SERVICE WORKS GLOBAL
ADDNODE GROUP

The Art of the Possible

IoT, Smart Buildings and Digital Twins

White paper

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1. Introduction

Perceptions around smart buildings need to change. Rather than be viewed as a mere concept, and in some cases a futuristic pipedream that is out of reach and budget, we need to approach smart buildings as a series of steps on the journey to making a building perform better and operate more sustainably. In other words, it is about taking tangible actions to make your asset 'smarter'.

Digital twins and IoT (Internet of Things) can play their part in this journey, but building owners and managers do not necessarily need to install numerous technology systems and sensors to be able to achieve results. With smart buildings, the aim should be to create a system that enables assets to use fewer resources, require fewer maintenance visits, and deliver their service in a more efficient way.

We often hear the term continuous improvement used in business strategy circles. The same mindset can be adopted with buildings – steps can be incremental and paced at a speed that works for your organisation. Indeed, when investing in infrastructure for a smart building, it does not need to break the bank.

That is the key takeaway from this paper. As well as further introducing what a smart building might look like (there is no one correct answer), we will outline seven steps organisations can take on their journey to creating smart buildings. Throughout, real life use cases and examples will be explored, showing that smart buildings are indeed far from an unattainable dream, but very much the art of the possible.

2. What is a Smart Building?

There is a plethora of smart building definitions. This is partly because smart buildings mean different things to different organisations, whose objectives, location, resources and expertise can all influence what they define their version of a smart building to be.

In a general sense, smart buildings centralise data from many different inputs and building systems, including the likes of lighting, HVAC and security. Through a combination of responsive automation and delivery of actionable information, more efficient and sustainable use of resources and an enhanced user experience can be attained.

As we have already outlined, smart buildings are about improving the performance of your assets. For example, you could combine room occupancy data with temperature measurement. By joining up this data, building managers will be better placed to make decisions around both cleaning rotas and heating / cooling based on occupancy and temperature information. This can lead to better efficiencies for cleaning teams and help to reduce energy usage from heating and air conditioning systems.

While this single feature may not constitute a smart building itself, it does represent the sort of thinking and action that organisations can take on their smart building journey – replicate these sorts of small improvements across a range of building parameters, and the foundations for a smart building will be laid.

3. Seven Steps to Creating a Smart Building

What might the journey towards creating a smart building comprise? Once again, there are many approaches that can be taken depending on a range of variables and circumstances within an individual entity and the building in question.

Our advice is to start small. Concentrate on one project at a time to give yourself the opportunity to assess the information generated and create positive change – be that in regard to your sustainability aims, efficiency, cost savings and / or service levels. Once this has been achieved, you can move on to the next phase with confidence.

To help visualise what a complete journey could look like, here are seven steps that form a sound process to create a smart building.

i. Selecting the Right CAFM Software

Computer Aided Facilities Management (CAFM) software represents the foundational building blocks of smart buildings.

In basic terms, CAFM software enables facilities managers to plan, execute and monitor all activities that might fall under their remit. This includes reactive and planned (preventative) maintenance, asset management, space optimisation and management, room booking and a host of other customer / building user services.

Regarding the bigger smart building picture, when integrated with other sdata such as building information modelling (BIM), a robust CAFM system will be able to actualise business benefits from an FM and operational perspective. Investing in this foundational technology layer is therefore a logical place to start.

ii. Digitising

The next step involves digitising parts of a building in order for them to become as 'BIM-ready' as possible.

In existing buildings, the process is sometimes referred to as retro-BIM. Here, the first step is to laser scan the building to create a digital replica which stores key data and information about various aspects.

It is important not to be put off from doing this because of your building's age. Rapid advancements in laser-scanning technology have ensured that harnessing data in older buildings is readily achievable, cost-effective and can transform how successfully a facility can perform in the future, from both a cost and energy-efficiency perspective. The more features that are scanned, and the more accurate the scanning process, the more complete a picture will be created. This is crucial to developing an effective BIM model.

iii. BIM Handover

The digitisation step may not be necessary if it concerns a new building whose constructors had already used BIM in the design and build phase.

In these instances, the BIM model should be handed over at the point in which the building transitions from construction to operation. It is crucial to ensure that the model is as accurate as possible – it should represent a built digital register of the building, its components and assets.

