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Asset and Compliance Digitalization

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Title
Using Building Information Modelling (BIM) to develop a digital twin of an existing building to improve strategic management of assets and compliance. To act as a platform for future innovations in building management.

Abstract

Building Information Modelling (BIM) is an intelligent 3D model-based process that gives asset managers the insight and tools to manage buildings and associated infrastructure more efficiently. BIM is the industry standard model to deliver insight on how a building will perform once built and to manage its performance and asset lifecycles.

While BIM processes are established for new buildings, older buildings are not maintained, refurbished, or deconstructed using this method. BIM enables the benefits of efficiency, resource management and compliance. It can overcome uncertainties of building condition and deficient documentation that are prevalent in older buildings. It also acts as a centralised platform, accessible by all stakeholders to hold 'one version of the truth'.
Due to complex built forms and increasing legislative pressure from the government for multiple occupancy buildings, a state-of-the-art overview with an easy to use visualisation of compliance and accountability is required for our existing building stock.

This document aims to show how we will implement these objectives and strategies into a PoC digital twin model in a step by step process. We will show accountable outcomes that can be validated at each stage. time & cost saving as well as developing Halton Housing's goals of creating places to be proud of, addressing customer safety, and asset strategy.
We will assist in creating a healthy organisation by improving IT platforms, making it easier for colleagues to do their jobs and promote brand and reputation, cementing our position and maintaining a strong voice in the sector.

We will demonstrate how an existing building can be modelled into a digital twin via a 3D BIM implementation. Starting small and utilising data that we already have available, we can develop an exciting innovative cross platform implementation and demonstrate the 'art of what is possible' and how to scale fast in the future by adding important assets and integrating IOT sensors to gain further insights. Most importantly, we highlight the advantages to the business at every stage and can adapt how we manage our business assets in an exciting and innovative way.

Introduction
BIM modelling was introduced in the early 2000s to support building design for architects and engineers. They focused on the improvement of preplanning and design, clash detection, visualization, quantification, costing, and data management. In addition, recently there has been the appendage of basic functionalities, such as energy analysis, structural analysis, scheduling, progress tracking and jobsite safety. The use of BIM is now starting to focus life cycle stages to maintenance, refurbishment, deconstruction, and end-of-life considerations. BIM is now an integral part of a business's building asset management strategy.

When BIM is used for facilities management in new buildings, clear benefits are reported e.g. regarding improved information flows and project management, risk mitigation and positive return on investments. In many existing buildings, incomplete, obsolete, or fragmented building information is predominating.

Missing or obsolete building information might result in ineffective project management, uncertain process results and time loss or cost increases in maintenance, retrofit and remediation processes. As existing buildings often lack as-built documentation due to omitted updating. BIM implementation in existing buildings has benefits of improved documentation management, clearer information on maintenance of warranty and service information, assessment and monitoring, energy and space management, emergency management and retrofit planning.

Various digital tools for building capture and auditing are available, such as 2D/3D geometrical drawings, tachometry, laser scanning or automatic locating of images. If building documentation is inadequate for maintenance or deconstruction processes, capturing and surveying techniques with different qualities are applied to audit and gather the existing buildings' characteristics. The functionality-related level of detail and the corresponding data capturing technique influence all following steps of BIM creation and its associated effort.

Although on the one hand, implementation of BIM both in new and existing buildings induces profound changes of processes and information flows, on the other hand it accrues considerable advantages. It can enhance project management and risk mitigation or to limit costs and duration of facilities management. It might also affect sustainability ratings and certifications. It could be possible to monitor energy consumption, wastewater, and maintenance costs. It would be achievable to illustrate environmental effects of the building and to verify and monitor consumption and emission values. It would also validate data management, maintenance schedules and equipment warranties with respect to deterioration and cause-effect relationships.

