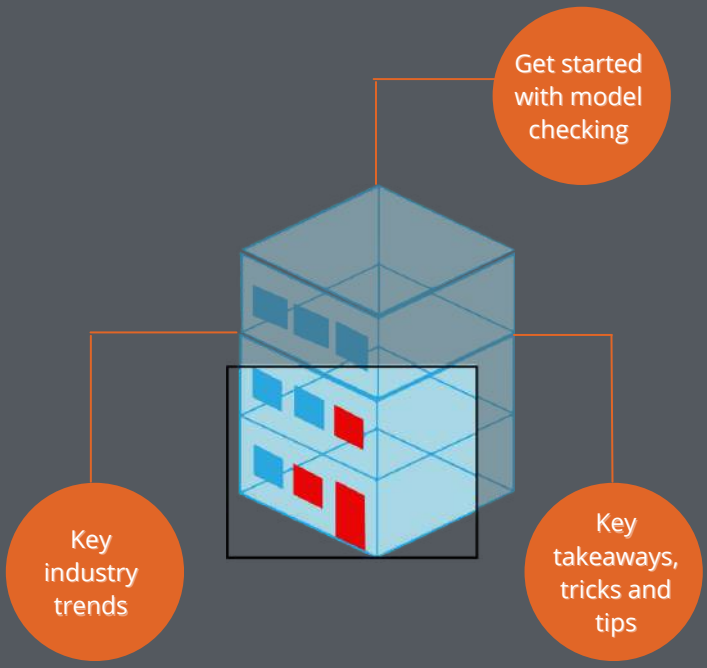
Xinaps

Includes practical case study

THE BIM MODEL CHECKING PLAYBOOK

Edition 1, May 2022



This book is highly recommended for every professional who wants to take model checking to the next level!

Contributors:

Microsoft mace buildingSMART International BASED on your future ARCDOX

BURO HAPPOLD ARCADIS AECMAGAZINE hazenberg | TBI

THE BIM MODEL CHECKING PLAYBOOK

Edition 1, May 2022

This book is highly recommended for every professional who wants to take model checking to the next level!

I never start the same company a second time. If it should come to it, I will not build another model checker for BIM data validation simply because it is already there. Not because it won't have a chance of success, but I won't be developing any more anytime soon, not the way I've been doing this for the past few years.

Of course, the temptation is to adopt and improve something than to create something new. Only for me, the challenge is in creating something from scratch. Is it easy? Not! Have the past years been fun? Yes, but not always! But to now see a product come to fruition is truly fantastic.

This book is based on experience from the past years where I have been searching with my team for the ideal combination of technology and processes. The technological challenges, building a team with the best possible people and making choices on any level come together here. Many brainstorming sessions preceded the development of our software. The outcome of common failures in strategy and development gave the team input for improving the application.

For us, this input was the starting point for creating something from scratch; it was the combination of knowledge with team effort to make the impossible possible.

Looking back, it was not even a decade ago when we couldn't even share CAD files over an internet connection. It was still impossible years later to have CAD files and a VoIP Call (Voice over IP) running simultaneously over the same incoming and outgoing internet line. A true revolution has taken place in the telecom world. Was this thought out beforehand? No, it certainly wasn't. We had a clue, we knew transferring data over a telecom connection was potentially something big. So we simply started developing telecom infrastructure without thinking ahead about what we could actually do with it all.

This is also how Xinaps started. Initially, we developed plug-ins that allowed designers to design faster, smarter, and above all, more efficiently to make choices to make buildings better and safer. However, the evolution of design

processes is going so fast that technology cannot stay behind. So we have developed software with a broad interdisciplinary purpose by listening carefully to the market and evaluating and anticipating industry transitions.

The idea behind this book is to share all our past years' experiences with anyone who wants to continue to implement new technology and sees this as an opportunity to be prepared for the future. In addition, I would like to share our knowledge of using technology to contribute to our industry that is characterized by many dogmas. In recent years, I have had the opportunity to meet and speak with many professionals worldwide who were able to create something from nothing and who have made a significant contribution to the development of this wonderful and critical industry.

Whether this book or just a part of it inspires or motivates you to initiate change in your environment, our goal has already been achieved.

Enjoy the read!

Frank Schuyer

CEO

Acknowledgement

Writing a book is harder than we thought and more rewarding than we could have ever imagined. This book is the brainchild of a conversation between Frank Schuyer and the industry experts thinking back to back on how to help novices and experts equally with model checking.

We, at Xinaps, would like to acknowledge the help of all the people involved in the development of this book and, more specifically, the authors and reviewers that took part in the review process. Without their support, this book would not have become a reality.

First, we would like to thank each one of the authors for their contributions to the stand-alone chapters and quotes. Our sincere gratitude goes to the chapter's authors - Salla Eckhardt from Microsoft, Chiara D'Amico and Pat Slattery from Arcdox, Denise Bos from BASED for contributing their time and expertise to this book. To Dr. Marzia Bolpagni from MACE Group, Alain Waha from Buro Happold, Andrew Victory from Arcadis, Richard Petrie from buildingSMART, Pim van Meer from VORM, Anna Lazar from Autodesk Construction Cloud and Martyn Day from AEC Magazine - thank you for your timely contributions.

Second, we wish to acknowledge the valuable contributions of the reviewers regarding the improvement of quality, coherence, and content presentation of chapters. Most of the authors also served as referees; we highly appreciate their double task.

A special thank you to Hazenberg Bouw | TBI for being our pilot user and helping us push through the challenges faced by the industry professionals.

Finally, our heartfelt thank you to our internal contributors, Christian Friedrich (Product Owner), Hugh Geoghegan (Product Specialist), Paul Varghese (BIM Consultant), Hristina Balabanova (UX/UI), and Milu Sini Lal (Marketing Executive). It took an immense amount of work and it would not exist without the invaluable contributions of these incredibly thoughtful and supportive people. Thank you to everyone who strives to grow and help others grow!

TABLE OF CONTENTS

Introduction

The AEC industry deploys BIM for 3D visualization, clash detection, feasibility analysis, constructability review, quantity take-off, and cost estimation. BIM results not only in 3D modeling, but also, and most importantly, effective information management, collaboration and coordination among professionals, and process automation.

