

The Future of BIM.



AVVIR[®]

BIM-focused reality analysis for the built world.

Glossary



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Introduction

BIM (Building information modeling) has been widely adopted by architects and engineers to document design intent and construction details. During the design phase of projects, most teams are now relying on BIMs in some capacity to create construction documents. However, as projects progress, the implementation of BIM software tends to trail off as the asset moves through construction and into operation. This is largely because CAD software was built with a focus on improving the documentation process. However, today, there are many tools available to make BIM and CAD data more accessible. In this eBook, we will explore how BIM has the potential to impact each stage of the building lifecycle beyond just design and coordination.



Using BIM to Speed up the Permitting Process.

Any construction project owner will tell you they would like building permits faster. The adage “time is money” is particularly apt in construction, as delays are costly. There are many ways to make the permitting process quicker and more efficient, but we believe there is a future where your BIM and reality capture will become an integral component to greatly reducing the approvals process.

BIM FOR PERMITTING

Just how long does it take to get a building permit for commercial construction today? In New York City **it takes** eight weeks for the city to do the initial plan check for major new commercial buildings, and believe it or not, this is actually one of the fastest jurisdictions for reviewing plan submissions. This does not even include the inevitable changes that can happen that force the ownership team to revise plans. Once the ownership team revises plans, they have to repeat the process, perhaps adding another eight weeks or more. (The review is on a first come, first served basis. So, the review may extend beyond eight weeks.)

With rising interest rates and inflation raging, letting assets lie idle is especially costly. Interest rates are continuing to rise, and the Fed is expected to continue raising rates. In an October 2022 article, **Reuters** said, “The Fed’s benchmark overnight interest rate is currently in the 3.00% – 3.25% range, and policymakers have signaled they expect it to rise further to 4.6% next year...”

Anything that can move construction forward should be welcome news for owners and the GC’s who win the bid for that project. So, let’s consider how your BIM and reality capture data may improve the building permitting process.

Advantages of using BIM

By the time ownership teams develop the materials necessary to obtain a permit, they have spent a great deal of time and money. The project has already been through conception, financing, planning, development, and more. By the time you reach the plan submittal stage, you are anxious to move dirt and start construction.

If the permit is rejected and you have to return to the drawing board – or at least do some erasing – it’s costly and frustrating.

If permitting plans were replaced or supplemented with a BIM submission, you could automate plan reviews with model-based code compliance checking. Automating the process of determining compliance with building regulations, codes, etc. results in plans with a higher degree of compliance. Finally, you could easily review any changes to plans in process to ensure they were compliant.

BIM reviews for model-based code compliance are quicker than if the task were completed by people. Automated BIM reviews enable designers and code reviewers to devote more time to other tasks, including addressing issues with compliance that are detected by the automated code compliance checking process.

If a permit is rejected and plans need to be resubmitted, resubmittal time can be sped up. As the team makes the necessary adjustments, permitters can be part of the live design process by immediately reviewing and incorporating comments for faster resubmission.

BIM and model-based code compliance speed up the permitting process and have the potential to minimize human error and save owners much time and money. Technology, like Avvir, can ensure that construction is completed according to the approved permit drawings and enable projects to proceed as envisioned.

Current barriers to adoption

Studies show that just 19% of New Year's resolutions are kept after two years; 77% don't make it past a week. Why is change so hard? People are creatures of habit. Many people/businesses do things because of a "that's the way we do things" mentality. With that said, there are barriers to implementing BIM.

- **Trust** – There may be a lack of trust in the software since some are unfamiliar with it. If all the stakeholders, such as AHJ (authorities having jurisdiction), engineers, contractors, etc. trusted that the software can assure compliance with the code, changes would occur.
- **Utilization** – BIM usage in the U.S. is growing but is still not the norm. A [Spring 2022 survey from Oracle](#) found that 50% of respondents use a BIM on between 76% and 100% of their projects, and 23% incorporate BIM processes on all projects. In order to truly force adoption, owners must require the implementation of BIM. Similarly, legislation could be passed to enforce the use of BIM and model-based code compliance.
- **Need for "Paper Trail"** – Even when a team robustly utilizes BIM, the ultimate deliverable is still a 2D set of permit drawings. Drawings are easy to catalog. Sign Offs can be physically stamped onto a paper which allows for a very clear paper trail of what was approved and when. The problem with this methodology is that the model must also be frozen in time and ends up becoming disconnected from the living model. This opens up an opportunity for information loss and missed scope.