When a building reaches its end of life there is the ability to consider its recyclability on a component level. With the addition of the latest technologies including IOT, sensors,

automated compliance and future trends of automated capture, onsite progress tracking, measurements and monitoring can be shown through cloud computing solutions depicting building information and live transformations.
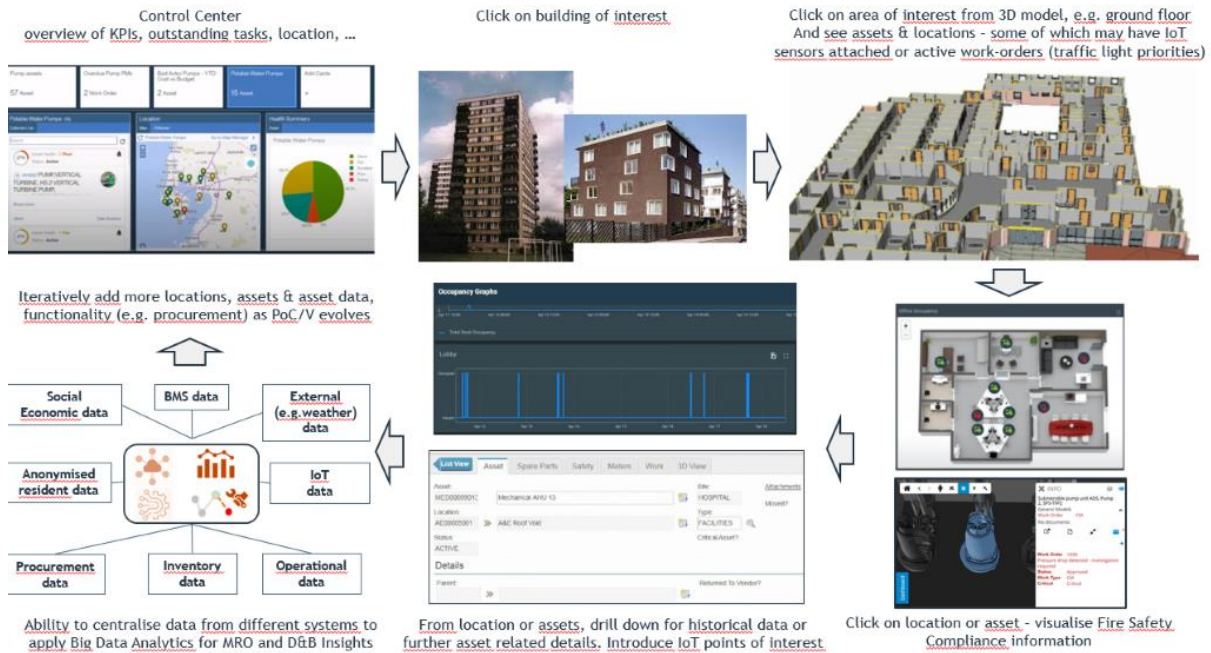
This can make serious improvements to the way buildings are managed. We aim to show the business advantages and prove cost, time and efficiency savings whilst depicting the environmental factors and how we can improve them.

Drivers

A key driver for change is the introduction of new fire safety legislation for properties with more than one dwelling which has resulted from the Hackett Report into the Grenfell Tower fire. The proposed Bill is currently at the stage 3 Committee stage in the House of Commons and will likely result in the introduction of new regulations which will extend the Fire Safety (Regulatory Reform) Order 2005; this will be supported by new and comprehensive Buildings Safety legislation. A draft version of the Bill will likely appear this summer and the contents is expected to further clarify the responsibility of building owners. Extending fire risk assessments to include the whole of the building, and additional responsibilities for the design and construction of new build properties. Other elements of fire safety will likely include compartmentation and fire mitigation measures. The solution would demonstrate a fire safety model, including records of who fitted what where and when, the materials used, time/date for replacement and other auditing checks. The advantages would include insight into when maintenance, service and checks need performing. We would have easily accessible records of building fabric and internal wall structures etc.

Below shows an example of how this model will work.