The construction industry is going through a digital transformation journey, leading to rising demand for better model coordination between teams and a better-integrated workflow. Although the construction industry operates in a highly competitive environment, it requires constant innovation and efficiency. Several impediments exist in the construction industry that prevents companies from embracing digital transformation.

A significant part of the classification and checking of building models is still performed manually, costing a lot of time, effort and is prone to error. Although every project is different, the most common challenges are model coordination and the lack of interdisciplinary coordination between designers, engineers, and contractors.

Changes during the design and construction of a project are inevitable, and they often result in a better end result. On the other hand, changes aren't always a good thing, such as those that occur because of a mistake or that could have been avoided.

Costly changes, such as those that necessitate reworking, can be the result of clashes that could have been recognized earlier—or, better yet, before the construction began—but were not. Other times, they are the result of a lack of attention to detail. When models lack the level of detail required for construction, they necessitate an excessive amount of interpretation.

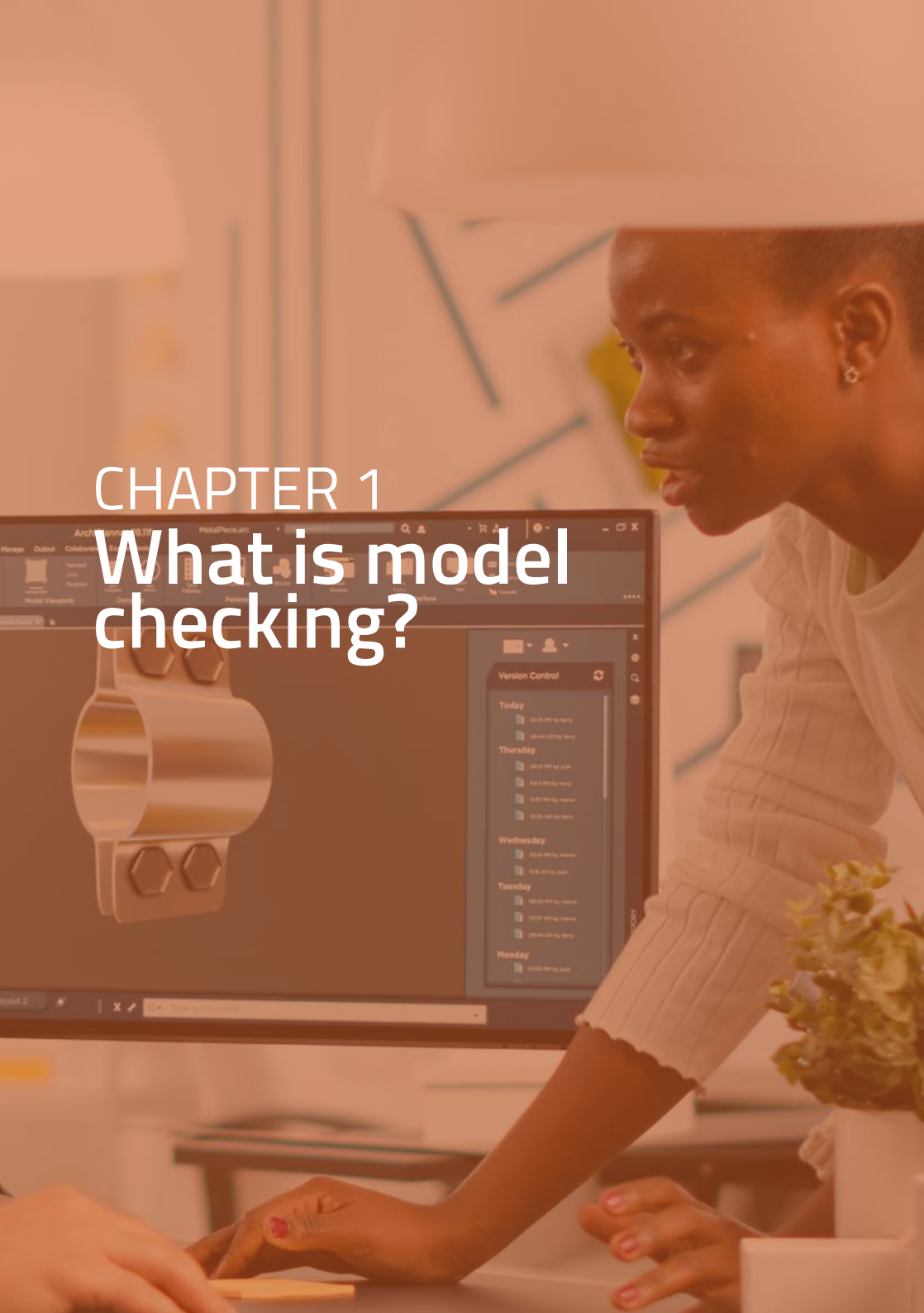
Teams often make changes on the fly that aren't well explained and communicated, causing delays in the work of those behind them. These changes can be painful and can throw timelines and budgets off.

A collaborative approach makes it much easier to ensure that the inevitable changes are reflected in everyone's designs accurately and consistently.

However, collaboration alone is insufficient. The usage of BIM helps with increasing construction efficiency, promoting team communication and knowledge exchange, and supporting construction-related tasks. As more businesses embrace digital transformation to better coordinate their workforces and streamline business operations, analog systems are being phased out for good. Model-checking has become an integral part of information modeling and management. How to identify potential clashes early on and improve collaboration with key stakeholders? How to minimize these types of changes? How to ensure that everyone involved is working from the same model?

Well, this book answers all these questions. It discusses the key industry trends shaping the AEC industry, how to improve the digitalization process of model checking and get started with clash checking. Furthermore, this book elaborates on the different options of clashing and checking, the top 5 benefits of clash checking in the cloud, and how templates help in simplifying the checks. Harness the opportunities automation provides by efficiently transitioning between manual and automated workflows (and vice versa).

Continue reading to have a better grasp on model checking, clashes, and how to avoid clashes. Read our user story to learn about the advantages that TBI is leveraging by implementing Verifi3D!



CHAPTER 1

What is model checking?

What is Model Checking?

With the growth of the use of Building Information Modelling (BIM) around the world there is an increasing requirement to manage and check the information being produced

There is a common misconception that when we refer to the "model" as it relates to BIM (building information modelling), that it is just a 3-dimensional geometric model, and that "model-checking" means checking the 3D geometry, or what is also know as "clash-detection" (making sure 3-dimensional objects can work and fit together to occupy the 3D space).

