently, operated on parallel tracks within most organisations. IT, predominantly back office and typically software-based, tends to focus on transaction processing, support functions and business intelligence, while OT, often in the field and device focused, offers asset control and device-to-device communications. Now, thanks to the increasing sophistication of the Internet of Things, smart grids and other device-oriented networks – coupled with standardised IT architectures, application integration and pervasive mobile access – both IT and OT are operating in tandem. This in turn promises improved asset management, faster problem detection, greater organisational efficiency and increased system reliability.

Smart meter rollout. By the end of 2020, a smart meter will have been installed in most homes – some 26 million – and small businesses across England, Scotland and Wales. It forms the major part of efforts to bring the energy system up to date, allowing customers to track consumption and costs. As such it is the UK's biggest infrastructure project in a generation⁷. And at a cost of £10.9bn, the programme effectively represents the UK government's biggest investment in the Internet of Things' technologies.

The rise of BIM. As a concept, BIM (Building Information Modelling) has existed for several decades, but it only gained traction in the early- to mid-2000s as a digital means of representing the physical and functional characteristics of a building or other facility. An example of using technology to share knowledge among all interested parties and across the lifetime of a building (from conception to demolition), BIM is an indicator of what connected technology can bring to the built sector⁸. The adoption of the Internet of Things sensors is latterly allowing for real-time Building Information Modelling, or BIM Level 3.

The emergence of the smart building. According to a government paper into the impact of the Internet of Things, 'sensors are increasingly being installed in buildings to gather data about movement, heat, light and use of space. This information could allow Building Management Systems (BMS) to make near real-time alterations to a building's environment. Sensor data may also be analysed as part of designing subsequent buildings and systems.⁹ The Royal Academy of Engineering believes 'advances in data gathering and analysis are opening up new possibilities for smart building technology.'¹⁰

Adoption of Sharing Economy models. Collaborative consumption of goods and services – from ride sharing to overnight accommodation – could soon be embraced by the built sector, looking to share the cost of heavy construction equipment and acknowledging the fact that much of this equipment sits idle for lengthy periods.

IN SUPPORT OF TECHNOLOGY ADOPTION

"Technology is one pillar in constructing a successful data-driven project; management, planning, plus social and economic factors also play a part."

The Institution of Engineering and Technology (IET)¹¹

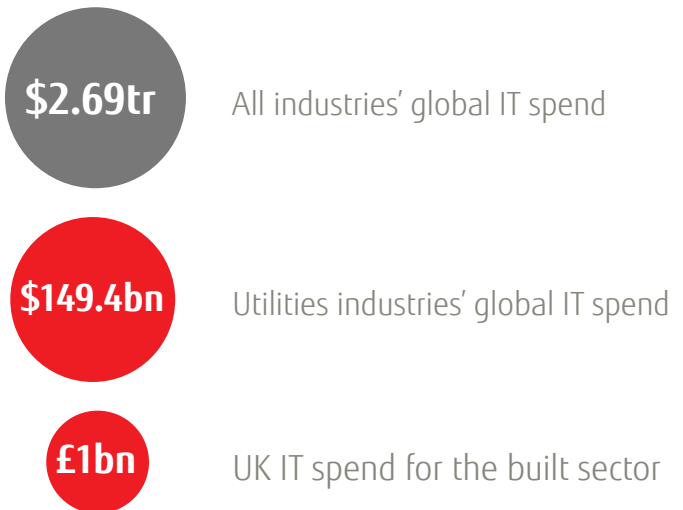
"Advances in data gathering and analysis are opening up new possibilities for smart building technology."

The Royal Academy of Engineering¹²

"We recognise that innovation in construction has traditionally happened very slowly, but by improving our members' knowledge and core skills, [we] can catalyse transformation."

Institution of Civil Engineers¹³

Utilities and built environment sector spend on technology remains relatively modest. To take advantage of the IT/OT convergence and to compete in a digital world, these sectors need to consider investing more.