- Centred around a web-based portal the buildings have a 3d model with the ability to be focus in on areas of interest.
- Showing live information about each individual component
- Alerts or upcoming scheduling information
- Location for compliance documentation and certification
- The data is sourced from external datasets, it feeds back to the dashboard creating a full live building model.
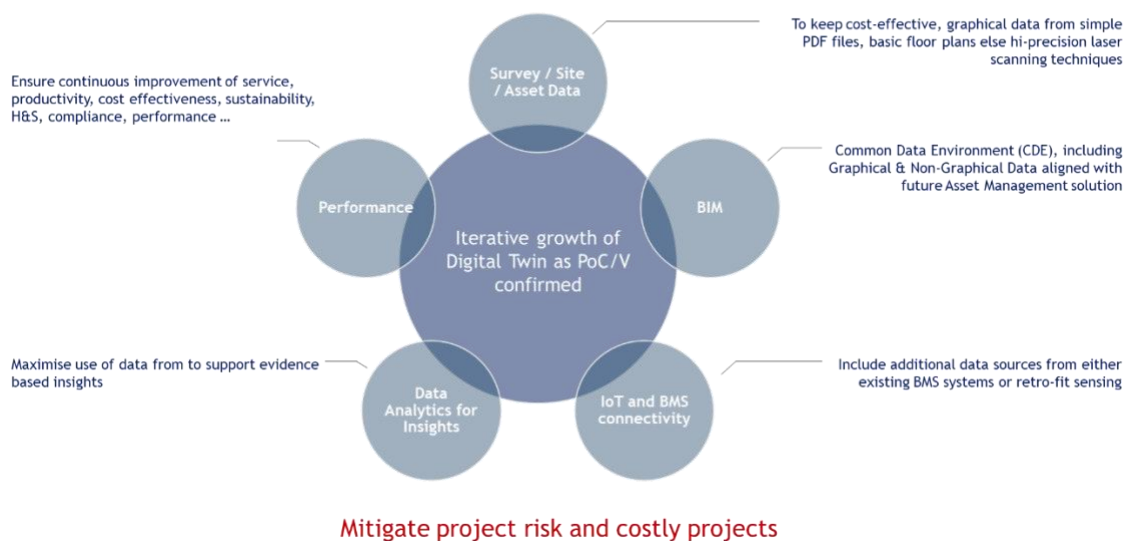
Control Center
overview of KPIs, outstanding tasks, location, ...

Click on building of interest

Click on area of interest from 3D model, e.g. ground floor
And see assets & locations - some of which may have IoT
sensors attached or active work-orders (traffic light priorities)

Iteratively add more locations, assets & asset data,
functionality (e.g. procurement) as PoC/V evolves

Ability to centralise data from different systems to
apply Big Data Analytics for MRO and D&B Insights

From location or assets, drill down for historical data or
further asset related details. Introduce IoT points of interest

Click on location or asset - visualise Fire Safety
Compliance information

How we will do it

Innovation is the successful exploitation of new ideas and by partnering with SiteDesk and ecosystem partners to introducing a small-scale model, we demonstrated the value of BIM to the business. Future aspirations include an integrated Digital Twin, for lifecycle asset management for all our multiple occupancy and single occupancy buildings, of which we have over 7000.

Illustrated below is the key drivers following industry best practice and the positive business outcomes when creating a digital twin.


Growth our Digital Twin(s) as benefits realised over time

To keep cost-effective, graphical data from simple PDF files, basic floor plans else hi-precision laser scanning techniques

Common Data Environment (CDE), including Graphical & Non-Graphical Data aligned with future Asset Management solution

Include additional data sources from either existing BMS systems or retro-fit sensing

Maximise use of data from to support evidence based insights

Ensure continuous improvement of service, productivity, cost effectiveness, sustainability, H&S, compliance, performance ...

Survey / Site / Asset Data

BIM

IoT and BMS connectivity

Data Analytics for Insights

Performance

Iterative growth of Digital Twin as PoC/V confirmed

Mitigate project risk and costly projects

The aim was to improve workflows and demonstrate an improved fire compliance and fire safety system. It evidences compliance requirements set out in current legislation with quick access to certification and direct links to our management information system. It will reduce management overhead costs and most importantly to make customers safer in their homes. The prototype demonstrates the foundations of a BIM system that facilitates intelligent data lead decisions and focus resource into areas that need them the most – We are the first to do this in the SME landlord sector.