But the "information model" as defined in ISO19650, is the combination of (1) geometry, or graphical data, (2) structured alphanumeric attributes and properties, or non-graphical data, and (3) relevant and related documentation, all held in a managed or controlled Common Data Environment (CDE), then "model-checking" should involve the checking of all three types of data, including the content and structure on the Common Data Environment.

The ISO 19650 Standards provides a structure to manage information over the whole life cycle of a built asset using Building Information Modelling. By doing so the information required, the party responsible for the data, and the Level of Information needed is clearly defined at an early stage so that the delivery of this data can be fully checked.

The BIM process provides greater clarity and transparency with regards to the information, is based upon collaboration and sharing of information, is aimed at avoiding waste, rework, and saving time, and avoiding misunderstandings to achieve our project goals. These aims can only be achieved with proper planning, definition, and management of the BIM process.

Checking the information models is critically important to make sure nothing serious has been overlooked, which may lead to problems later, but before checking the information model, we must first understand what it is we are checking for, where do the different parts of the information model reside, who is responsible for creating and delivering the different part of the information, when must they deliver the information and how. Only when we understand

this can we check that the information provided meets the project information needs and standards.

The graphical data required in the BIM Model, is defined, and managed in a responsibility matrix, so the BIM coordinator/manager can reference this to check the completeness of the information. The non-graphical data also comes from the BIM 3D model and must refer to the requirements managed through the responsibility matrix.

The documents and their requirements are defined and managed in the Master Information Delivery Plan. The Responsibility matrix and the Master Information Delivery Plan therefore are essential documents for managing a BIM project and provide tools to measure and check progress against. These agreed processes in line with ISO 19650 are documented in a BIM Execution Plan and implemented through a BIM protocol

In defining the information requirements and level of information needed it is important to understand that the "information model" must provide the necessary information to achieve the objectives of the project. So, what are the "objectives" that most clients want to achieve through BIM on projects?

- They want a clear understanding of the "Scope of Work". Will the project meet their needs? The 3D geometric digital representation will help them understand what is being proposed, and whether it can be physically assembled and constructed in 3D space.

- They want a clear understanding of the "Programme", or the time it will take to deliver, and the sequence of work or logistics of how it will be delivered safely (what is sometimes called 4D BIM)

- They want a clear understanding of the "Cost", and "Cashflow" (or cost over time), as well as confirmation of "Earned Value" as works progress, so they are not overpaying, or under financing (this is sometimes called 5D BIM)

- They want a clear understanding of the "Quality" of workmanship, and the expected durability and performance of the building or infrastructure

asset, as well as lifecycle ·costs, such as cost of ongoing operations and maintenance (sometimes referred to as 6D BIM)

- They want an accurate and complete digital building record, or information resource, to support future operations and maintenance or their asset, and also to meet their obligations under various regulations (sometimes called 7D BIM).

So "Model-Checking" has to answer the following questions:

- Do we have a complete and comprehensive "list" of all the "products", materials or components, required for this project?

- Is there a 3D geometric or graphical representation of the "products" to indicate it's size, location and relationship (or connection) to other "products" in the 3D model?

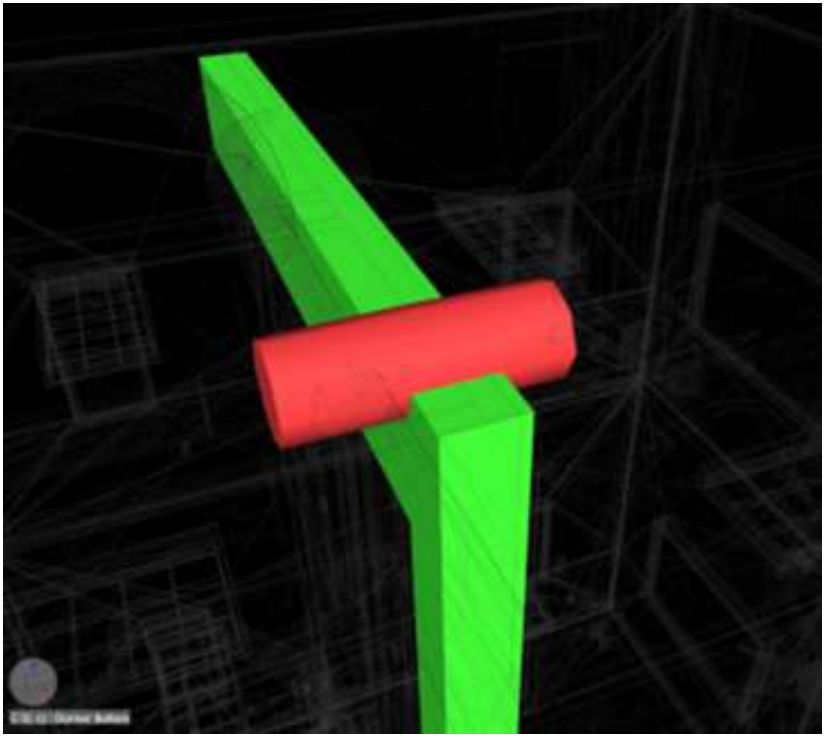
- Is there a collection of structured (organised) alphanumeric properties/attributes of data, that described the physical and functional aspects of the product, in a digital machine-readable format that may be required for other analytic purposes?

- Is there a collection of relevant and related "documentation" about the "products" to certify it's installation, demonstrate compliance with regulations, and provide useful information for operations and maintenance?

- Is all the information noted above available in a carefully managed and organised Common Data Environment (CDE) as specified in ISO19650 standard?

Content-checking and validation can analyse if models have been properly constructed according to the BIM Execution Plan and the responsibility matrix for that specific stage of work, that they comply with specific appointing party's (client's) requirements. The information model should be appropriate to the project stage, with sufficient information for that stage to be developed further at later stages avoiding over modelling and waste of effort.

All models must have the data needed for each specific project stage before being shared with other stakeholders through the Common Data Environment (CDE) for the following phase. For instance, COBie (Construction Operations Building Information Exchange) and Uniclass (non-graphical data) attributes should be added from an early stage and increased during the life cycle of the project.