- **Code Checking** – Building codes are regularly updated and changed. Keeping track of the changes is a task in itself. To get the most out of BIM's model-based code compliance and offer a thorough check for code adherence, databases need to be up to date. Governing authorities could maintain a database of building codes so they could automate the process of checking adherence to the BIM. Developing a machine readable database on the front end is time consuming. However, that effort will save time on the back end. Also, database maintenance could become standard practice anytime an amendment or new addition of code is approved.
- **Code Interpretation** – There are other challenges to using BIM to check for code adherence. Some building codes leave room for interpretation, which does not translate well to automation. In addition, building codes are not standardized nationally, as each AHJ may have its specific code.

Moving forward with BIM

There are certain parts of the permitting process that are out of your control but by utilizing a BIM to automate a baseline adherence to code, it would be possible to drastically reduce the permitting review process. One example of a good step towards automated permit reviews is ComCheck. ComCheck automates and speeds up the process of confirming energy code compliance checking for commercial buildings. However, while the software is appreciated as a reliable means for verifying compliance, it checks for a very narrow set of requirements.

Avvir offers one big piece of the solution. Previously there was no systematic and accurate way to connect the BIM to the reality of the job site. A BIM-focused reality analysis platform, Avvir provides critical insights and closes the loop by updating the model throughout a project. With Avvir, you have much more assurance that what you have designed and permitted, is what is actually being installed.

If you'd like to learn more about how Avvir's platform can connect your BIM to the reality of your job site, check out our [solutions page](#).

BIM-empowered Approach to Construction Inspections.

The proverb, “necessity is the mother of invention,” which is credited to Plato, is an apt way to describe many U.S. industries during the recent shutdowns. The pandemic pushed entire industries into remote work. It also encouraged the digitization of many transactions that previously could be done only in person.

BIM FOR INSPECTIONS

The building inspection industry was among the industries that needed to adapt. Previously, inspections were done exclusively in person, but many jurisdictions began allowing virtual inspections so projects could continue. In most cases, a virtual inspection consisted of a zoom call, facetime, or teams chat to allow the inspector to see the job site remotely. And while this is a great step towards efficiency, we believe that BIM (building information modeling) can be part of the virtual inspection process and enable it to happen more effectively.

The International Code Council, Inc. (ICC), a nonprofit that provides a wide range of building safety solutions, has developed guidelines for conducting virtual inspections. The [guidelines](#) note that authorities having jurisdiction (AHJs) had “...to come up with solutions to perform all aspects of codes and standards administration from remote locations....”

One solution that uses the available technology is remote virtual inspection (RVI). The ICC notes the practice gained wide acceptance during the pandemic and “... its advantages are so great that it will likely become a popular and routine tool for the foreseeable future.”

Consider the technology needed for RVIs and how BIM can make the process better.

The necessary technologies and their roles

Virtual Reality

Virtual reality (VR) is a three-dimensional computer-generated environment that people can engage in. An essential technology for an RVI, building inspectors can “walk” the job site remotely with VR and note any deficiencies for the team as compared to the model.

VR technology enables building inspectors with highly specialized subject matter expertise to review any job anywhere in the world. The cost and time involved in getting inspectors to and from job sites are eliminated and inspectors can check more buildings in less time.

In addition, physically walking any site is potentially dangerous. An inspector can access and inspect any part of a building during an RVI that might otherwise be risky or unsafe.

Drone technology enables access to inaccessible locations, heights, and vantage points that a person cannot reach by simply walking the location.

How does BIM help?

Inspectors can review a job site via 360 photography or LiDAR scans (3D laser or laser imaging, detecting, and ranging) overlaid on a BIM. This allows inspectors to review the project, identify deficiencies, and proactively direct the site team to make corrections. Instead of making multiple time-consuming trips to the building, the site team can work more efficiently. For example, with Avvir, an inspector could utilize the BIM to ensure that all scope was installed prior to signing off on closing in walls or ceilings.

