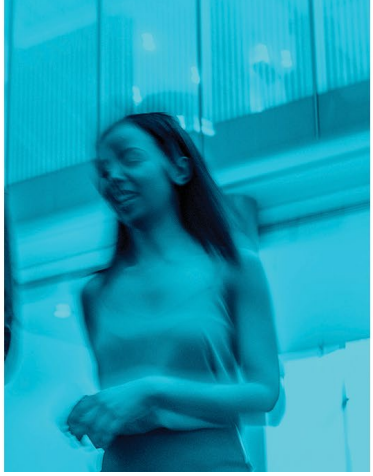

Paul is part of Capita consulting, covering a range of services associated with Smart Buildings, Data Centres, Critical Infrastructures and IoT (Internet of Things).

An experienced presenter and with over 20 years of accumulated knowledge in telecoms, ICT, networking and security, Paul brings a more holistic approach to his role, helping clients realise greater benefit through consultancy and business modelling.

Paul Thomas
Capita Consulting

Digital Ecosystems for Smart Building Stakeholders: Using IoT (Internet of Things) to optimise Smart Buildings

A key challenge for the building industry, as a whole, is to reduce their impact on the environment, in line with sustainable, social and environmental requirements. This is while improving the performance of the buildings they create and setting the foundation for the workplace of the future, in order to aid the sought after innovative and production environments for our workforce.

An IoT ecosystem will assist in realising these requirements and provide a distributed architecture that can be configured and fine-tuned to deliver against the aforementioned requirements. We've modelled natural ecosystems for decades, even centuries, and we can now apply this concept to buildings through IoT, which covers the acquisition, transportation, analysis, and monetisation of data for revenue and cost savings.

Specifically, for Smart Buildings we can 'make sense of this data', and create 3D rendered virtual buildings that reflect the health and performance of buildings, so we can fine-tune their operation and respond to changes in the buildings in near real-time.

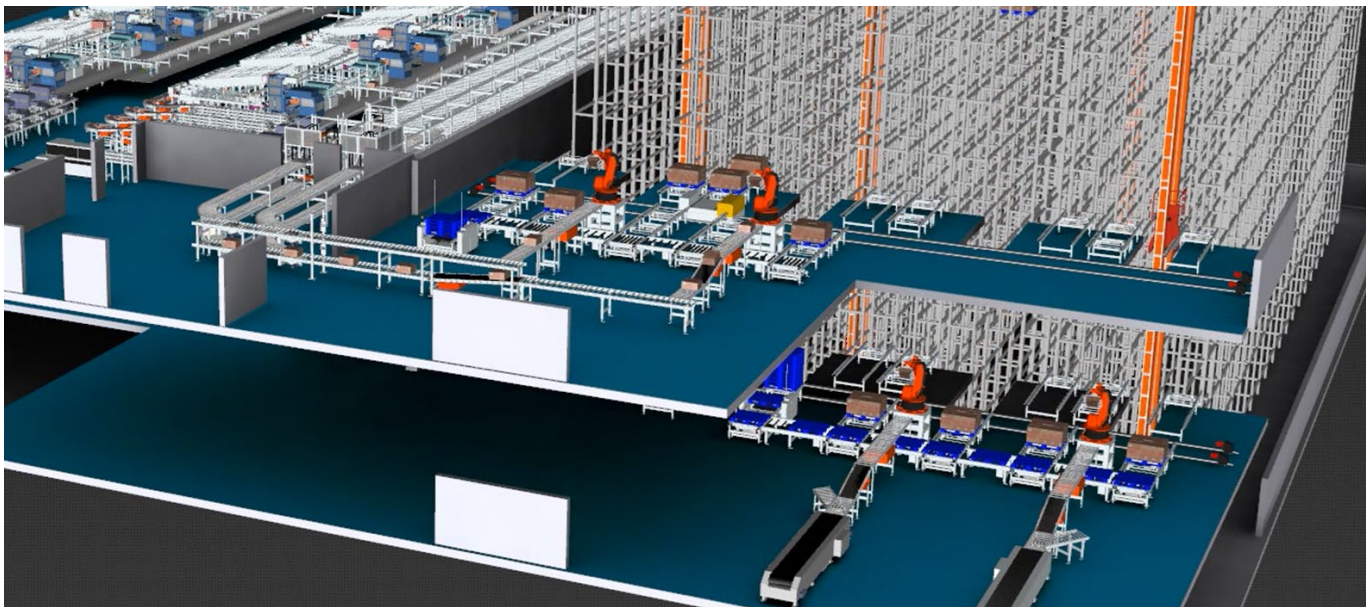

Figure 1 – Still image from a Dynamic 3D factory, presenting Digital Twin capabilities – courtesy of Iconics.