Evidence of a clash between a HVAC and Structure component

For consistency, models must follow the same organization in terms of family name, parameters name, workset, and phases used in the project. A file naming convention is also agreed at an early stage for all documents and should be followed to pass the validation step and be accepted by the task information manager of the organization. Moreover, BIM-process is a synonym of collaboration and for this reason, everybody needs access to be able to review other parties' models. The format file saved for sharing purposes is also

important to ensure interoperability between software. It needs to be kept clean and organized for future and third-party ease use. For instance, unused views and working views must be removed, model issues must be removed, model file purged to manage file, project browser set up correctly and so on.

Content-checking involves the use of software that checks the information in a model by using predefined rules. There are different software applications available that that allow us to customize or create rules to interrogate the model allowing the customization of checking parameters.

Another important aspect of BIM-based model checking is clash detection. There is a number of different software available that allows us to create a federated model (combination of multiple models of different disciplines) and to check, through customized rules, if there are clashes to be removed. The purpose of clash detection is to coordinate a project from an early stage and have zero clashes before going on-site, reducing construction rework and material waste.

Clashes occur due to the intersection of physical components of different disciplines sharing the same space, the lack of space around equipment following specific project standards, the conflict between the workflow and the equipment schedule.

Once the clashes are found, they are assigned and reviewed by the responsible party and resolved or agreed. Clash detection can be automated, and rule based using relevant and customized rules to avoid reporting false issues. For instance, a typical false issue is a clash between the ceiling and an air terminal. In that case, the BIM coordinator or manager must create a rule that makes the software understand that this clash cannot be considered a proper clash or issue.

The increased collaboration between the different disciplines within the design and construction teams, the single source or truth in the information model geometry, non-graphical data and documents hosted in a CDE, a properly planned and defined set of deliverables, and robust checking procedure, provide the template to deliver our projects with less errors, less rework, less overall costs, and provide a better product for our clients and end users.

The importance of "model-checking", cannot be stressed enough. Everybody should be aware, that resolving a coordination issue on site, is the most expensive, most disruptive, and most dangerous place to resolve problems, and most often these changes made on site are not captured in the digital record. Resolving coordination issues in the digital model, before executing work on site, is the least expensive, least disruptive, and safest place to resolve problems, and that is why we need to strive to complete as much of the information in the digital model as possible, and check it thoroughly, before trying to execute the work on site.

Meet the contributor(s)

Chiara D'Amico
BIM Coordinator
ARCDOX

Pat Slattery
Managing Director
ARCDOX

Rule-based model checking is transformational.

With BIM, we shift our industry to a "Semantic" representation of the design and the assets. This becomes truly valuable only when we exploit this new representation of our Built Asset information. With rules-based model checking, we take a quantum leap in using this information in new ways. We mobile computing power to improve our ability to deal with the complexity of projects, to validate designs, or to assure data we hold and transact.

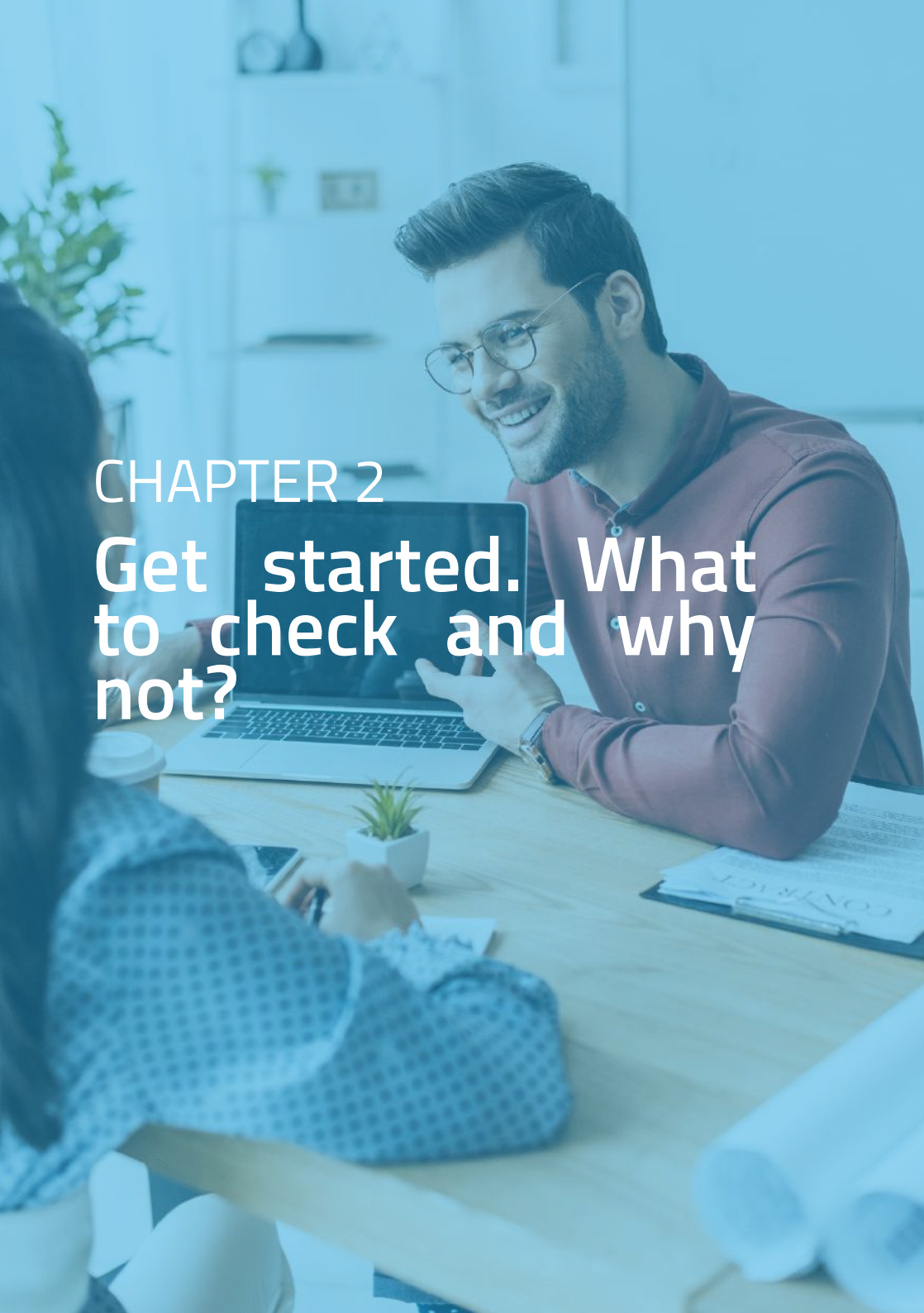
First, to implement ISO19650 meaningfully, we must have high information quality and assurance. This is a pre-requisite on achieving value from Collaborative BIM (the promise of CDBB: £3 benefit for every £1 invested) We need to assure the information is being delivered as required, and to the declared standards. At scale, this is only possible with machine-readable rules, and automated model checking. We are excited that XInaps is building the product the industry needs: cloud-based, collaborative, pre-integrated into the BIM ecosystem.