Indeed, careful execution of the handover process itself carries some key benefits, as demonstrated by SWG's work with Stepnell at the University of Worcester.

Case Study: University of Worcester

Objective: To transform the former Worcester News building – a large two and three storey building constructed in 1965 - into a first-class centre for the education of health professionals.

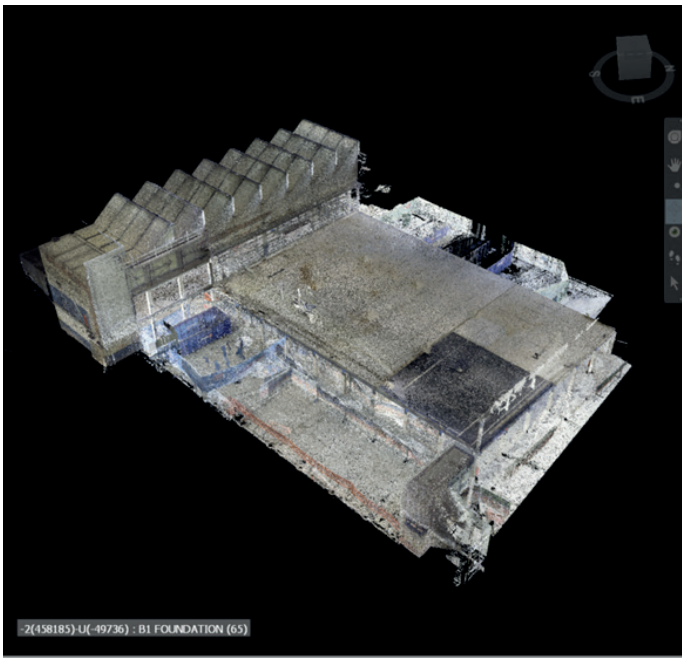
Outcome: The University of Worcester intends to use its new BIM standards to define all projects going forward and now has a fully operational CAFM system.

Stepnell was awarded the contract to part refurbish and part rebuild / extend the building. A key specification from the university was the development of a robust CAFM system that would be fed data from maintainable assets within the building. The university also had a clear vision to use BIM on the project, including the Revit 3D collaborative model application, ensuring that all data relevant to facilities management post-handover could pass from the Revit model through to the CAFM system (Archibus).

SWG and sister company Symetri managed the project which unfolded over several key stages:

1. Establishing a BIM level 2 framework
2. Simplifying the data focus
3. Connecting physical and digital worlds:
   a) Gaining visibility of the frame
   b) Seeing the site progress 360° image capture

Ensuring the flow of data between Archibus and the project models was critical. This means that changes can be made in the model authoring software and easily exported, issued to the university and imported into the CAFM system.



Charlotte Brogan, Technical Manager at Stepnell:

"This has been a completely BIM-driven project and, as all asset data now moves seamlessly into our CAFM system, it will carry on being so for long into the future. It was a steep learning process for all parties as we set out to integrate numerous technologies, while also working up against the many complexities of combining a refurbishment with a new build."

The smart building journey, up to this point, has been about making buildings BIM-ready. The next step will explore BIM in more depth and detail how real business benefits can start to be realised.

iv. Integrating BIM and CAFM

The integration of BIM and CAFM is where the art of the possible starts to be realised. By this stage, organisations will have robust CAFM software operating alongside a digitised or scanned building which provides rich data points and invaluable asset information.

This combination enables intelligent information management. Indeed, BIM should be viewed as a process that supports optimised management of data throughout a building's lifecycle rather than a technology in and of itself.

The purpose of BIM is to provide the informational underpinning that enables building managers to deliver on operational objectives in key areas such as user experience, building safety, cost efficiency and sustainability.

If executed properly, an array of applications and benefits can be realised, some of which are outlined in the use cases below, which refer to CAFM integration with SWG's QFM BIMi software.

An asset is damaged and needs repairing or replacing

Building managers know all too well that things can go wrong. In the event that assets are damaged or malfunctioning, BIM is key to ensuring disruption is kept to a minimum.

Firstly, it provides an accurate visual of exactly where in the building the damaged asset is, with users able to click on the asset in the 3D BIM model and access relevant information such as detailed measurements, manufacturer, model and component parts.