Proposed high level model
- A web-based solution that everyone in the business can have access to and provide them with the information from any platform.
- A control centre for offline & online assets and related work-orders.
- Manage, measure, optimise workorders & staff, manage compliance, H&S ensuring right qualified resource to complete the job.
- Manage, measure, optimise 3rd party contracts and pull data from existing models and visualisations and interact from within an Asset Management window.
- Details of KPIs and Service Level Management for Ops teams, suppliers, and critical assets the system will directly link to E-procurement for spares and consumables.
- Inventory Management to ensure inventory & reduce procurement overheads
- Procurement model would ensure right product, right price, right lead-time based on right criteria– to ensure uptime, compliance, H&S, SLAs, target KPIs.
- Directly linked into data analytics displaying energy consumption and carbon footprint with evidencing positive improvements.
- Planned & IoT enabled Predictive maintenance to ensure parts delivered on-time, in stores and reserved for jobs.
- Improve uptime: and optimising Procure-to-Pay for materials, spares and consumables. Improve Supplier Performance, Management and Consolidation.
- Real-time auditable trail shared between customer and 3rd parties to ensure SLAs, Compliance, Pricing, Contractual Agreements … respected and improved.
- Smart Contracts - reduce procurement overheads and optimise P2P process via a traceable end-to-end process.
- Service Level Management for Operations, Suppliers & Assets: SLAs vs Costs of service.
- Compliance – auditable trace of genuine products & certified operators (insurance & auditors).
- Transparency between customer & suppliers to increase loyalty – one version of truth.
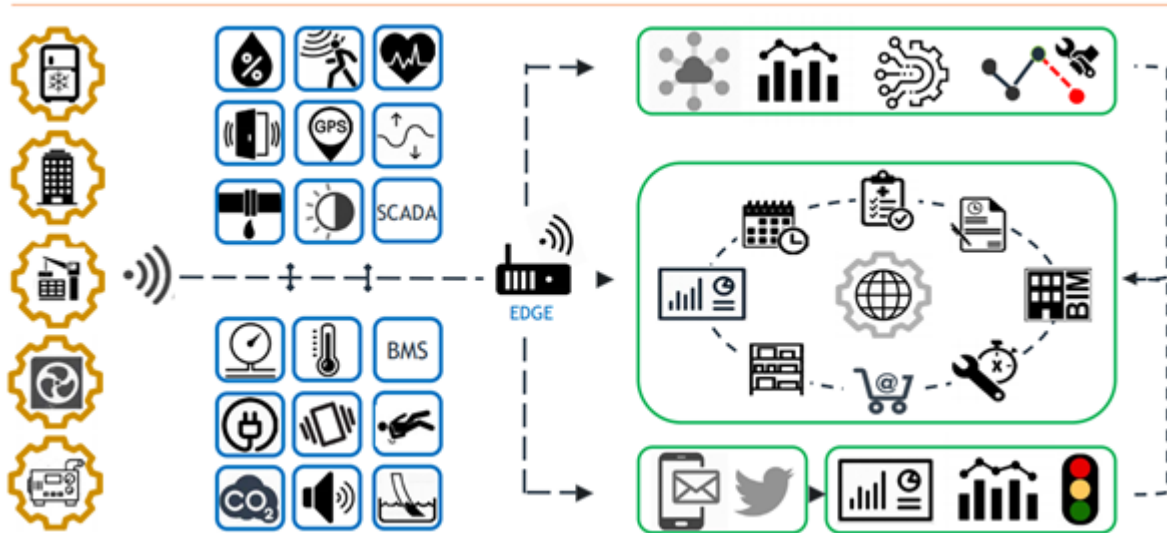
The pieces of the puzzle illustrated below will create an outstanding capable system utilising the methodology listed previously
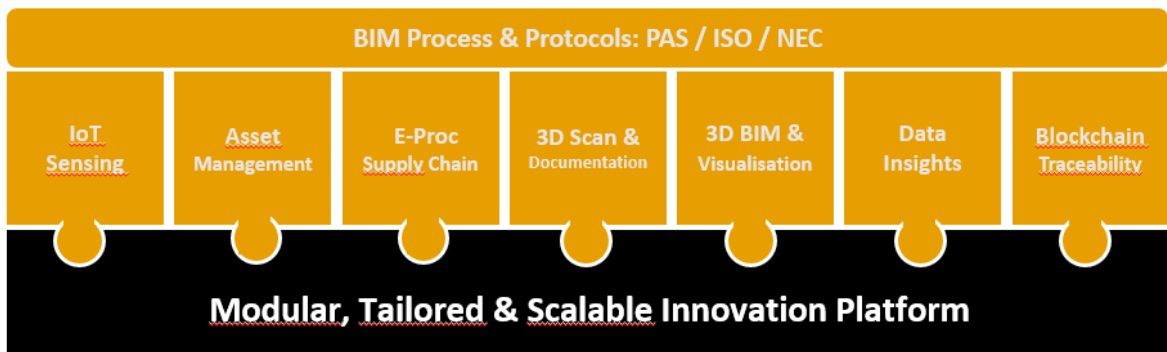
By bringing each piece of the puzzle systematically and proving business benefits we start on the road to a creating our vision. We aim to start small, with the ability to scale fast, whilst thinking big.

