INDUSTRY INSIGHT

buildingSMART International

What do Facility Managers need from BIM?

Case 2: Workplaces in Public Government Real Estate

A perspective from the Building Room

CONTENTS

1. Summary

Efficient workplace management requires correct and easily available information about the asset. This requires systematic and preplanned collection of structured data.

Building Information Modelling (BIM), either from the design-construction of a new asset or a scan-model of an existing asset, allows for efficient access to machine-interpretable, detailed information. The methods are complimentary to each other, not competitive nor cancelling.

The openBIM workplace management information requirement will be structured according to well established EN 15221-4 (taxonomy) and ISO 41001 (FM information and data requirements). BIM will be based upon the basic principles of BIM standardization in ISO 19650 (such as basic principles, Common Data Environment (CDE), project execution, and asset management), ISO 16739 (IFC, model object classification and exchange format), ISO 12006-3 (data terminology) and ISO 29481 (use-case oriented information specification).

This work will specify standardized openBIM deliverables utilizing information management across projects/assets, migrate data where it is best processed, uniform information requirements and, long-term storage. OpenBIM means that information is exchange across multiple platforms on an Internationally uniform exchange format Industry Foundation Classes (IFC, ISO 16739).

Standardized information deliverables and management creates predictability for the entire industry and for the development of new tools for a digital, efficient construction industry.

2. Goal of the Paper

Building Information Models (BIM) have been used in design and digital construction for many years; however, they are still a new concept in facility management and owner operation applications. Practices and terminology of building information management (BIM) are being redefined to create long-term roadmap for BIM centric workflows and BIM based applications. The data flow harmonization between systems is an opportunity that is supported with new on-the-market technology, requiring very little remapping of data to make it consumable for FM teams. That being the case, “What do FMs need from BIM?” introduces new opportunities for workplaces in public government real estate and the future of public buildings.

Use of building information models in facility management is generating discussion internationally. Industry Foundation Classes (IFC) as an openBIM standard is established as the global standard for open information transfer in digital construction projects. Building information modelling (BIM) is gradually merging into digital facility management processes. BIM offers the benefit of reliable structured data which in long-term plans open opportunities for AI for built environment applications.

Sustainable and accessible smart environments FM consists of a very broad task portfolio. It is a welcome challenge for digital transformation of FM framework to accommodate everything within the building portfolio in a single digital entity (BIM) across multiple digital platforms. This is a big opportunity because digitization of as-is documentation requires digitalization of work processes to be standardized.

The goal of this paper is to create clarity on why real estate owner organizations should adopt BIM as a tactical tool in their digital core for facility management operations. BIM is traditionally used for creating the physical buildings, but there is a lot of potential to continue updating the models with the latest & greatest FM attribute data for proactive maintenance purposes.

3. Definition of scope

3.1 What do we mean by "Workplace" as a service?

To discuss the information requirements of FM-providers in relation to the facility product "Workplace" it is necessary to define what we mean by "Workplace" as a facility product.

The European Standard EN 15221-4 provides a taxonomy with a relationship model which integrates the FM-model, the process matrix, the product/service structure, and a classification system. This standard uses the term "product" in accordance with ISO 9000 which defines a product as the result of a process. In the context of FM, a product is a result of a process and the respective activities/facilities (Source EN 15221-4).

This paper will use the definition from EN 15221-4 to clarify the scope of the inquiry.

In the EN 15221-4 standard the workplace product (product no. 1400) is described as follows:

"Ensure usable workplace and space for any place where work is, or is to be, performed by a worker, or a person conducting a business or undertaking."

This definition includes places commonly recognized as workplaces, such as offices, shops, factories, construction sites or hospitals. It also includes many other types of less obvious workplaces, such as a vehicle supplied by an employer for use by a worker in the performance of work.

The product "Workplace" encompasses sub-products such as, for example, occupier fit out and adaptations, space management and furniture.

3.2 Information requirements according to ISO 41001

The ISO 41001 standard describes FM information and data requirements. It specifies that the organization shall determine its information requirements to support its FM system and the achievement of its organizational objectives. It further specifies that the organization should consider its FM information and data requirements related to the following areas (excerpt):

- Facility asset characteristics (e.g., ownership, design parameters, vendor information, physical location, condition, in service dates, materials)
- Service delivery and operations […] including maintenance management (e.g., historical failures, betterment or replacement dates, future maintenance requirements)
- Financial and resource management issues (e.g., historical cost, replacement value, date of acquisition, materiality, life cycle costing analysis, useful service lives)
- Asset management

This paper will use these recommendations as guidelines when considering the information requirements of FM providers.