This efficiency is carried forward and issues noted in the inspection can be addressed quickly. Therefore, there's less chance something will slip through the cracks. Plus, potential problems don't drag on, and safety issues are remedied, leading to a safer building/construction site.

Augmented Reality

It's important to note that to ensure compliance and safety, most projects will require some level of in-person inspection. In such cases, technology is helpful. For example, augmented reality (AR), which integrates digital information with the real-life environment in front of a person to provide a composite view, helps with inspections.

Typically, inspectors carry physical drawings of a site while walking the site. Drawings may be cumbersome and heavy, and they can become disorganized or damaged during an inspection. An even bigger issue is an inspector arriving at a site only to realize the approved permit drawings are not available because they were lost on site.

Flipping through drawings to verify and find the needed information in context is time consuming. However, drawings are essential for an inspection because they enable an inspector to compare the plan with reality.

When AR is part of an inspection, an inspector does not need physical drawings because AR technology automatically detects an inspector's location and positions them within a reference model. With visual and auditory sensory information overlaying in-person reality, an inspector gets a greater, enhanced sense of the building. They're not simply reviewing documents but walking through them, making it simpler to detect issues.

How does BIM help?

AR makes it easy to compare a construction site to all the critical construction documents and the planned scope of work "held" in the BIM.

The up-to-date scope of work can be viewed as the inspector is on site and looking at what is occurring. Information can be taken from the site and compared to the BIM so progress is charted, and issues are identified.

Reality Capture Analysis

Another valuable technology for building inspections is reality capture. Laser scanners and UAV photogrammetry enable scanning of a site to develop a set of data points that can be used to create highly accurate 3D models.

Using reality capture allows inspectors to analyze complex data with precision and ease. 360-degree images and LiDAR scans enable much more accuracy, granularity, and reliability, leading to more precise analysis.

How does BIM help?

A fully digital workflow can be realized through the analysis of reality capture datasets against a project's BIM, so inspectors can perform highly accurate inspections. Furthermore, the details can guide future construction to help ensure construction is proceeding as it should. The cause of on-site issues noted in the inspection can be identified and addressed.



Barriers to Adoption

It's clear that these technologies improve the accuracy and quality of inspections and have much to offer users. So why aren't they, and RVIs, standard?

Some of the same headwinds that all new technologies face are holding back AR, VR, and reality capture. Incorporating new technology requires a learning curve for employees and companies. The construction industry, which is notoriously tech-averse, is less likely to incorporate new technology until its professionals are positive it will be helpful and are confident they can use it effectively.

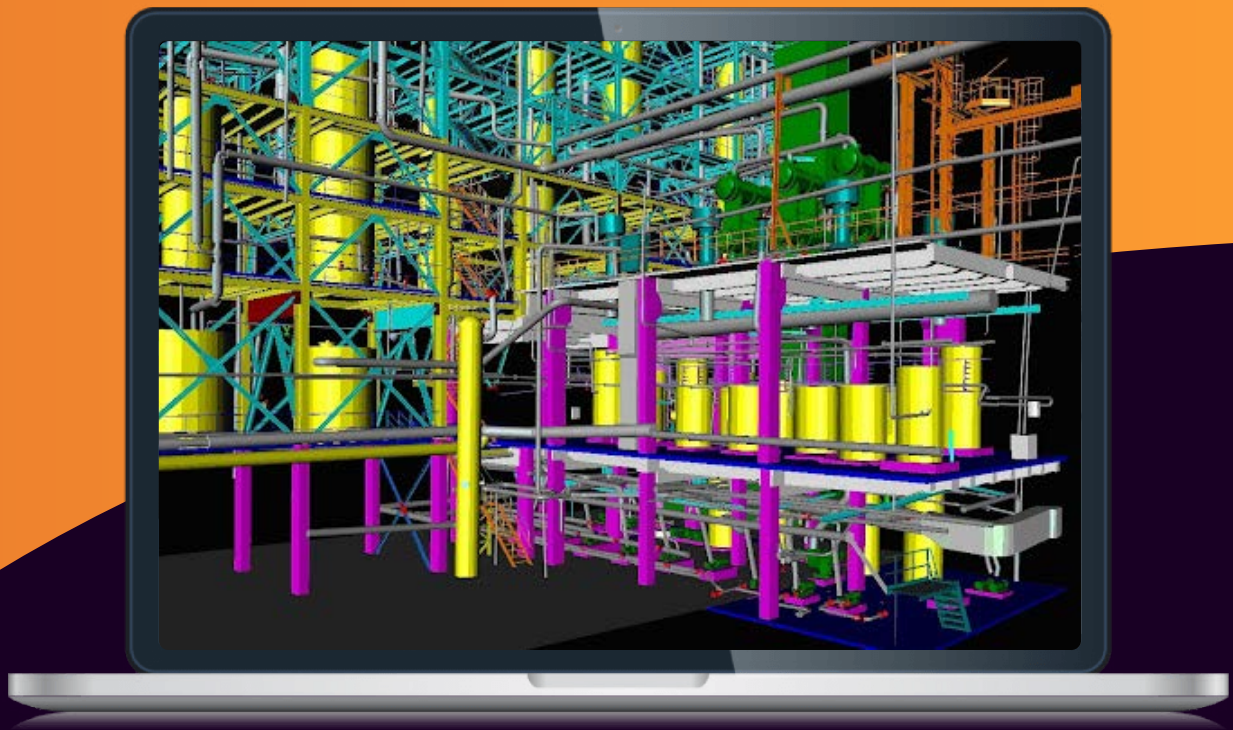
On a practical note, wi-fi is not always available on construction sites. Until a workaround is created for those sites, incorporating such technology will continue to be a challenge. It's also difficult to conduct an RVI for very complex projects.