	Start Small	Scale Fast	Think Big
	Demo 'art of possible'	Extentd PoC/V within high-rise flats	Expand on functionality & building
SiteDesk	3D model, BIM ready, basic common database enviro., 3D navigation of model	Integrate IoT points of interest & real-time data for analytics and insights	Multi-site; bi-directional integration to EAM (asset mgt); procurement integration ...
1st H.		Scan-to-BIM, low-res.point cloud rendering locations & assets of interest	Increased area of scan + may include utilites (underground) or voids surveying
IAC		Introduce IoT sensing & display on 3D model + basic 'Asset Control Center'	BMS / IIoT integration. Migration of 'Asset Control Center' to EAM
SRO			EAM: Work-Order Mgt + Contracts Mgt, H&S, Compliance,Eproc,Inventory, Big Data

To get to the target of an Integrated Digital Twin for end-to-end whole lifecycle Asset Management an agile methodology needed to be followed it was underpinned by : Think Big,

Start Small, Scale Fast and demonstrated risk aversion to prove benefits. Its supported by the 'Try then Buy' ethos and the idea of Minimal Viable Product (MVP)

A key premise behind the idea of MVP is that you produce something of value of which to demonstrate as a solution to the business problem. This may be no more than a landing page, or a service with an appearance of automation, but which is fully manual behind the scenes. Seeing what people do with respect to a product is much more reliable than asking people what they would do. The primary benefit of an MVP is you we can gain understanding about the business' requirements for the product without fully developing the product. Proving the model will improve the staff and customers' workings, the less effort and expense spent on a solution that will not succeed. Which is what has been done.

Following the MVP style by completing phase 1 then building from, whilst the whole time keeping the overall goal in mind. Like the depiction below we built a test scooter to prove we need wheels and proving the benefits knowing that we are aiming to make self-driving car.
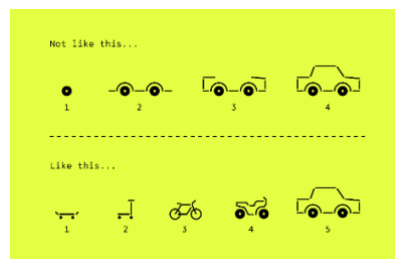
The process of moving to a digital twin solution started by incorporating available 2D and 3D data for Churchill Mansions into BIM models which Sitedesk made available as a digital twin – Sitedesk is the BIM visualisation component of the Ecosystem offering and it provides a simple and easy to use environment through which users can interact with 2D and 3D digital twins and also access the underlying power within the various elements of the Ecosystem. Initially Sitedesk's own common data environment (CDE) was used to underpin the collaborative process.