At Buro Happold, we believe Automated Model Checking will go beyond data and will augment in other ways our work to design a higher performance environment. Often, our work is advisory, and we would prefer this to be codified in machine-readable rules, so that our design teams can focus on solving the challenges, rather than identifying issues.

Alain Waha

Chief Technology Officer,
The United Kingdom

BURO HAPPOLD



CHAPTER 2

Get started. What to check and why not?

To check or not to check?

In a project, various disciplines work together to form the building. Working digitally in the project sometimes feels like solving an impossibly large puzzle. For a digital building process to work and in order to create a good building, all disciplines must work together.

What we often hear is that this puzzle is easily solved by 'model checking', putting models together and looking for the intersections between the models. By underestimating the work which needs to be done, these parties often struggle with a process that does not run smoothly and where everyone points at someone else rather than themselves throwing information over the fence. Something we definitely want to avoid.

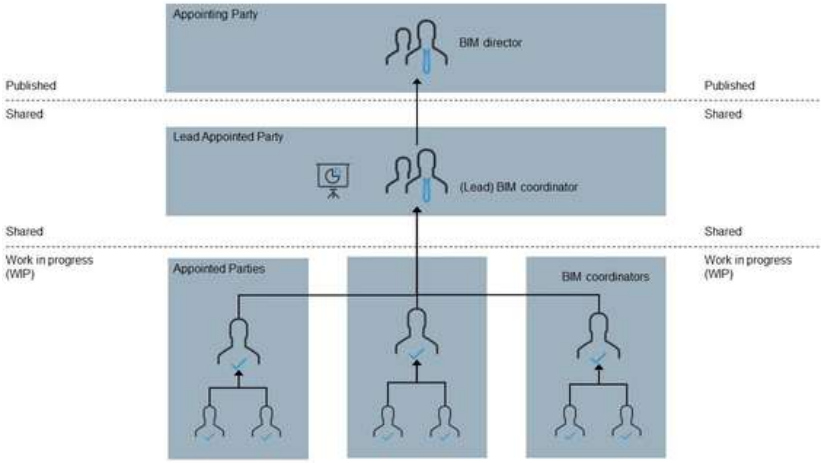
For a good approach to model checking, it is important not only to look at the model check itself but also to think about the collaboration and the process. After all, you don't just start puzzling until a piece of the puzzle fits, there has to be a plan.

The central BIM coordinator according to ISO 19650

The ISO 19650 is our backbone for our services, the standard for digital information management throughout the building lifecycle. Looking at the standard, the role of 'lead appointed party' is defined in order to achieve a good process.

As 'lead appointed party', often in the Netherlands the central BIM coordinator, you are in between the project team, the client and the contractors. You ensure a supported process by means of a BIM execution plan (BEP), a plan for the collaboration and delivery of the information model. This is a very important step that will be crucial for model checking. It establishes the basic agreements for the project and creates a base for further collaboration between the project team and other stakeholders. If everyone is on the same page, achieving the goal is much easier. In addition, a 'lead appointed party' is responsible for the delivery of the information model to the client. Disciplines are well coordinated, so that all the pieces of the puzzle fit together. Not only the spatial position but also the object information is well coordinated with each other and with the client's requirements.

A BIM model is a treasure trove full of information; it not only describes a geometric shape but also has a lot of non-geometric data linked to the elements. This data is becoming more important every day; it is increasingly seen as the new gold. As central BIM coordinator, your task is not only to check the spatial coordination, but because you act between the contractor and the project teams, the data is also an important part.



Action plan

As the lead appointed party, you think about the entire process in advance and draw up an action plan together with the other parties. By means of a BIM execution plan, it is established how the project team will work together and when, which information will be conveyed to the other parties. It is also agreed where the demarcation of the models lies, and who is responsible for which parts of the building. The BIM execution plan is a living document in which certain BIM-related decisions are captured during the development phase and handed over to the construction parties for the next phase.

Four flavours of model checking

Together with the project team, the building is shaped and the project coordinated, comparable to a (super-advanced) puzzle where the pieces have to fit together. But there is a catch: an added dimension where the shape of the puzzle pieces can change at any time. Therefore not an easy task. Not only do the various disciplines have to fit together, but the parties also have to ensure that the information supplied is correct.

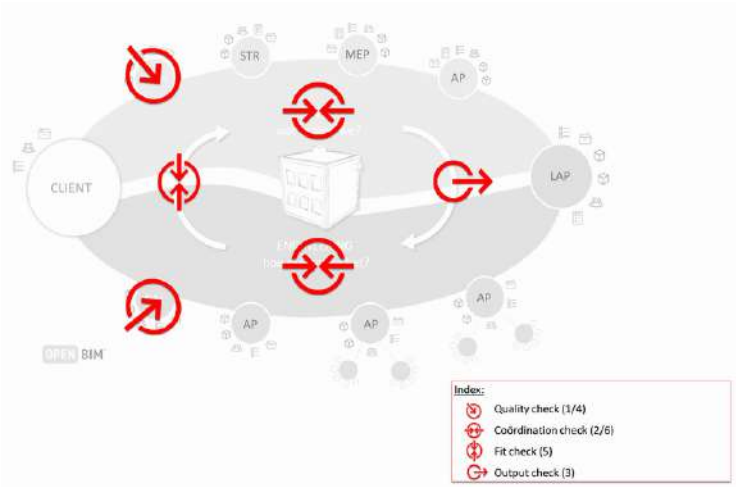
From various perspectives, different flavours of model checking can be defined throughout the process, resulting in 4 flavours and 6 checkpoints.