THE INTERNET OF THINGS IN NUMBERS¹⁴

By 2020:

- **30 billion** connected devices in the home and in the utilities industry worldwide¹⁵
- **50%** of all European water meters should have smart capabilities¹⁶
- Over **\$200bn** worldwide revenue opportunities for utilities¹⁷
- **44 zettabytes** of global data¹⁸

7. Smart Energy GB <http://www.smartenergygb.org/national-rollout>

8. National BIM factsheet, 2015 https://www.nationalbimstandard.org/files/NBIMS-US_FactSheet_2015.pdf

9. The Internet of Things: making the most of the Second Digital Revolution, Government Office of Science, December 2014 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/409774/14-1230-internet-of-things-review.pdf

10. Royal Academy of Engineering, <http://www.ingenia.org.uk/Ingenia/Articles/831>

11. IET, <http://www.theiet.org/sectors/built-environment/resources/digital-technology.cfm>

12. Royal Academy of Engineering, <http://www.ingenia.org.uk/Ingenia/Articles/831>

13. Institution of Civil Engineering <https://www.ice.org.uk/disciplines-and-resources/industry-transformation>

14. Taken from Fujitsu Utilities DIO report

15. "The Internet of Things", Utility Week, July 2014

16. "The Internet of Things is Now", Morgan Stanley, April 2014

17. IDC, June 2014

18. IDC, April 2014

Unlocking complexity for operational excellence

Fujitsu believes that connectivity – when done properly – leads to operational excellence with a significant value via productivity improvement and new business models. Where infrastructure is connected, assets become intelligent and information is available to employees any time, any place, anywhere; as a result, organisations prosper.

Fujitsu's 'Always Connected' approach makes particular sense for energy and utility companies, and for those in the built environment sector – from construction to engineering to facilities management. Why? Because these are companies that are asset-rich and have a mobile and geographically dispersed workforce. Moreover, such organisations will often work on an ad-hoc, project basis in partnership with other organisations. Connectivity of people, objects and data will fuel operational excellence. And it will be underpinned by:

- developing intelligent assets
- building a smart workforce
- running sustainable operations
- maintaining security and safety; and
- managing complexity

Some of these core concepts will now be taken in turn.

1. Connect a collaborative workforce

Typically, the mobile workforce – in transit or onsite – has poor access to data and a lack of visibility across the entirety of a project. If, instead, information is available 24/7 organisations can realise productivity and supply chain improvements. Consider the following employee-use cases:

- instantly order stock and update engineering logs
- arrange customer appointments remotely and on the move
- use real-time, context-aware training and information to complete tasks more quickly and to a higher standard
- receive over-the-shoulder guidance, using video or augmented reality in challenging conditions, and to fill the skills gap

2. Reduce risk and operate safely

Higher levels of automation, data analysis, connectivity, geo-tracking and machine learning help make the working environment safer by:

- ensuring the right people are onsite with the correct levels of access
- using sensor data to detect dangerous substances such as asbestos
- retrieving asset data to ensure equipment is at operational standard, and as an early warning ahead of repair, so enabling proactive, condition-based maintenance
- supplementing workforce expertise with augmented reality to ensure employees are armed with the very best and latest information
- using wearables to monitor health and wellbeing of employees, for example detecting anxiety rates and pulse

3. Deliver on the customer promise

Meeting and exceeding customer expectations is another benefit for the 'Always Connected' organisation. Consider the following use cases:

- reduce the need for second-time visits by ordering and tracking relevant parts in real-time
- get the job done first time by using augmented reality to support engineers in the field, dealing with unfamiliar customer equipment
- create 'pop-up' sites combining WiFi connectivity, secure unified communications and business applications, using Fujitsu's Hyperconnected van

4. Create intelligent assets

Smart asset management enables maintenance to be shifted from a time-driven exercise to a proactive exercise for the first time. Machinery, parts and equipment are repaired when they need to be repaired rather than simply using the calendar as a prompt for assessment. By pre-empting and preventing breakdowns, organisations can reduce the cost of outages, avoid subsequent penalties and exceed customer expectations.

Moreover, by tracking plant, construction materials and assets across a project's lifecycle, organisations have end-to-end traceability from onsite delivery through to in-life operations. This allows project costs to be better controlled with accurate information about available equipment and resources.

Case study: Saint-Gobain: managing assets on a large scale¹⁹

Saint-Gobain designs, manufactures and distributes building materials including self-cleaning windows and photovoltaic glass. Given the firm's global reach – across 64 countries – and its inventory volumes, asset management is a priority issue. Today this is handled out of Memphis, Tennessee where Fujitsu moves \$2m of inventory and provides a transparent view of Saint-Gobain's technology stock. In addition, 500 field engineers supplied by Fujitsu make more than 600 onsite visits per year to resolve local technology issues – and Fujitsu has helped create a single, standardised catalogue from which employees can select the hardware they need.

"We've reduced our support costs; we're keeping a tight lid on inventory and resolving incidents more quickly."