The building used for the project.
Churchill Mansions, Runcorn, Cheshire, WA7 1DH

- [Google maps](#)
-
- [Steet View](#)
-
- [3D floor plans (hosted)](#)

The building has 11 floors with 44 apartments and the documentation for this building is limited. Using he plans shown below SiteDesk have created the building as a 3D model to use for the visualisation and contains the addition of the extra asset details not in the original drawings.
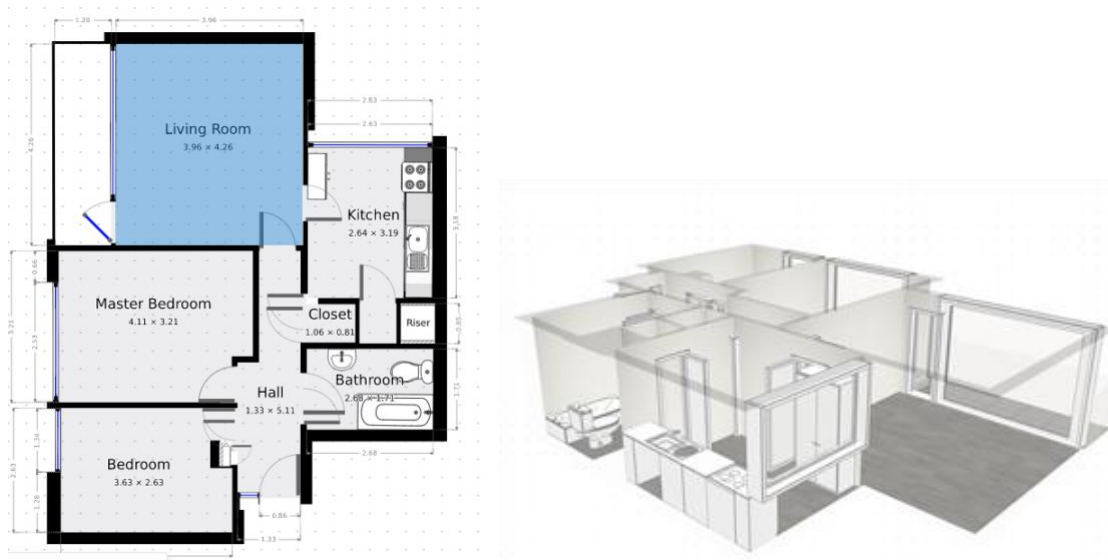
Ground floor and access level

Example floor plan

Basic 3d floor diagram

Example single apartment

Phase 1 – Start Small.

By interacting with the digital twin of Churchill Mansions Halton Housing were able to identify key components and areas which came under the umbrella of the revised regulatory requirements. Once identified SiteDesk enabled Halton Housing to monitor the workflow and store all associated documentation to provide a complete record of what had been undertaken to comply with the legislative requirements.

The benefits Halton Housing experienced as a result of using SiteDesk

- Higher quality data controlled within a central system rather than being kept in an unstructured way within multiple systems
- Improved productivity through simple, intuitive interaction with the digital twin to locate and report on assets/locations of interest
- Improved monitoring and adherence to H&S and Compliance obligations by having centralised data with auditable operations and intervention tracing.
- Ability to access the digital twin and all its associated documentation using mobiles, tablets and laptops
- Being able to make the most of the variable quality of data available for sites being controlled – some sites have 2D documentation only for example

In the future, as Halton Housing's requirements grow to necessitate deploying other sophisticated components within the Ecosystem, the data within SiteDesk can be used to seed these other components to provide a straight-forward migration path to the further advanced functionality that is available throughout.