Lastly, AHJs typically require that inspection cards be physically signed for approval.

Each of these challenges can be overcome, however. With the great benefits an RVI provides when technology, including virtual reality, augmented reality, and reality capture, is used, the barriers will be removed.

As companies move forward with VR and AR technology, they can visually compare the planned scope of work to the actual project site. However, this process is highly manual and error prone. A tool such as Avvir enables teams to sync data from the field with their BIM and automatically generates insights based on a comparison of those two data sets. This helps to ensure accuracy.

An inspector can review deviations within Avvir to gain a better understanding of what changes may have occurred from the approved permit drawings, enabling them to make their job easier. It's a win!



The Future of Building Commissioning.

One may look at a building and see a simple structure. Yet, constructing a building so it operates properly is a complex process. Many elements need to operate in sync for a building to function ideally. Building commissioning helps teams construct and operate a building while considering every element.



BIM FOR COMMISSIONING

What is commissioning?

Originally, building commissioning focused on documenting HVAC systems. Later, the value became so apparent, that commissioning transitioned to include all MEP and fire protection systems, according to [Consulting-Specifying Engineer](#) magazine. The information was to serve as an additional set of eyes for owners.

Commissioning has morphed into whole building commissioning. In addition to the systems noted above, the magazine notes commissioning now also includes information technology, cellular, audio-visual, renewables, enclosure, and air quality monitoring.

According to [Complete Commissioning Inc](#), building “commissioning is the process of planning, documenting, scheduling, testing, adjusting, verifying, and training, to provide a facility that operates as a fully functional system per the Owner’s Project Requirements. The goal of the Commissioning Process is to enhance the quality of the delivered project by focusing the design and construction team on the Owner’s goals for a functional and energy efficient building.”

How is commissioning done today?

Building commissioning is typically led by a commissioning agent who works for the owner and interacts with all the key players during the construction process.

Today’s commissioning process tends to be done manually and inefficiently. The work requires that the commissioning agent spend significant time at the construction site reviewing construction with the building engineer and other relevant team members. Those involved are engaged in loads of trial and error as they test/access processes to note how equipment is functioning. Because this is a lengthy process, the commissioning agent often tests only a percentage of the equipment.

The resulting reports from the team and even the commissioning agent often involve multiple siloed spreadsheets. This makes interpreting the information and recognizing how work is progressing more challenging. Building commissions can be excessively time-consuming, thus lessening its benefit. There are often even contractual deadlines for project close out which creates an incentive for taking short cuts in the process.

Three ways we can use technology to improve the commissioning process

How can the building commissioning process be improved so the gains can be realized more quickly and efficiently? Let's consider three ways that BIM technology could improve the process.