4. What does this specific FM service industry and client sector need?

People in the FM Service Industry are facing a big digital transformation with BIM adoption to meet the client sector needs. There is a generational transformation happening at the same time as the digital transformation is expanding. People need unlearning of old ways of working, relearning of the latest tools, and learning about what is emerging.

Business and processes are facing a big re-engineering and adoption of global, international, and national standards to support automated data & information management. Everything is connected digitally and need to be governed for reliable data analytics and digital processes management.

Technology is developing fast as the FM Service industry is adopting to new smart building systems and facing first round of renovation construction in sustainability certified legacy portfolio. The industry needs more technology to process accumulated data into reliable information and clustering it into applicable knowledge.

5. Information requirements in the different phases of the PDCA-cycle

The ISO 41001 standard specifies that any FM core process starts with understanding and defining the following criteria within a demand organization (which are also clauses within the document):

- **Context of the organization:** understanding and determining the appropriate FM-system (clause 4)
- **Leadership:** understanding organizational roles, responsibilities, policies, and authorities (clause 5)
- **Planning:** understanding risks, strategic objectives, and current policies (clause 6)
- **Support:** understanding available versus required resources in the form of financial, human and technology (clause 7)
- **Operations:** delivering integrated FM-services (clause 8)
- **Performance evaluation:** benchmarking standards, monitoring, and meeting target requirements (clause 9)
- **Improvement:** reviewing benchmarked standards, identifying, and implementing process improvement initiatives (clause 10)

The standard further specifies that the clauses of the document can be considered through the process approach methodology known as "Plan-Do-Check-Act" (PDCA), a process that can be briefly described as follows:

- **Plan:** establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies (clauses 4-7)
- **Do:** implement the processes (clause 8)
- **Check:** monitor and measure processes and products against policies, objectives and requirements for the product and report the results (clause 9)
- **Act:** take actions to continually improve process performance (clause 10)

The following chapters (5.1 – 5.4) describes information requirements in the different phases of this process approach.

5.1 Planning phase

During this phase, the FM-organisation is planning the delivery of the services in question (strategic and tactical). The first two clauses (as mentioned above) focus on establishing the context of the FM-organisation and the leadership requirements (policy, roles, responsibilities, and so on). During these stages the information requirements from the BIM are limited. The next two clauses focus on planning the delivery of the FM-service and determining the resources needed, and during these stages information about the building, the technical systems in the building, and the equipment available in the building are important. Some of this information should be supplied from the BIM.

Important tasks during this phase include assessing risks and opportunities, planning how to achieve FM-objectives, determining what resources are needed to deliver the FM-services (both physical and human resources), what competences are required, and so on.

To plan the delivery of "Workplaces" as a service (e.g., to determine possible service levels, demand management, competence requirements, etc.) the FM-organisation needs information about the building, such as floor plans, space distribution, capacities and functionality of HVAC systems, logistics (stairs, elevators, corridors), design parameters, physical location of assets, materials, future maintenance requirements, and so on. The information should also support life cycle costing analysis and determination of useful service lives.

Strategic planning:

A multi-year plan is supported through structured data driven insights linked with organizational commitments, both of which are required for budget management/fiscal spending.

The ability to reference current portfolio positions (leases, building condition reporting, assets etc) in combination with known information on specific functions/service areas; a combination of existing and new requirements /growth factors would expedite the research stages of data collection.

At present, much of this information is held in fragments, portions of information residing in basic data tables. The ability to consolidate this information from several sources into one holistic view would greatly speed up planning, being generated in an open format, ensures the ability to migrate data where it is best processed, over having to translate between platforms- potentially resulting in data loss as it migrates from source to source.

From here, established governance leads to more focused tactical planning, and scaled elements of requirement gathering, noting on larger capital works, requirement details expand exponentially.

Requirement gathering:

Data collection from Stakeholders and Service Area representatives by subject matter experts form the initial data entries, which support future modelling baselines and become reference points for future consultants as they develop the product.