Working with SiteDesk on Phase 1 demonstrated the art of what is possible by create the first piece of the puzzle (highlight below) now the prototype has been developed, it is in its testing phase, working on functionality with the business partners and stake holders.
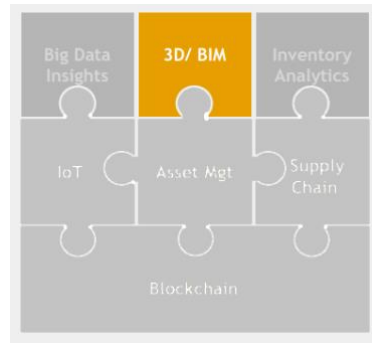
Goals (achieved)
- Demonstrate the art of possible
- Build the 3D model
- Create a basic database environment
- Construct a navigation system
- Record business critical assets
- Create framework for collaboration and management of risk
- Record Assurance and compliance
- Support cultural & change through training and mentoring

Advantages found
- Ease of information access
- Auditing strategies
- Business acceptance
- traceability
- compliance

Phase 2 - Scale Fast

Phase 2 is the next step and the foundations have been put in place to start this expansion with the goals to improve collaboration and integration of known assets during the life cycle phase of the building. Using the 3D models previously created allowing interactions with assets and locations in an intuitive manner to be able to have quick and easy retrieval of asset condition, service records and location information automatically by connecting the model to data sources. As depicted bellow it adds more pieces to the puzzle expanding functionality, performance and automation.
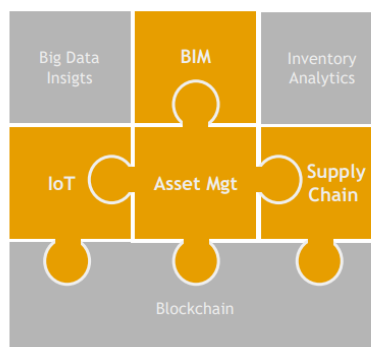
Goals
- extended PoC within the high-rise flats
- Integrate IoT points of interest
- Generate and demonstrate real time data
- Scan to create point cloud renderings of locations and assets of interest

- Introduce IoT sensing and display on 3D model
- Add a basic asset control Centre
- Record supply of recorder building materials and associated traceability

Advantages
- Ease of information access
- Auditing strategies
- Business acceptance
- traceability
- Automated compliance
- Real-time data from overlaying IoT devices for increased productivity
- Automatic ordering of faulty parts
- Boiler house monitoring

Phase 3 - Think Big

With a constant stream of live data from people, sensors and devices the model can encompass all effecting factors. Looking at the final pieces of the puzzle and bringing them online will change the way the buildings are not only managed but lived in as well. Asset management can be challenging. With phase 3 it would be possible to offer comprehensive solutions for managing physical assets on a common enterprise platform for many built forms. Now we are talking about the building as single living asset.
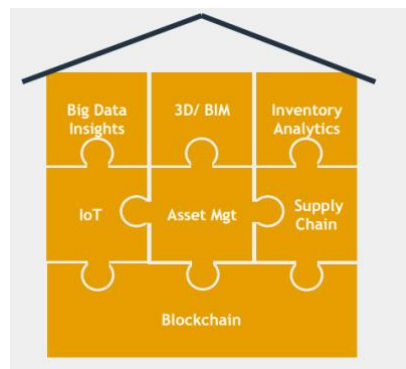
Advantages
- Operations Productivity & KPIs
- Improve Asset Uptime
- Optimise Asset Usage & Performance
- Improve Energy Sustainability
- Gain insights from connected assets
- Reduce P2P overheads & cost of spares
- Reduce inventory and consolidate suppliers
- Improve Service Level Management and introduce Smart Contracts
- Compliance and Health & Safety: apply, trace and report
- Improve employee working environment
- procurement integration

Future development

With phase one completed and the business desire to continue to the next phase the changes to building lifecycle management is profound. By expanding to a constant stream of live data from people, sensors and devices the model can offer comprehensive solutions for managing assets using Building Information Modelling to develop the digital twin of Churchill Mansions and improve strategic management of assets and compliance. This is the start of a platform for future innovations in building management in the social housing sector.