Digitize the commissioning process

Spreadsheets here, there, and everywhere. We've all had to look at a pile of spreadsheets and think, "Where do I start?"

Start by digitizing the information with a BIM-based issue management platform. Using a cloud-based web application, like BIM, as a database and repository for information about the project is a time saver. Plus, information is updated in real time.

Mission Critical magazine lists eight benefits of digitizing the commissioning process. Among the benefits are improved design review, collaboration, and organization. Information is maintained in a way that is easily searchable and updated. With multiple people/entities involved, keeping information organized and up to date is a challenge. Digitization can organize and maintain information to facilitate smooth collaboration because everyone is clear on who did what and when. This keeps everyone on the same page.

Other benefits listed include efficient search and sorting for deficiencies and filtering deficiencies based on criticality or status. Each of these benefits positively impacts efficiency.

Depending on the complexity of a building, a building commissioning process could take tens of systems, hundreds of pieces of equipment, and thousands of tests. Keeping this mammoth load of information organized is challenging. The ability to search and sort information means a person can quickly and easily find and generate relevant data. This ability can also be used to make lists of tasks, to note who is responsible for completing tasks, and to send notifications to team members responsible for the work.

Consider the benefits of using a BIM-based issue management platform such as **Hexagon Intergraph**. It promotes project collaboration, offers real-time status, and extends data/information to all stakeholders, such as owners, EPCMs, contractors, and vendors, with a responsibility toward common startup outcomes.

Utilize technology in the field to automate performance results

Just because a piece of equipment or a system is constructed and includes all of its components does not mean it will function properly or even work. Complicated systems and equipment are not like a desk from IKEA. Just because all the parts/equipment have been used doesn't mean it will work per the specs. Testing is essential.

According to online magazine **Automated Buildings**, "At the heart of commissioning, functional performance testing is arguably the most critical and time-consuming step in the start-up process. This is the point at which all of the components and subsystems are tested together to verify that the overall facility meets design objectives from a systems perspective." This step requires the "coordinated participation by all the suppliers and the simulation of a wide range of normal and abnormal operating conditions."

Although not all testing is as challenging as functional performance testing, all testing is essential and costly. Therefore, the information needs to be noted accurately and on a timely basis. If not, the testing process could be less accurate and therefore less valuable.

But how to ensure accuracy and speed? Automated Buildings notes that testing and balancing are typically performed by a team (a balancing contractor who makes measurements with a flow hood and a controls technician who changes the appropriate control software parameters using a laptop computer). Ideally one person immediately makes the needed changes to the controller software, according to the online magazine.

There's also a technological solution. Automated Buildings suggests, "... use a special intelligent flow hood that communicates to the VAV terminal unit controller via a network connection through the thermostat cover. The technician can use the intelligent flow hood to view the current controller parameters, override the position of the controlled devices, calculate any necessary calibration parameters (e.g., K-factors) and then download these parameters to the controller." So, intelligent flow hoods get testing information directly to a digital database, ensuring its accuracy and usefulness.