Key elements generated at this stage which are hosted within a single database, managed by the FM teams:

- Performance specifications of MEP (mechanical, electrical, and plumbing) systems
- Broader Architectural details/massing of spatial volumes
- Occupancy loading and capacity planning
- Space functions and supporting furniture/equipment listings

Historically, the process of gathering requirements was typically gathered in a very rudimentary format, be it simple tables or written documentation, potentially supported by basic layout examples. Updating these as a project moved forward was an arduous task, particularly when attempting to pinpoint a particular change catalyst, or validating requirements, post occupancy should an issue arise. The risk of information loss is terribly high as it relies heavily on human intervention.

The ability to gather this information and recall it within a structured database, and directly apply into a working model immediately improves the fidelity of the information. A further benefit resides in the ability to draw attention to gaps /errors between the requirements and digital model.

The very essence which underpins the BIM process relies on clear communication between data points, the ability to generate and apply this data should not be hindered.

5.2 Delivery /Operations phase

During this phase the FM-organization is delivering the service in question. This encompasses operational planning and control planning, coordination with interested parties, and integration of services. Again, information about the physical attributes of the building is important (see 5.1)

There are 2 levels of effort present within this phase, linked directly with the scale and nature of the project. Both rely on similar data sets and are either generating from scratch or updating existing spaces.

Smaller scale works looks more towards the operational ‘day to day’ of a workplace alongside the more tactical delivery of the service/product limited to a 1-year timeframes and tied to operational expenditures in a given fiscal year. Typically associated with a floor(s) within a building.

Larger scale works can encompass campus planning, new build, or full building refurbishment, which increase in complexity and scale, though broadly speaking, data points are similar. Information gathered within the following main headings, scaled to suit the project scope/scale:

Planning & Managing Space use:

The following data elements (shown in figure 1 below) are typically being tracked independently, in many cases manually, but all form part of a wider understanding on what elements make up the workplace. Each sub-set rely on various aspects of the built environment to operate from (e.g., Security systems will need architectural plan references to understand zonal /threat control)

Considering there are several specialized platforms which rely on specific content, having the base data consolidated and support a bi-directional flow of information, in an open and unimpeded manner, serves to improve efficiencies of a set system -ensuring up-to-date accuracy without delay for manual resolution.

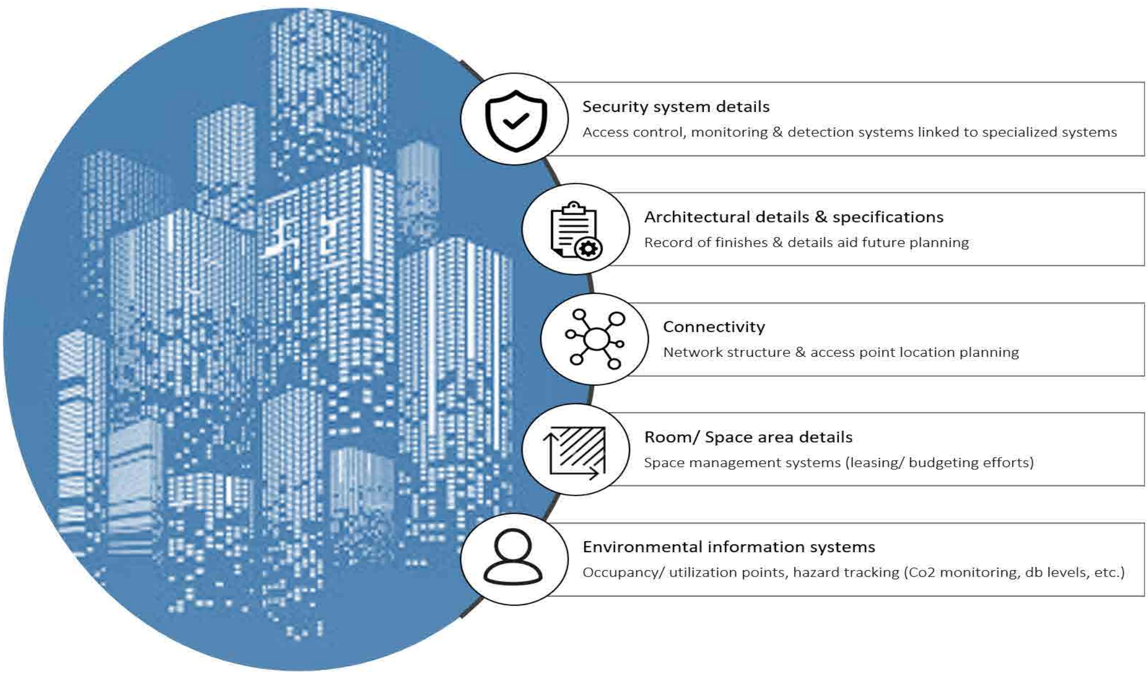

Figure 1: Different use-cases utilizing information from openBIM (Matthew Glynn, House of Commons, Canada)