The hamburger model

In the Dutch building process, two major phases can be distinguished, the design phase and the realisation phase. The concepts of the two phases can be mirrored using the hamburger model, developed by Wim Gielingh in 1988.

The model distinguishes between the performance models at the top: WHAT are we going to make and WHY do we need this solution and mirrored at the bottom of the hamburger the production models: HOW are we going to create it.

In other words, the requested functionality in design is mirrored to the actual solution in the realisation phase, where this solution should directly map the functional concept. This is also the process we see in the models.



Quality check

The first taste of model checking focuses on each aspect model itself. Each model in itself must have a certain base quality. The Dutch standard BIM Base IDS focuses on a workable model with basic information. The quality control checks for correct geometry as well as for unambiguous and structured data. The information provided is correct and there are no clashes or duplicates in the model itself. The responsibility for delivering quality is a task of the delivering party, but as a coordinator, it is an important first basic check in order to be able to work with these models. This model check occurs in both the design phase and the realisation phase.

Coordination check

The second flavour of model checking is the coordination check, which checks the intersection between different disciplines. Most people think of this kind of check when thinking of model checking. Different models are loaded together in a federated model and are checked for intersections (or so-called clashes) and other integration-related topics. This step is applied both in the design phase and during the realisation phase.

Fit check

The third kind of check focuses on the cooperation between the design models

with a similar kind of model in production, a so-called fit check. Does the production model fit within the framework of the design, or are there major differences to be discovered? So instead of a clash, we look for similarities in the geometry.

Output check

Finally, the fourth flavour is a check of the information that is sent to other parties or the client. Is the information present that was required by the client? It is also possible that information is passed on to suppliers. In that case, a check is needed for the information they need to be able to continue working with the model.

Each flavour has a different approach in model checking and which parts of the building are going to be important in the check.

But then...

The process is arranged, the different flavours and the purpose of the model checks are clear. The coordination process then seems to be very simple, we integrate the different aspect models into the federated model, enable a ruleset that will analyse the models and press start! The tool gives a total of 10,000 issues in the blink of an eye. So where do you start? How do you get to the issues that really matter? And what are the most important issues to start with?

The building as a puzzle piece

Sort out the right pieces of the puzzle

Approach the building as a puzzle: every aspect model is part of the puzzle, every object a puzzle piece. Each piece has its own place in the puzzle, each object its position in the building. As we begin to lay out the puzzle, we will not fit each piece into another one by one. We will start sorting the puzzle pieces, by colour and/or by position in the puzzle, edge pieces or centre pieces, images we recognize. Sorting the pieces provides focus and makes it easier to solve the puzzle.

The building can also be approached in this way by sorting, classifying, the building, object by object. In doing so, choose a filter that fits the work that needs to be done. Is this a quality check or a coordination check? Is the building shell being tested or will you check the free space around mechanical installations? By making filters for example based on entities and characteristics or based on classification systems the model is divided into logical and recognizable work packages. With this practical working method, you will get to know the building and its models easier, and you will have more insightful coordination of the building.

A visual check

After the puzzle pieces have been sorted, we suggest carrying out a visual check. With the most important pieces, the edge pieces, we look for exactly the right shape and colour of the puzzle piece that fits. This defines the working framework and gives the puzzle its shape.

In a visual model check, we also include the previously created work packages. Starting with the most important parts, for example, will the structural slab fit with the walls of the architectural model. Here, the building is approached as it will be built. Working from coarse to fine and according to the created plan. When working with digital models make sure to keep the focus on what is important for the phase of the building. It is easy to check objects which are not yet ready or lose yourself in the details. Create a plan and work according to that schedule.

Automation as a blessing

Putting together a puzzle is manual work and because of that, it gives most people a sense of relaxation and control over the process of creation. A process that you actually do not want to automate, because it will lose the magic of puzzling. And it's just that (super advanced) puzzle of the building in which we want to automate processes and decrease the chances of mistakes in manual work. It is also nice to automate boring repetitive tasks or specifically an automation process for very complex tasks.

In any case, make sure that this automation follows the natural learning process. Nobody benefits from a black box being created in which it's not clear

what is happening after clicking on start. The step-by-step deployment of small understandable micro-processes provides more insight and faster acceptance. For example, drawing up a clash matrix will provide a practical guide for setting priorities for that specific task. It's a plan of action for sorting out which work packages should be checked first against each other and which building parts should be checked later in the process of development.

Stick to the plan

This super advanced complex puzzle of the building is not easy to crack. It takes time, teamwork and, above all, human effort. It involves much more than just a quick check of a model. Good agreements ensure that this complex puzzle will become clearer and can be built up step by step.

Making a good plan in advance of your project gives everybody on the team a clear insight into how the coordination process will be carried out and how models will be checked. Make sure to add this to the BIM execution plan of the project. And don't forget to ask yourself with every piece of your puzzle; 'to check or not to check?' before you click that button CHECK!

Meet the contributor

Denise Bos
BIM Consultant
BASED
on your future

Verification and validation of information are keys to getting information that we can rely on over time. It happens to me that a client with 200+ models contact me because they had information, but they could not rely on it as checks were never performed: what a waste!