Tim Guyer, CIO, Saint-Gobain North America

19. http://www.fujitsu.com/global/Images/CS_2014Apr_Saint%20Gobain_Eng_v0.1_tcm100-1044969.pdf

Barriers to entry

Technology for field workers is generally low, in part because of inflexible value chains and in part because conventional processes, championed from the top of organisations, prevail. Indeed, some workplace cultures – where problem-solving is rewarded rather than prevention – mean technology solutions are not sought to the same degree as they are in other sectors. Data privacy and security concerns that have deterred collaborative networking only make the environment more challenging.



All this has a cumulative effect: few digital skills and little experience to draw upon mean not enough digital champions in leadership positions.

Construction, for example, remains a relatively low-tech industry with only a small percentage of its two million workforce in the UK working in technology roles²⁰. Typically, the operational machinery has remained divorced from any information technology software that has underpinned back-office and project-based work.

This may be about to change however. Industry watchers believe that an increased investment in software and IT services is a means of responding to volatile market conditions. Pierre Audoin Consultants has argued²¹ that cloud delivery models – coupled with mobile connectivity and collaboration software – will see strong adoption in the construction sector, prompted by the attraction of pay-as-you-go pricing and little in the way of legacy systems locking firms in.

Case study: Metawater: using augmented reality to transfer knowledge²²

Japanese water services company, Metawater, faced two interlinked challenges: how to improve efficiency and how to transfer the skills and experience in water facility repair and maintenance from a generation of engineers approaching retirement to a younger cohort. The solution to both involved arming engineers with tablet computers running augmented reality software. Using the tablet's built-in camera, the engineer is able to view a component with relevant information overlaid on screen. The engineer can annotate reports with photos and audio recordings should he or she notice anything wrong. Moreover, inspection data is stored on the server for analysis, while onsite observations help predict component failure, as does data collected from sensors installed throughout a water facility.

Fujitsu Software Interstage AR Processing Server uses a set of markers that enable the device's camera to recognise relevant components irrespective of water, pollution, distance or camera shake. A typical large-scale water purification plant employs a set of around 400 AR markers in the form of diagnostic sheets that an engineer can access instantly.

"Using the tablets allows less experienced operators to spot problems easily by comparing the situations they encounter with stored images of normal operations."

Yasushi Nakamura, Director, Metawater

Case study: Heathrow Airport T2: state-of-the-art network²³

When Europe's busiest airport Heathrow set about rebuilding its second terminal, it sought a technology partner which could interface across every element of construction. It wanted to deploy a network to cover every stage of the passenger journey from car parking to check-in, through security to boarding a flight. The final network featured fibre cabling, switches, wireless LAN, IPTV, and IP Telephony infrastructure to cover 110 comms rooms, 1,700 cameras, 34,000 CAT 5 and 6 network ports and many other areas.

"The network is both the backbone and the brain of the operation."

Bally Grewal, Director of IT Delivery at Heathrow Airport

20. <https://www.pac-online.com/uk-construction-it-spending-hit-%C2%A31bn-2015-press-release>

21. <https://www.pac-online.com/uk-construction-it-spending-hit-%C2%A31bn-2015-press-release>

22. Based on <http://www.fujitsu.com/global/vision/2014/casestudy/metawater/>

23. Based on <http://www.fujitsu.com/uk/about/resources/case-studies/cs-2014nov-heathrowairport.html>

Business value from an 'Always Connected' approach

A look into the future

From organisation to employee to partners and customers, here are examples of how an 'Always Connected' approach can drive value²⁴.

The organisation

- auto Identification technologies such as RFID scan stock and locate items needed to complete engineering tasks, driving down costs and driving up efficiency, as well as traceability of materials
- local infrastructure team forms 'pop-up' site –in a van and on the move
- maintenance work is supported by full-audit trail
- connected devices in the hands of customers increase the opportunity for more frequent, value-add engagement and interactions in what are traditionally low-touch sectors
- data turned into actionable intelligence from sensors, smart meters and other connected assets create the opportunity for new business models

The employees

- wearable devices provide instant alerts to changes in conditions, promoting the health and safety of workers
- remote library of 'how-to' guides delivered using augmented reality offers engineers over-the-shoulder advice