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To realise the benefit of this new approach requires a change in the design, management and operation of the supply chain. This is because quantifying the cost of technology in isolation rarely delivers the benefit and financial value it's articulated to deliver. Instead the overall supply chain needs to be involved in the whole cycle to reap the best outcome in terms of time and costs.

Afterall, what seems a good idea always needs testing and validating.

Which areas are important to stakeholders?

Equipment running costs – utility utilisation is a key concern for building owners as it's a cost that hits the bottom line of an organisation and one that is easier to focus on to try and reduce. From a utility perspective, it's not just electrical energy, it can, and should include gas and water as both are resources and have cost implications to the business and environment.

An IoT sensor-based system can analyse building utilisation. This includes dimming lights to conserve energy as well as understanding the use of the workplace for capacity and real estate planning.

If we ensure building equipment systems, i.e. the heating, ventilation, and air conditioning (referred to as HVAC) only operates when it needs to, it also reduces the wear and tear of equipment. If we then connect these systems, depending on their 'intelligence' into the wider IoT ecosystem, this is where we can build a digital twin of the building and 'make sense' of the data they produce. It follows that preventative maintenance then becomes easier through remote diagnostics, which introduces further value, through waste elimination, in the supply chain.

Improving Health and Wellbeing – The cost of replacing staff can be double the salary when we consider recruitment fees, temporary staff, overtime and associated administration with our own Human Resources departments. This can be a mis-aligned cost to a business in some instances, but it will always hit the bottom line eventually, notwithstanding the disruption to your customers.

A variety of reports over the last decade from leading institutions (many sources exist on this topic) cover the impact of Oxygen, Carbon Dioxide, Nitrous Oxides, volatile compounds, lighting and heating on cognitive, and health aspects. This topic is pervasive, and affects other areas in addition to industry, such as health and education. Quoting an article by Harvard Business Review, employee feedback came back quite clear. It said *"…better air quality, access to natural light, and the ability to personalize their workspace. Half of the employees we surveyed said poor air quality makes them sleepier during the day, and more than a third reported up to an hour in lost productivity as a result."*

IoT enables real-time analysis and data collation of the indoor environments and ongoing optimisation. This technology falls hand-in-hand with workspace planning and agility in that having the optimal physical layout coupled with the appropriate environmental conditions has a causation effect with the performance of staff, whilst also eliminating the £70bn waste through poor productivity in the UK, as shown in the Mercer Report[1] and in the Stoddart Report[4]. The other part of the equation here is identifying and designing the right HVAC equipment that can be optimised with the correct filters to improve the environment.

The exact figure may be difficult to quantify, yet I'm sure we've all experienced this issue personally, or with others. Productivity is an area also identified by several UK organisations, including ACAS[2] (Advisory, Conciliation and Arbitration Service), looking to improve this limiting factor of competitiveness.

An earlier paper by members of the Institute of Electrical and Electronics Engineers show this integration very clearly on a paper "Leveraging Machine Learning and Big Data for Smart Buildings"[3] hosted by Cornell University, as shown below in Figure 2.

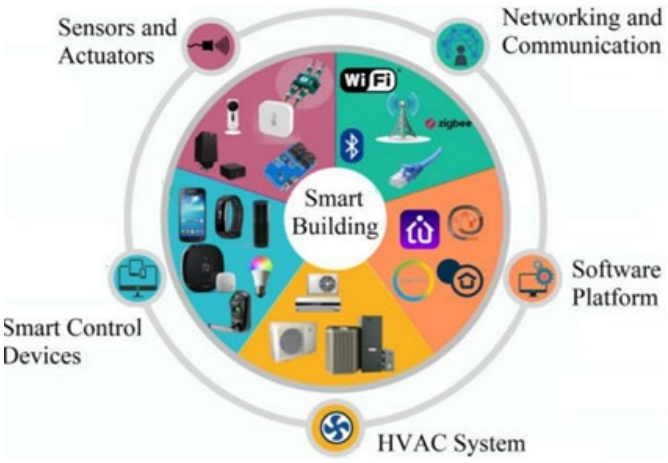

Figure 2 – Jigsaw/similar showing the interconnection of the Ecosystem.

Safety and utilisation, user locations

A variety of methods exist for analysing workplace utilisations, from the ‘person with a clipboard’ in the corner of the room, to newer technologies such as sensors, Bluetooth beacons and so forth. The 'person with a clipboard' approach can seem intrusive whereas the technical solutions are more passive, and more importantly, can operate continuously.