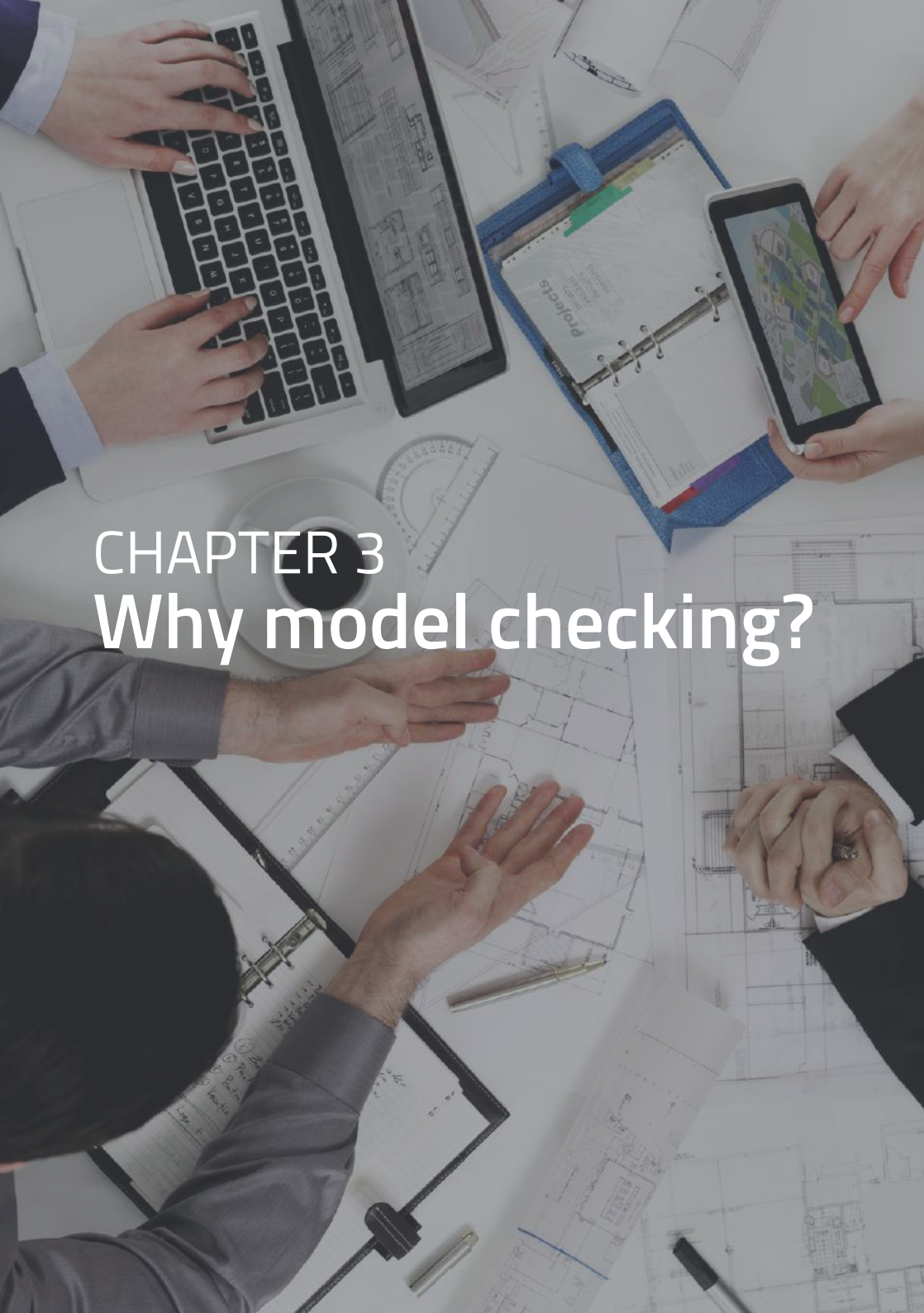
If you want to be successful in implementing digital methodologies such as BIM, you need first to define your requirements in a way that can be automatic or semiautomatically checked by following the indications of the level of Information need standard EN 17412-1. Then it is key to set a strong strategy for quality assurance with well-defined roles and responsibilities, tools and processes. The delivery team should self-check their deliverables before submission, then the client's team should perform quality and assurance and make sure that requirements have been met.

Do you not be surprised if the implementation of digital in your projects is not working if you did not implement a strong quality and assurance strategy. Lean principles also include the checking phase as key to assurance quality: plan, do, check, act!

Dr. Marzia Bolpagni

Head of BIM International - Associate Director, The United Kingdom

mace



CHAPTER 3

Why model checking?

BIM usage evolves

As BIM usage evolves, so do reasons for model checking. In recent decades, the construction industry has moved from paper-based drawings to digital drawings. From there it proceeded to BIM models. Even more recently, it started to embrace BIM supporting services in the cloud.

Nonetheless, the level of BIM adoption is unevenly distributed. Many companies work on digitising and encoding their paper-based document structure into structures of digital documents. Other companies have continued to the follow-up step, digitalizing, and adopting fully digital workflows. They rely on information structures that exceed the conventional notion of documents.

Especially the latter steps of digitising and early steps of digitalisation form a threshold for BIM adoption. This is due to the need to overcome both cultural and technological complexities in construction projects. It is necessary to connect a multitude of software systems. Professionals from multiple disciplines need to co-create coherent digital twins. And contractually obliged companies need trustworthy business propositions.

To grow beyond this struggle, model checking has to lower the threshold for transition. It needs to reduce the biggest risks, establish common languages, help people to express what they expect from one another. There is more than one reason to engage with model checking. How are these reasons related?

A dynamic model for motivation

The complexity of the ongoing digital transition contributes to the diversity of reasons to adopt model checking workflows. To get a better grasp on this situation we will consider a well-known model for motivation, Abraham Maslow's Hierarchy of Needs. (Maslow, A.H. (1943). "A theory of human motivation". Psychological Review. 50 (4): 370–396.).

Maslow noted that "typically an act has more than one motivation." As motivators for human action, he identified five basic needs:

- physiological,
- safety,
- love,
- esteem and
- self-actualization, which he further detailed into
  - cognitive,
  - aesthetic,
  - self-actualization and
  - transcendence.

Maslow's hierarchy of needs is best known in the form of a pyramid diagram (Figure 1).