Update your BIM during the commissioning process to deliver a digital twin asset

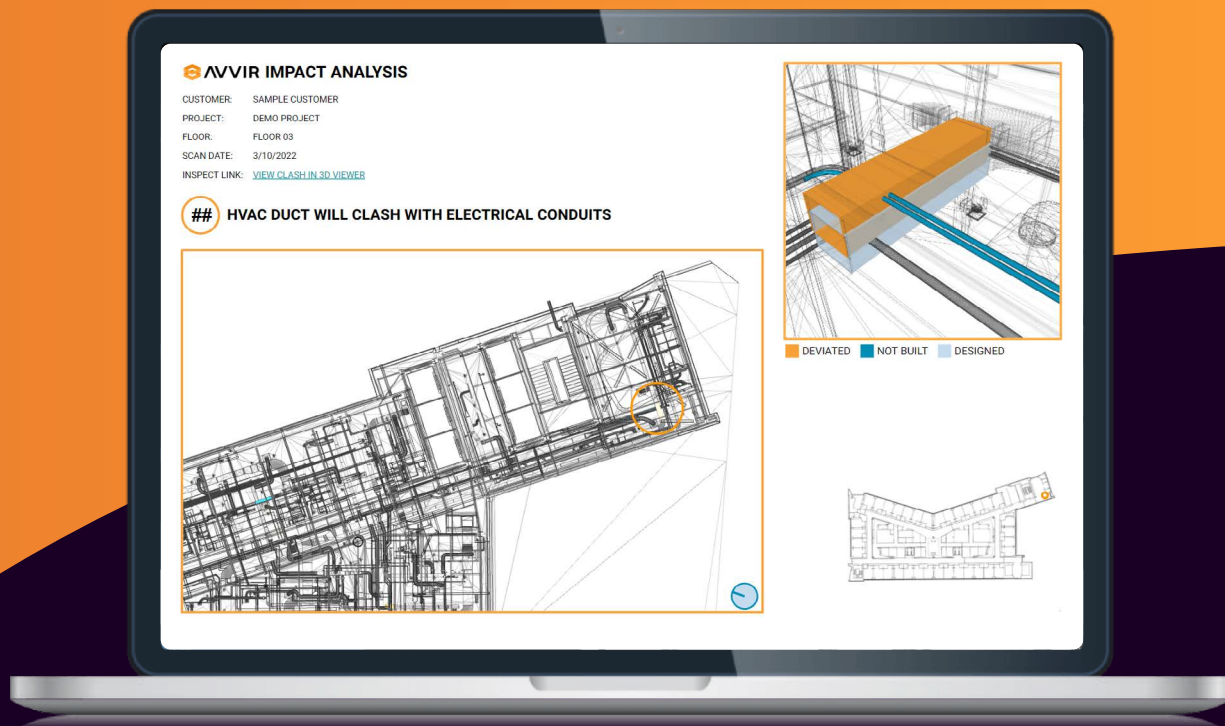
To maximize the usefulness of the BIM, it needs to be updated regularly. If information is not downloaded, it can fall through the cracks and lead to mistakes occurring on the project.

If the commissioning agent (or other team members) update the BIM, a digital twin can be developed from which to compare and ensure that reality and the design are the same.

As noted [in this blog post](#), "The resulting model should be according to [the] owner's handover requirements – it should be as-built and as-requested. The only way to achieve that is adding extra commissioning data to the model and logging adjustments made on site for the designers to update the model."

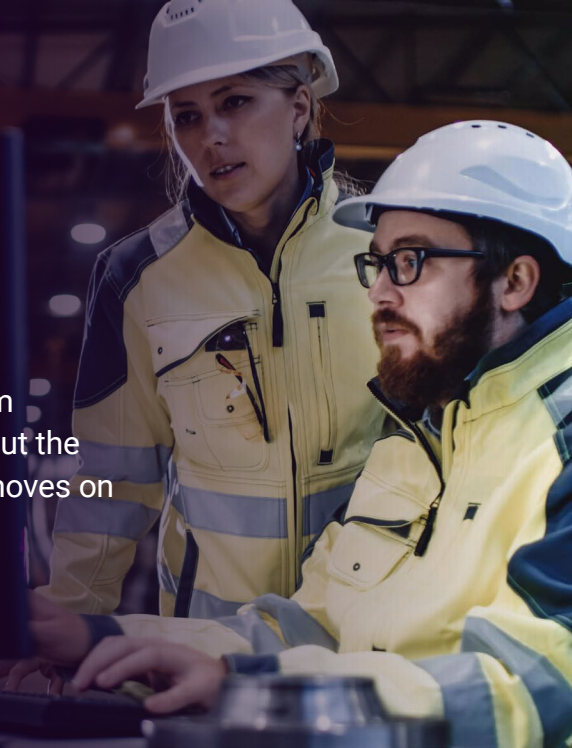
Regularly updating the BIM takes time, but such updates will save time in the end. The digital twin can be reviewed by the owners and their representatives to inform countless business decisions.

Whole building commissioning is a valuable process. It can provide owners peace of mind and confidence after their buildings are completed. The building's systems will operate in a cohesive manner and function as planned. Technology makes the building commission process better, faster, and more efficient.



How BIM can Improve Facility Management.

Construction is complete, and the project was on budget. The team involved with the product can feel proud of the work. But what about the building's next phase, namely, operation? The construction team moves on while a new team takes over the responsibility of management.