Understanding how people move and utilise the building serves two purposes: first, we can optimise the real-estate, perhaps downsize or sub-let part of the building. However, we can also use this geo-location for emergency situations too, such as when we’re looking to determine the location staff or visitors.

Each technical solution comes with its own merits and cost/benefit assertion; however, the value comes in how we make use of the data. In brief, we have at least three data sources that we can make use of: firstly network equipment that can track and detect WiFi and Bluetooth signals, secondly, we have workplace focussed analytics such as room sensors or similar, and thirdly, we have the Physical Access Control systems.

By analysing this data, we can glean insights into working patterns, building usage, and in the event of an emergency, we can get real-time notification on the locations of our first responders. These are all components of an IoT based ecosystem that improves organisational resilience and advise on cost savings.

The image below shows the insights that can be returned to building and estate managers to make informed decisions on real-estate usage and changes.

Figure 3 – Example heatmap produced by fixed sensors operating continuously, courtesy of Iconics.

Stronger security postures

Historically, there have been examples of ‘quick fixes’ on deploying IoT technology, whether malicious or not, that have then led to data breaches. This isn’t a technology issue per se, it’s a flaw in the design, deployment and ongoing management.

By increasing the deployment of IoT-enabled devices we can obtain more data sources, and therefore improve the security position of an organisation. Again, this improves the level of organisational resilience to mitigate events and highlights the benefit of scenario planning.

In its simplest and most rudimental example we can correlate the use of ‘physical access cards’, or their digital equivalent on a smart phone, at a particular location. We can then correlate this data with any requests to access IT resources, or any IT connected resource for that matter, with the physical movements of individuals. If a user hasn’t swiped into a location, then they should be ‘denied by default’ and alarms triggered if other resources are accessed. From a network video perspective, we can take video streams and integrate these, utilising the ‘CCTV’ cameras as IoT endpoints in their own right.

Solutions and delivering the outcomes

Enabled by Infrastructure – IoT enabled ecosystems require infrastructure to function. Inbuildings solutions will use different connectivity to that of external systems. In brief, copper data cabling that delivers power and data, is a flexible solution to ensure ubiquitous coverage in your building, and negate the need for batteries and wireless protocols. Of course, the design should match the requirements, and there is no single correct solution.

It is the design aspect that is important to ensure end-to-end encryption of the data within the building, considering power and remote access to the edge devices as needed. Ultimately, what we have here is the need for that 'convergent architecture' within the buildings that allows for a layered architecture and provides management and support options in a holistic and structured way.

This approach is fundamental to ensuring continuity as many of the IoT applications and platforms are cloud-based to achieve economics of scales, and ease deployment whilst taking advantage of wider data sets. As a result, the overarching network security and perimeter designs need a cohesive, planned and tested approach.

Getting the outcome artificial intelligence, analytics & insights

With the organisation possibilities and benefits known, and the edge sensors deployed across the building network connectivity which provides the nervous system, Artificial Intelligence and relevant organisational algorithms can then be applied.

This system is built up by providing various layers within the organisation, overseen by working with the value chain in the context of the organisation, as shown in the simplified figure below.

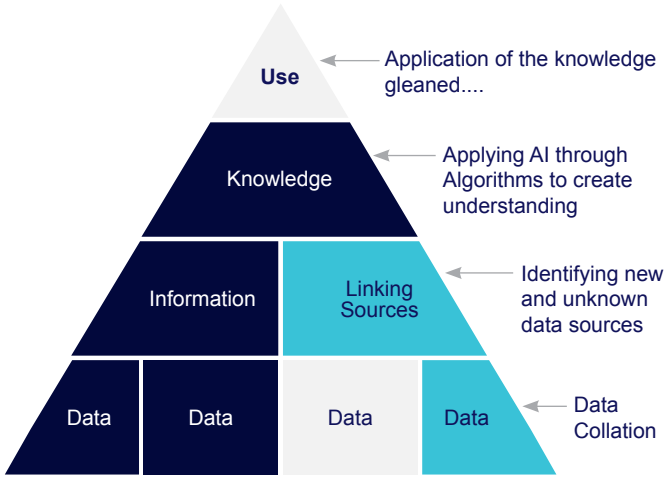

Figure 4 - layer approach to building out intelligence and insights

At Capita we collaborate with our customers to enable them to meet their business objectives through the utilisation of IoT and data. We provide an integrated managed solution across the whole value chain from sensors in the field, security, connectivity, data analytics and services. This is underpinned by our Professional Services, which enables companies to better understand and define their IoT needs through consulting, development of new business models, proof of concepts and the development of actionable information as a result of advanced data analytics.

Paul Thomas

Principal Consultant

+44(0) 7856 000 049

Paul.Thomas@capita.co.uk

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