Services and Assets:

Critical information surrounding item specifications, warranties, operation manuals, life expectancies (age/condition) and contractual contact details must be readily accessible to support operational and planning teams. Source of this information typically emanates from the construction phase and is easily captured within a live model, hosted within a database, openly accessible by an array of platforms to both monitor and maintain.

Bi-directional data/feedback into a system or model surrounds general maintenance, and service calls (unplanned maintenance) linked to the overall life expectancy/cycle of the components. Listed below are examples of data points (not exhaustive):

- Floor level MEP: HVAC (e.g.: Fan Coil Units, Variable Refrigerant Flow), leak detection, independent cooling, UPS, specialty lighting, specific localized controls (e.g.: thermostats, blinds) etc.
- Building Level MEP: Main plan (e.g.: chillers, pumps, Air Handling Units), generators, vertical transport (e.g.: lifts, escalators), lighting, dampers, fire & protections systems etc.

Taking an openBIM approach ensures ease of translation between platforms without risk of information loss or dissociation between platforms/software points, resulting typically in duplication of information which increases inefficiency and is more prone to input errors.

Budget, Leasing and Contract Management:

Drawn from elements of project delivery and ongoing operational efforts, the need to ensure contracts are up to date and covering the correct assets in line with requirements established at the handover phase of a project is essential to ongoing operations.

The collection of live project costs on tactical and operational side informs on progress, lined to the Monitoring and Reporting stage, and equally may contribute to strategic planning efforts. Specific areas of interest:

- Progress reporting on drawdown/cashflows impacting budgeting and forecasting (Larger scale projects having accurate cost modelling data to aid development of build projects).
- Contract details drawn from service/asset section expanded to cover non asset service elements of the built environment (e.g.: MEP consultants, contractors/trades etc)
- Leasing details linked to area management and occupancy information. Relying on accurate measurement detailing.

Consolidating these data sets directly into the data model, with the ability to easily export across different systems, continues to drive efficiencies across the business. This is especially true if there are several Service Areas/departments or stakeholders with vested interest in the information as projects develop. having a centralized source of data, ensures current expressions are accurate across several platforms (e.g., Finance, Legal/Leasing, etc).

Furniture, Art & Artifacts:

Created and managed as their own asset class outside of building elements, these moveable/temporary elements have specific sets of data points captured initially in the requirements gathering stages, developed further as the design process progresses to tender stages.

Specific areas of information collection rest in the following and are potentially tied into contracts for procurement, insurances, and maintenance:

- Component and/or system specification information (manufacturer, line, range, colour/finish)
- Product/artwork detail (artist, historic relevance, value, insurance)

Over time, elements within this category are more likely to change and very likely from different sources, which may not be directly linked to tactical works. (e.g. a change in a framed print in a reception area) and are often managed independently.

Consolidating this data within a model assist with corporate planning and ensures operationally, the data is a current reflection of what exists within the physical world.

5.3 Evaluation and improvement phases

The ability to monitor performance of the workplace is a key element of the FM role. Monitoring existing systems in line with gradual depreciation of assets enable lifecycle and asset management cycles, supported directly from the operational phase and feed into both tactical and strategic planning.

Performance metrics can range across the workplace, below are initial points of interest, not considered exhaustive:

- Efficient and effective use of space: relying on space use metrics typically sensor based, though user feedback and other data points around space may be drawn upon (e.g. service/maintenance calls or complaints point to system fault/design failure) interlinked within a system feeding from BIM and other areas.
- Insights on energy performance and consumption over time rely on data from both the building and external environment, the former found in BIM.

The ability to access and update these elements of a database, across a range of different service platforms would greatly improve efficiencies in data management and provide direct metrics to draw upon as strategic and tactical sources demand.

5.4 Reporting & Monitoring

Information requests can stem from both the public and executive management levels at any given moment in time, which draw upon both the delivery stages of a project as well as the ongoing operational phase.