Additionally, operatives can view important documentation like manufacturer's instructions to assess how to fix the asset, as well as evaluate warranty information to see if it is their responsibility to carry out the repair or replacement – knowledge which could yield FM teams vital cost savings.

Checking asset location / position and undertaking renovation work

If your team does need to carry out remedial work, by knowing where the asset is, what it is made from and how it can be fixed, several efficiencies can be realised.

For example, there will be no need for a site visit to determine the exact size and location of the asset.

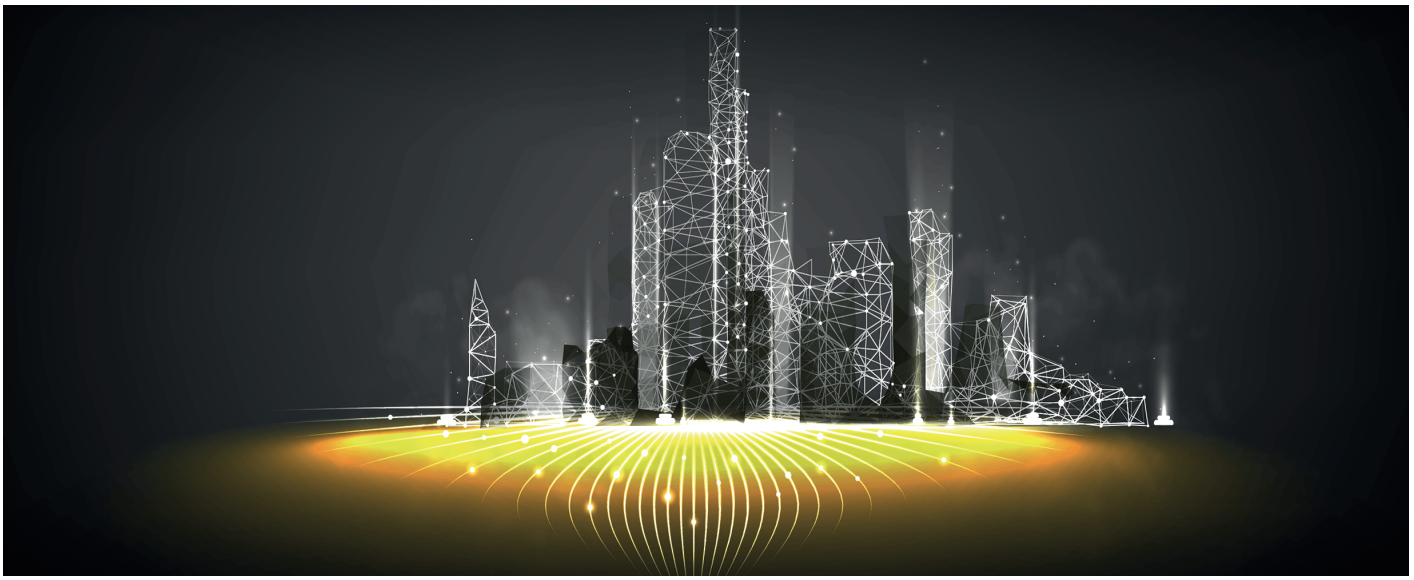
Meanwhile, operatives will be able to better prepare for when they do need to visit to perform repair or replacement work. With access to documentation, they can order the correct amount of 'like for like' parts, while prior visibility of the affected area enables them to consider additional equipment that might be needed (such as a ladder if the asset is up high).

This will also ensure disruption is minimised while work is being undertaken. If surrounding areas are busy, operatives can plan to carry out maintenance at quiet times to avoid disruption to the organisation. This might be applicable to a busy transport facility, school classroom or corridor, where traffic is high during specific hours.

Accessing asset information and documentation

A CAFM solution which leverages BIM data will act as a nerve centre for FM teams which is easy to navigate and provides a complete repository of building data.

Key information obtained at the BIM / building handover stage, including warranties, dimensions and materials, as well as health and safety and compliance related documents. can then be utilised by FM teams in advance of and during the performance of maintenance tasks.



It is also important to note that the integration of BIM and CAFM is most effective when it is a two-way process – as updates and developments occur on one side, the other is automatically updated in tandem, meaning the data that is extracted on the building, and thus the FM services provided, are up to date.

This can prove extremely useful if there is a requirement for those responsible for managing a facility are obliged to return an up-to-date BIM model upon end of the contracted term.