BIM FOR FACILITIES MANAGEMENT

Content with design and construction phases that came in on budget, the owner expects their facility to be managed as efficiently as possible. We believe this is the perfect opportunity to allow BIM (building information modeling) and other building technology to help teams with facilities management, leading to a greener building with reduced operating costs.

An often-cited report from the [National Institute of Standards and Technology](#) entitled Cost Analysis of Inadequate Interoperability in the US Capital Facilities Industry estimated that \$15.8 billion per year is wasted due to poor interoperability in the US capital facilities industry. The bulk of those costs – \$10.6 billion – is borne by owners.

What is causing the waste? A large portion can be attributed to inefficient handovers. Key information is fragmented and not smoothly transferred from the construction team to the facility management team. At project closeout, the facilities and operations teams are typically handed piles of unstructured data in the form of O&M manuals and often inaccurate as-built information.

The facilities and operations teams are left to sort out the unstructured data and figure out how to best operate the building. Important information is either lost or never shared, leading to delays and additional costs for operations teams.

These inefficiencies can be avoided. With the wide adoption and proper application of BIM, teams can revisit data standards and change how projects are handed over to facilities management teams.

Barriers to adoption

With so much money wasted on facilities management, why don't more owners insist on using BIM? The software serves as a single source of truth and a holding place for all things construction related.

It boils down to incentives. The challenges begin long before operations and management teams are on a project. The design team takes the first pass at creating BIM content, but they're hired to only oversee the successful design, permitting, and construction of a building. Once a building has achieved its certificate of occupancy and closed out the punch list, a design team is no longer involved. Therefore there is no incentive for them to spend additional time enriching a model with information a facilities team would need.

Incentives and timing are also at the root of the next roadblock. Consider that to be profitable, a general contractor must focus on handing over a project so they can receive payment and move on to their next job. Anything that requires more time and/or effort (unless they are under obligation or are compensated) isn't going to happen. So, unless there are strict requirements regarding project handover, a GC will essentially pass data along in whatever format it was provided to them, since that is simplest and quickest.

Finally, there's the operations and management team itself, who are not necessarily familiar with BIM. So, a facilities team would need training to use model-based information.

These barriers can be overcome. Design-build contracts are more conducive to a collaborative environment where cross-team coordination leads to a better outcome for a facilities management team.

However, other project delivery scenarios can also result in better outcomes for a facilities management team. One way to make this happen is to involve the operations team early in the process.

A team can discuss and determine their goals for building operations. For example, they can create procedures for asset inventory reports. With a goal in mind, it's now possible to start taking steps towards enriching BIMs for the purposes of facility management.

By involving the operations team in the BIM execution plan, a facilities management team can help dictate how a BIM is arranged, so it will have the information needed to efficiently manage a building. It also leads to a cohesive vision that makes it more likely a building will meet key performance indicators.



Important information for facility managers

Just how does BIM help facility managers? One easy win is that BIM elements contain information such as unique identification numbers. These could simplify documentation and cataloging of equipment on site as they contain the makes and/or model names of equipment, manufacturer information, and approximate location.

Let's review how a facility manager would benefit from such information. With relevant data about equipment stored in an easily accessible way, a facility manager could avoid countless hours hunting down physical copies of O&M binders and stacks of drawings. In this way, they can focus more on the issue at hand rather than hunting down product information. In addition, optimally managed equipment runs more efficiently and lasts longer.

Such data is also useful when repair or replacement is needed. Having relevant information handy helps a facility manager skillfully interact with a repair company. When a team is sent over to look at equipment, a facility manager will be more prepared. So, equipment will be fixed more quickly, with less downtime.

Vital data gained from BIM

Specific data that BIMs should contain that general contractors can provide for facilities management at project close-out include the following:

- i **Replacement timelines** – With this data a replacement can be planned with minimal downtime. Budgeting will also be more accurate as replacement surprises can be limited.
- ii **Servicing requirements** – This information will enable the facilities management team to best operate the equipment from day one. Following a servicing schedule extends the life of equipment.
- iii **Approved/recommended repair companies** – Working with knowledgeable companies leads to repairs that effectively solve problems. Finding a reliable repair company can be time consuming and expensive.
- iv **Safety manuals** – Keeping staff safe and out of harm's way should be a priority for every facility management team. Having relevant safety manuals assists in this goal.