Depending on the nature of the request, several sources may need to be consulted across a range of subject matter experts (e.g.: equipment specifications, spatial data, budgets/spending, schedules etc) to acquire the information required.

Fusing all aspects of the digital build environment in a way which is accessible and digestible by any system could see significant savings in resource efforts in processing data and generating key performance indicators.

Boils down to:

Consolidated data within a model improve overall efficiencies being a single source, traceable over time and easily disseminated across a range of end users. Raw data should be able to freely migrate between platforms in a way which maintains fidelity and supports bi-directional exchange of information, resulting in a system which is de-risked to its core, transparent and self-regulating -unladen and agile.

5.5 Examples of practical use cases

Opportunities from linking BIM data, dynamic data, and BMS systems

Facility Management companies are assigned to ensure the safety and comfort of the users of public workplaces, may it be employees, residents, or visitors. To accomplish this task, FM companies react and orchestrate different dynamic processes within the building, such as equipment maintenance, cleaning services, catering services etc. For that reason, installing equipment and management systems in office buildings for tracking and countering dynamic processes has been a standard for many years. Nevertheless, often enough, the dynamic data that building systems deliver is hard to obtain, and when obtained, it is not referenced with the correct location in the building, making it hard to analyse.

Integrating a link to dynamic data in the BIM process can help FM companies obtain an advanced analysis of their assets and reduce operational expenses.

Tracking and detecting equipment failures- BIM based alarm management

BIM in operation and BIM-based BMS (Building Management System) can help FM detect equipment failures near real time. It can help the technical building management reach the alarm-causing asset on time, reducing the risk of security problems or discomforts created by the failing equipment.

To manage the asset maintenance, FM installs systems and software to give an alarm when assets fail. Those systems and software often only provide a technical overview and no indication of asset or alarm location. As a result, the technician or the FM knows how the systems are connected, and what system is affected by the alarm, but does not know the specific location of the asset causing the alarm, nor what areas of the building are influenced by the failure. It is therefore common for the technician to wander hours in the building until the asset is found, and when it is found, it might be out of reach for a direct repair, e.g., inside the ducts. This sort of maintenance delay creates unnecessary downtime and could potentially cause security issues and higher maintenance costs.

BIM in operation and BIM-based alarm management provides FM and technicians an instant overview of the exact location of the failure and enables them to react to the failure on time. Reducing the time to locate the asset decreases downtime and maintenance costs, and enables technicians to estimate the work process, prepare for the maintenance task or call an expert in advance if necessary.

Energy efficiency and optimization of system performance

Public buildings and workspaces contain a significant amount of electrical equipment and complex systems. Using BIM-based BMS helps drive a better analysis of energy efficiency and system performance in the building, making the energy expenses more transparent. This can be done by tracking near real-time data of energy generation and by monitoring self-consumption and respective storage. Together with the system's location, an early corrective action to prevent budget overrun and inefficiencies are enabled. Additionally, associated CO_2 emissions and cost on global level can be tracked.

Tracking space utilization

With the help of BIM-based room comfort systems and dynamic data, a precise analysis of space utilization in the facility can be supplied. Space utilization analysis helps FM understand the spatial limitations and advantages of their managed assets. It can show areas of high utilization, which might create a bottleneck for day-to-day operations. It can also display areas with low utilization that should be redesigned to accommodate other functionalities. Spatial analysis and the combination of BIM-based comfort systems and dynamic data can help FM establish a better understanding of actual and potential uses of space, based on real numbers.

Better booking systems and better equipment utilization

Many of the booking systems used today to manage different rooms and areas of the modern workspace cannot capture real-time data. As a result, the users cannot know if a room is utilized longer or shorter than expected. Combining BIM-based room comfort data and dynamic data from the building sensors allows a clear association of a room with its occupancy data. The booking system can then retrieve this data to enable a better and more precise understanding of the schedule. Improving the booking system with real-time data will help FM better utilize their spaces and allocate cleaning efforts accordingly.

Many more beneficial use cases can be enabled by simply linking BIM data with dynamic data from automation systems. For example, basing the cleaning services on real-time data and analysing the air quality data of frequently utilized rooms can help create a more sterile work environment. In addition, advanced people-flow simulations can help identify evacuation routes or security issues in buildings with limited access.