Accessing non-visible assets and systems

Some parts of buildings that require maintenance or remedial work, including HVAC, plumbing and heating / air conditioning systems, may not be visible to operatives in the field.

Here, the ability of BIM to provide 3D viewing of non-visible assets is extremely valuable. Such tools can be used by contractors or in-house personnel to view information such as ceiling plans, HVAC systems, and plumbing and electrical models, enabling them to plan their jobs in advance.

This will help to prevent unwanted surprises when they arrive on site, ensure contractors can accurately quote for work, and reduces the number of occasions operatives need to physically visit the site, all helping to save time and cost and minimise disruption to building users.

Maintaining a 'golden thread' of information

A good BIM operation will provide a 'golden thread' of digital information about a building – an ever-updating encyclopaedia that informs many of the most important decisions FM managers must make on a daily basis.

Indeed, when integrated with CAFM software, updated information can be fed back to make sure all data pertaining to a building and its assets is always accurate and up to date. This allows organisations to be confident in remaining compliant with various legal standards (for example, around fire safety assets such as fire doors and extinguishers) and client expectations at all times.

Training new staff

When new recruits join the FM team, it is vital that they know where key assets are located, the affected areas around them should work need to be undertaken, and where common walkways and important access areas are within their building.

BIM provides the ability to do this via a 3D model instead of physically needing to be being on site. No specialist CAD training is needed to leverage 3D BIM models within CAFM tools, and useful 2D drawings or 3D videos can be extracted and placed into training materials and videos.

v. Real-time Data

The next step or evolution in the smart building journey is to fuel your processes and the aforementioned use cases with data that is as close to real-time as possible.

This is possible through the installation of IoT-enabled data sensor technology across key assets are areas within the building.

Selecting the right IoT platform to integrate with is another important decision. It will enable you to seamlessly and instantly extract real-time data obtained by the sensors about key elements of building performance which could include anything from room occupancy, air quality and temperature to waste

management, energy usage and natural light coverage. Once again, developing these capabilities need not break the bank or appear out of reach. Start small in areas that are most important to your building and expand from there.

For example, air quality has become an extremely topical issue for public sector buildings such as schools and hospitals.

The Covid-19 pandemic highlighted the importance of not only improving indoor air quality and ventilation in these spaces, but more fundamentally the ability to monitor conditions at all times to see if remedial solutions are effective.

IoT sensors have a crucial role to play here by feeding back real-time information to building managers about the quality of air that students, teachers, hospital workers and / or patients are breathing in.

Commercial office buildings, meanwhile, also need to provide comfortable and safe working environments for employees. Here, IoT sensors could initially be focused on key comfort metrics such as room occupancy, temperature and humidity – this would enable FM teams to alter air conditioning and heating systems in certain rooms as and when needed.

This real-time data can also be integrated with CAFM and BIM operations to generate a holistic view of building performance that can underpin strategic FM actions.

For example, an office may have a meeting room that nobody uses because the heating is temperamental. BIM data can pinpoint the location of the room, the FM system will detail its maintenance history, and the IoT system can give real-time performance data – combined, the holistic view enables remedial action to be taken quickly and effectively.

Another use case centres around optimising maintenance schedules, as demonstrated by SWG's work at several stations within Sweden's rail network.

Case Study: Swedish rail stations

Elevators and escalators are vital components of rail stations that enable passengers to access and navigate rail stations. When these systems incur faults, the costs and impact on the customer experience can be significant.

In Sweden, SWG has been working with the country's rail station operator to support maintenance services through a connected digital twin model of elevators and escalators at numerous sites. This has involved installing a mixture of BIM, IoT and FM software systems, creating an ecosystem that works in harmony to optimise maintenance activities.

Sensors installed in the assets provide real-time data that feeds into embedded visualisation tools. This makes it easy for operatives to see the availability of elevators/ escalators, their live status, alerts, and when the next maintenance work is due.

Thanks to the initial laser scanning process, operatives can also see where station entrances, exits and access to elevators are on an interactive floorplan or within a 3D BIM model / point cloud, helping them to plan site visits and determine which tools they can easily get into the building. Dimensions, parts and other critical information on assets are also available in one click.