Avvir: More information and more help

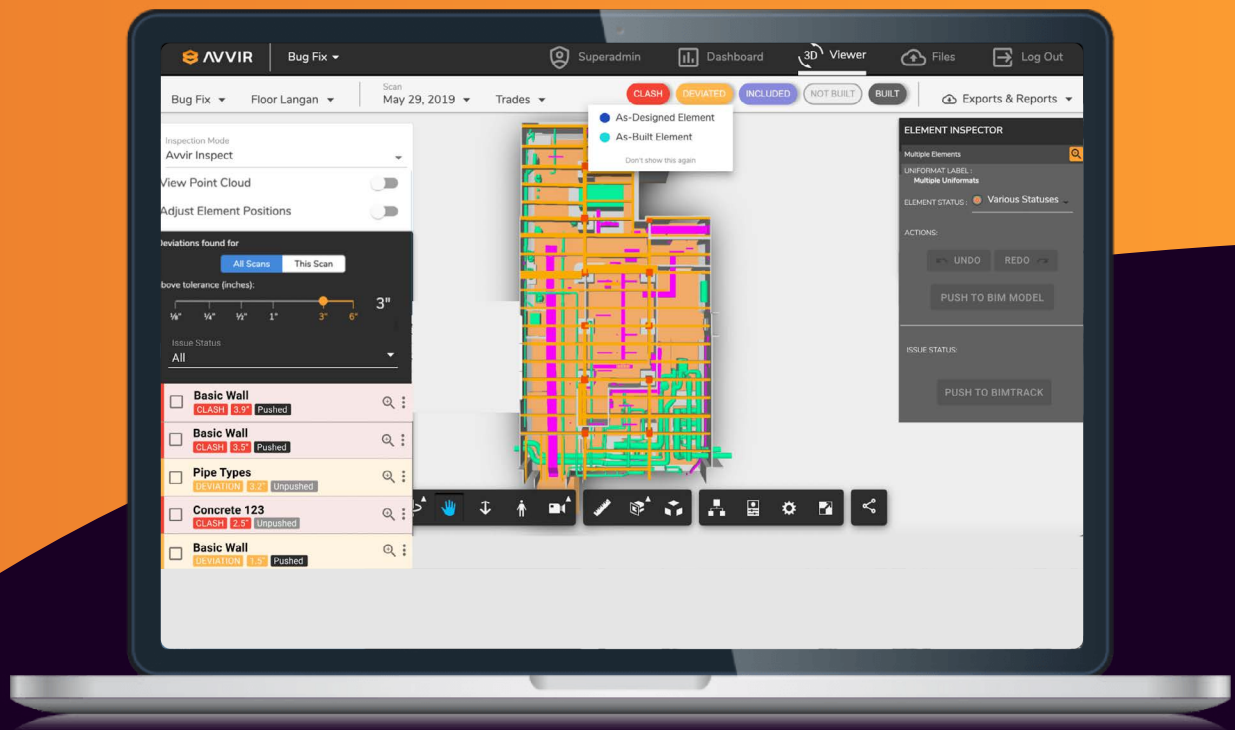
When you use Avvir to validate As-Built conditions, facility management is easier. There's no guessing or approximating where assets are located because you know the exact as-built conditions. The facility management team can have confidence that future renovations are based on reality.

You also get a historical-reality capture record. With this, teams can see behind walls, above ceilings, and within slabs without having to demo. Issues remain localized, and more extensive remedies are utilized only when necessary.

Finally, with Avvir, a facility management team has the approximate date of installation. With this information a team knows when items/equipment need to be updated and when maintenance should happen. When this data is easily trackable, upkeep is more likely to be done on an ideal schedule. countless business decisions.

Encouraging adoption of BIM practices for facilities management

BIM can help owners and their teams define their data goals and standards. With BIM (particularly when the operations team is brought in early), maintaining equipment and systems within a building is easier. Facility management teams are better able to keep a building operating, and at an optimal level, leading to real savings for owners.



Closing

At Avvir, we are a team of construction people making tools for construction people. Each person at Avvir was drawn to work here because we collectively believe that technology has the potential to greatly improve the construction industry. We are excited to contribute to this future where BIM and other construction technology will become a normalized way of working.