6. Issues causing failure costs for Workplace service provision

In the context of this paper, the failure costs of workplace service provision are related to missing or inadequate information.

Key data regarding space, equipment types, systems, materials, zones, and so on, need to be entered into the FM-system that the service provider uses. If all data/information is readily available there is the cost of manually entering all the necessary information into the digital system (CAFM). In many cases, however, the data is not readily available and additional costs incur trying to find the relevant information or verifying the validity of the uncovered information.

An integrated system providing accurate and complete information will result in significant cost benefits.

7. Pains/gains in using BIM for Workplace service providers

7.1 General gains from using BIM in work planning, decisions processes etc.

Using information models utilizes efficient, repeated, and reliable quantity reporting. Quantity information includes areas, spatial volumes, object classes (furniture, equipment etc.).

Models are powerful tools for communication of complex, multi-disciplinary designs. It is easy to sort information by systems, object classes, types/subtypes, properties, and classification.

7.2 Required conditions

Information models require standardized information structures.

Not all technical information is stored in the model itself, as illustrated in figure 2 below. The information model consists of a set of object models linked with other sources of structured and unstructured information.

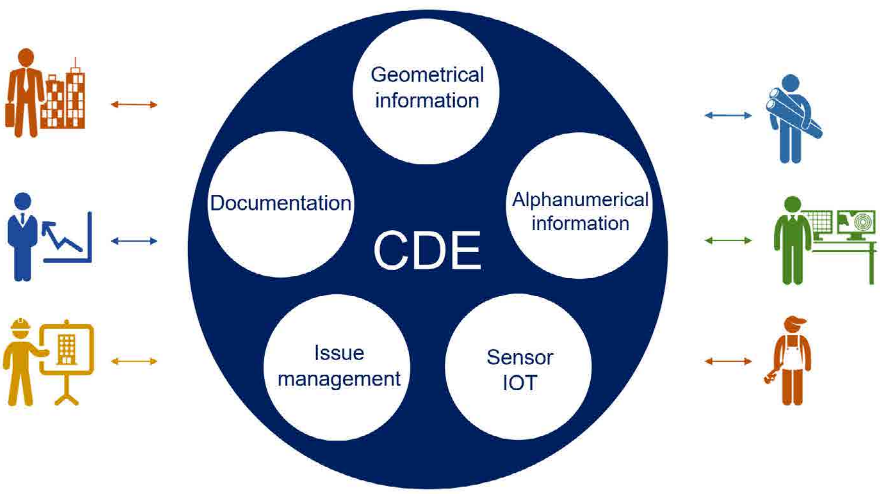

Figure 2: Concept of digital twin. The information model is a federation of different information sources, accessible for multiple users and interfaces. (Steen Sunesen, Statsbygg, Norway)

Information shall, as a general principle, be registered in the system where it shall be maintained.

Information shall not be redundant and only be registered in one system. Access to information is secured by linking together information sources.

Integrating dynamic data and BIM data for better FM operations

The benefits of combining dynamic data with BIM data are immense, but the actual integration of BIM data with the BMS dynamic data is a complex engineering task. To accomplish this task, it is best to involve the system integration suppliers from the commissioning phase in the BIM process, preferably already in the early stages of the building design. By doing so, the fire safety, personal safety, and comfort of the medical staff and the patients are improved, and the daily operational tasks of FM are modernized.

Leveraging the power of dynamic data and BIM data in greenfield buildings:

To achieve the best system utilization, the FM and the system integration provider must be involved in the early stages of the design and conception stage of the building. Together with the asset owner, they should agree on the relevant use cases of the building automation systems and ensure that the relevant data is listed in the exchange information requirements and that the system integration provider is involved in the BIM process.

To leverage the power of dynamic data, it is necessary to link between the static 3D model and the corresponding BMS data points. The data points delivering dynamic data about a building are related to the electrical equipment of BMS systems or to IoT devices. These are often connected to the mechanical and electrical systems of the building (air conditioning, heating and ventilation systems, lighting systems, etc.), helping to monitor and enhance their processes based on desired use cases. Therefore, it is advised that the use cases for the utilisation of automation systems are decided upon upfront, namely in the conception/design stage of the building. Moreover, the task of combining BIM data and dynamic data should be formalized in the exchange information requirements.