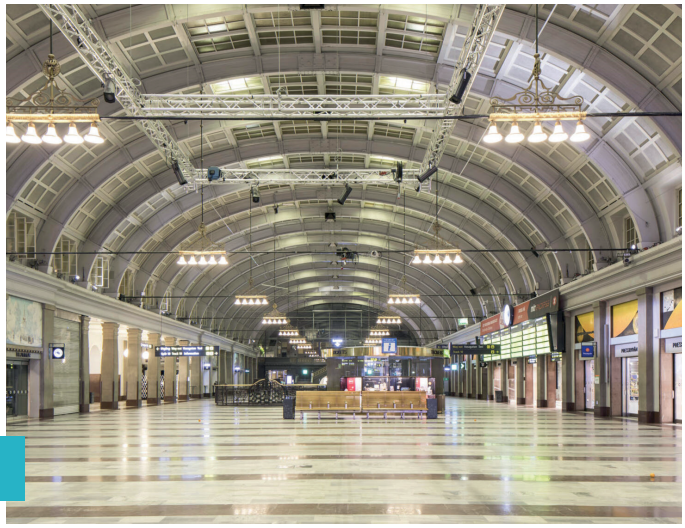
Key outcomes and benefits derived from the implementation include (based on 150 elevators):

1. Efficiency: A 20% reduction in the need for on-site maintenance visits

2. Sustainability: 120 fewer car/road trips being made to sites per year

3. Finance: Savings of £20,000 per year

4. Availability: Downtime of elevators and escalators reduced by 240 hours



Picture: Jernhusen

vi. An Ecosystem of Technologies

By this point, the end goal of a smart building has been reached. You will be operating within an ecosystem of technology and processes that work in harmony to deliver data-driven building management.

That ecosystem will enable buildings to perform close to or at their optimum level across a range of key metrics, including user experience, sustainability, and efficiency in terms of finances and other resources.

Indeed, we can revisit the definition of a smart building outlined at the beginning of this paper:

"Smart buildings centralise data from many different inputs and building systems, including the likes of lighting, HVAC and security. Through a combination of responsive automation and delivery of actionable information, more efficient and sustainable use of resources and an enhanced user environment can be realised."

By breaking the journey down into a series of attainable and logical steps, reaching this endpoint should feel like a realistic ambition that organisations of varying shapes, sizes and budgets can pursue.

vii. Digital Twins

It is at this stage when a smart building can be paired with a digital twin to view and test building performance. Put simply, a digital twin is a virtual replica of a physical building and all the assets, systems, technologies, sensors and users within it. The digital model is derived from the various real world data streams established in the creation of the smart building and can be utilised to test a variety of new situations and scenarios to explore how it can become even more efficient.

How would a building's cooling system cope with a 10 per cent increase in occupants? What impact would changing a planned maintenance schedule have on downtime and disruption? These are the types of 'what if' scenarios which can be tested and used to inform FM strategies.

The quality and volume of data being inputted into the digital twin is vital. Abundant and accurate information will feed a digital twin that is capable of generating likely performance outcomes that can help organisations and their FM managers to determine what actions will optimise performance further.

4. Conclusion

Smart buildings are accessible and drive desirable outcomes for organisations seeking to optimise the performance of their built assets.

By starting small, based on their priorities and budgets, organisations can build a foundation and expand development to other areas. This ensures that smart building projects need not break the bank or be considered an unrealistic pipedream reserved for the wealthiest and largest firms.

SWG has undertaken every step of this journey with customers operating across a huge range of sectors and in a variety of building types. We partner with organisations in the truest sense, fostering a deep understanding of what is possible and working side by side with clients to realise the potential of their buildings.

Contact us today to see how we can help make your building smart.

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About Service Works Global

Service Works Global (SWG) is a leading international provider of facilities, property and workplace management software with offices in the UK, Sweden, Canada, Australia, and the Middle East. SWG is a wholly owned subsidiary of Addnode Group, listed on Nasdaq Stockholm.

Established in 1994, SWG is certified with ISO 9001 for quality management and ISO 27001 for information security management, and has a wealth of expertise in computer-aided facilities management (CAFM), public-private partnership (PPP), and building information modelling (BIM) software.

We invest substantial resources into product research and development to ensure functionally rich solutions that meet the needs of an evolving profession. Some of the clients that we support include Honeywell, Mitie, BNP Paribas Real Estate, Melbourne Cricket Ground, Cardiff University and NHS Trusts across the UK.