The ecosystem

- information and the right equipment at the right time means tasks have faster resolution rates resulting in increased employee and customer satisfaction levels
- cloud-based systems provide immediate access to workplace systems and allow partner organisations to share authorised information
- mobile site communications quickly assembled and shared among partner organisations
- exposing data on individual parts and equipment provides better visibility and collaboration across the supply chain
- increased automation combined with connected devices offers more self-service channels to customers, delivering the speed and simplicity customers crave

Fast forward and this is how a utility or built environment sector organisation is likely to operate in an 'Always Connected' world:

The workforce

Employees are no longer disconnected from the corporate systems once out of the office, armed as they are with wearable devices (to monitor health and wellbeing and to alert the user to dangerous onsite conditions); smartphone (for audio-visual communication and access to productivity apps); and augmented reality-enabled tablet computers (for in-the-field assessments and operations, real-time reporting and support, and inventory ordering and logging).

The safety factor

Onsite sensors provide minute-by-minute updates on the working environment; wearable devices monitor the health and wellbeing of employees; and geo-fencing mobile apps use GPS to track smartphones and other devices, providing a virtual barrier to restrict access only to those with authorisation.

The bottom line

Sensors embedded into plant with analytics pre-empt breakdowns and extend asset lifecycles; plant can be used between partners and manufacturers embracing the Sharing Economy and using the data generated from plant to create new revenue streams, with visibility into the condition of plant at a point in time and insights into how much it had been used.

The IoT innovations

Information and operational technology convergence continues apace with organisations taking advantage of the proliferation of sensors: utilities use the 2020 completion of smart meter rollout to better engage with customers and provide them with additional services, whilst construction companies create smart buildings where sensor data make real-time environmental adaptations – relating to heat, light, space – a reality.

24. Fujitsu Utilities DIO report , July 2015

Conclusion

As IDC's Vernon Turner notes below, the real opportunities of technology advance remain in the enterprise. For those working for utilities and for the built environment sector, the opportunity is now. Technologies discussed within this white paper – including the Internet of Things – are not just enablers, they are game changers. As such, the information generated by your business may soon become more important than the current products and services you offer. And the application of this technology will disrupt current business models, changing the way customers and workers are engaged and how they interact with the environment, products and services. This white paper has outlined the business imperative of an 'Always Connected' approach. 'Always Connected' unlocks complexity and ensures operational excellence; it mitigates risk and drives efficiency; it ensures businesses meet customer expectations; and, finally, it opens up opportunities for new business models.

As this white paper also acknowledges, many organisations are still in the early stages of exploring an always-on, digital approach to business, and the low-adoption of information technology to date in core business operations has been an understandable response by some. The advice, therefore, is not to ignore the potential of the 'Always Connected' concept but to embark on manageable change. There is a need, too, to find a technology company that will help this integration and act as a business partner on all new builds and development. For the construction industry, where partnerships elsewhere in the business are a natural state of affairs, this approach should not prove a conceptual leap in the dark. For others, it's time to rethink the approach to digital technology and put it at the heart of the business.

"While wearable devices are the consumer face of the Internet of Things, and where recognition of IoT appears to begin, the real opportunities remain in the enterprise."

Vernon Turner, Senior Vice-President and research fellow at IDC²⁵

RECOMMENDATIONS

- Map out capital-intensive and resource-hungry parts of the business and assess how these can be optimised by a networked approach to business.
- Map out what information you have, should have and must have – as well as the information you don't need. Identify what's valuable to you and others, then assess how this can be optimised through a networked approach to business.
- Learn sector-specific lessons from peer organisations.
- Learn non-sector lessons from industries such as financial services that are typically earlier adopters of technology. Look too at the retail industry to see how it engages customers and staff. Apply these lessons to utilities or the built environment sector.
- Map out an ecosystem of project partners and list the benefits of sharing information and data.
- Start small, learn quickly. This technique is sometimes known as fail fast, and scale up. Ensure you run a risk assessment of data sharing and connectivity, and build in security from the start.

ABOUT FUJITSU

With over 100,000 global patents registered and an annual R&D spend of over £1.2bn, Fujitsu is working with customers every day to deliver a truly connected society.

Fujitsu is a world class technology partner with a proven track record in integrating IoT for operational excellence and innovation.

Fujitsu enables businesses to become 'Always connected', leveraging all their assets and workforce, to unlock complexity, innovate and meet their business demands.

Fujitsu believe human centric ICT can help create a more intelligent society, a better place for human beings and a better place to conduct business.

This in turn creates a sustainable world where we can live and prosper.

25. IDC, June 2015 <http://www.idc.com/getdoc.jsp?containerId=prUS25658015>