In addition, it is essential to ensure the use of a common data environment (CDE) in the operational phase. A CDE is a tool to manage models, alpha-numerical data, and all documentation of a building project. It helps to avoid duplication of data and facilitate a more transparent collaboration between different project participants. After the handover process and during operation, the BIM models and dynamic data are still collected and maintained, even if less frequently than before. It is best to facilitate the change processes in an adequate information management system, namely CDE, that can track the necessary files and corresponding metadata.

Lastly, enhancing openBIM standards and processes with adequate BMS referencing can help to ensure better information exchange and appropriate mapping between data points and locations. By enhancing IFC terminology, creating a corresponding MVD, and focusing on use case-based communication, facility managers can avoid studying complex engineering knowledge and rely on the information requirements to fulfil the desired use cases.

Leveraging the power of dynamic data and BIM data in brownfield buildings:

A significant part of the information about the building structure and BMS systems is lost in the handover process or remains in the hand of the system integration company assigned to the job. Nevertheless, integrating the dynamic data and BIM data in brownfield buildings can be done by re-engineering and digitizing the managed assets. Digitizing the built asset can be done, for example, by scanning the built asset and assigning the relevant data points to the recognized assets. It is essential, also the case of brownfield buildings, to use the help of service providers that are familiar with the operating systems in the building to ensure the best allocation of data points.

7.3 Pains

Varying information quality is a challenge that needs to be addresses to utilize BIM for building operation. Model information is either not delivered according to required deliverables or is not structured according to the project's information standard. Reasons for deviating model deliverables are:

- Lack of clearly expressed requirements.
- Lack of modelling competence among the appointed parties.
- Lack of support from software.
- Lack of priority from project managers

Due to varying quality of information BIM usage should be functional with high tolerance to varying quality of information.

Consolidating information and workflows from legacy systems can provide a challenge with adoption to new systems/setups. Due to both competence, technical and organizational issues.

7.4 The business case for openBIM

Models can both be exchanged on proprietary and open formats. This white paper and the following work to specify exchange processes and requirements will focus on openBIM exchange. Some of the main reasons for requiring openBIM is as follows:

- OpenBIM provides free competition between service and solution providers.
- Detailed delivery requirements can be expressed on one common format. Standardized requirements can easily be harmonized between the industry's leading client and owner organizations, supporting predictability in the industry.
- With 5-10 years between version updated open format IFC is more suitable for long-term storage of models during the building lifecycle. IFC is developed by a not-for-profit membership organization, buildingSMART International.
- Standardized information can be accessed and utilized across project stages and projects, ideal for streamlining the information flow in building operation.

8. Opportunities for FMIR protocol, FMIDM/H and FMCDE

On the bases of the ISO 19650 and ISO41000-series:

- FM Information Requirements (protocol)
- FM Information Delivery Manual/Handover (specification of required information exchange).
- FM Common Data Environment (specification of FM CDE solutions and workflow).

8.1 Implementation in standards:

The use cases listed above will be translated in the second phase of this project in information requirements, with the purpose of implementing the requirements in available supported information exchange standards provided by bSI.

At the time of writing this document, the following process is the one accepted and supported by the bSI community.

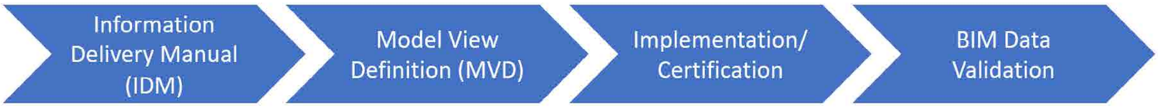

Figure 3: Sequential development of digital standards for FM and openBIM, starting with identifying the processes and information needs, the technical specifications for information exchange, implementation in software and processes, and finally checking deliverables are according to requirements (Steen Sunesen, Statsbygg, Norway)

Any future standards and processes are also acceptable, assuming they are supported and available in production state. The implementation should adhere with the documentation in ISO 16739-1:2018.

Supported: software provided by software vendors in the built asset industry are certified to use the standard and can exchange information with it.

Available: the standard is accepted by the community and can be developed by bSI community and the tools.

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Ryan Tennyson, Infrastructure Technology Advisor, Scottish Futures Trust Ltd, Scotland

Steen Sunesen, Chief Architect and BIM Group Leader, Statsbygg, Norway

10. References

Reference documents are:

- ISO 41001
- EN15221-4
- ISO 19650
- ISO 16739
- ISO 29481