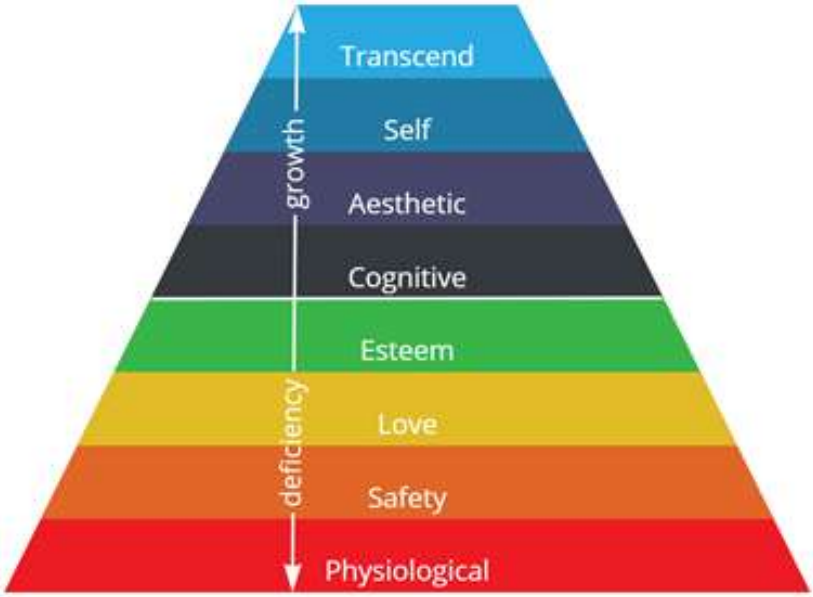


Figure 1 - Maslow's Motivation Model

The hierarchy is more than an ordered list. It is a dynamic model for the relationship between needs which explains how primary goals change over time. Maslow noticed that the drive to fulfil any one need is related to the fulfilment of other needs. The motivation to fulfil higher-level depends on the fulfilment of lower-level needs. The lowest unfulfilled need is the most important. As each need from the base up is satisfied, the next following appears as the most important. As we scale the hierarchy all fulfilled needs still matter, but in reverse order (Figure 2).

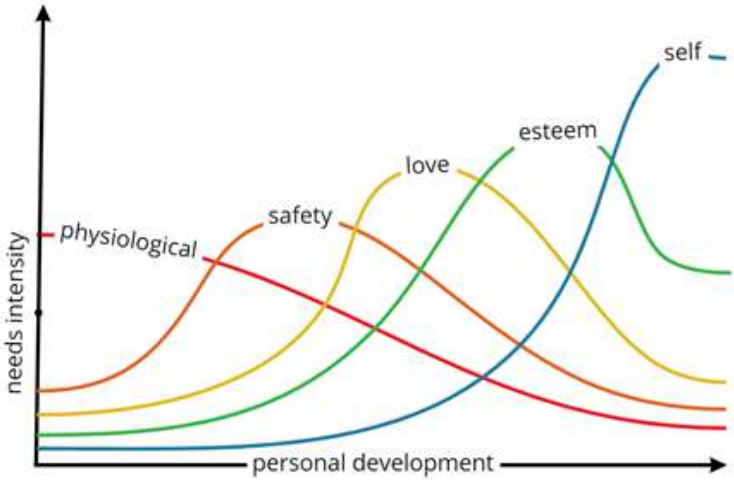


Figure 2 - Gratified needs are not active motivators

A hierarchy for model checking needs

We can adopt Maslow's hierarchy to better understand needs and motivators for model checking. By doing this, we will also gain insight into how these needs depend on one another. The resulting hierarchy of needs for model checking looks as follows (Figure 3).

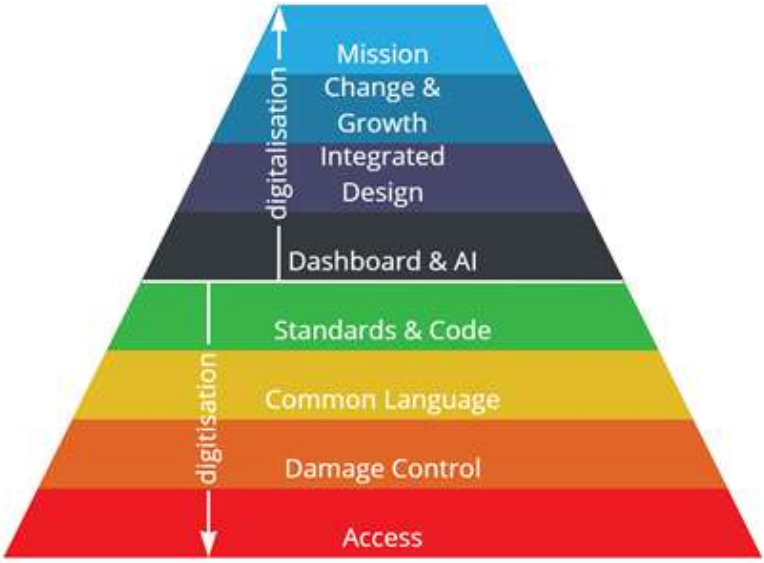


Figure 3 – A hierarchy of Model Checking needs

1. Access (Physiological)

Ensure secure access to the models.

Fulfil pre-requisites for any form of model checking to occur. Models must be accessible, and files should not be corrupt. It should be possible to view the models.

2. Damage Control (Safety)

Avoid the costliest mistakes.

Shield the project from the costliest modelling and specification mistakes. One example for such mistakes are geometry clashes that can prevail through design, estimation, and construction. A checking environment also needs to be secure. Access by permission only.

3. Common Language (Love)

Establish a common language within the project team.

The participants of the project team need to be able to find a common language. They need to be able to express their expectations to one another. This can be done in the form of exchange information requirements, product data templates, and project-level information delivery specifications.

4. Standards & Building Code (Esteem)

Relate to the outside world and earn recognition.

The common language needs to resonate with standards and practices widely acknowledged by the industry and with the regulatory requirements laid out in the building code.

5. Dashboards & AI (Cognition)

Gain knowledge, acquire an understanding.

Now there is objectively meaningful information to display on dashboards. Key performance indicators can be defined. This is also the level where machine learning can deliver ever better insights.

6. Integrated Design (Aesthetic)

Exceed the technical perspective.

Requirements can be expressed for both design concept and technical performance. In this way, aesthetic solutions are on equal footing and better match with technical solutions.

7. Change into Growth (Self-actualization)

Grow and differentiate your company.

Individual users and organizations can develop a signature style and diff-

erentiate themselves, whilst still ensuring the achievement of common goals.

8. Mission (Transcendence)

Understanding to wisdom.
Holistic perspective. Change the industry. Build a better world.

You may disagree with the order of this hierarchy, or even with the items in it. If so, take the model as a basis for discussion. Which needs do you think exist, and in which hierarchy?

Be prepared for the next why

The proposed model offers the following:

- It is a generic overview of the needs which model checking can fulfil.
- It lays out how they exist in a hierarchy, and how this hierarchy develops dynamically.
- It helps name the needs you currently perceive, in relation to other needs.
    - o Find which lower-level needs ought to be fulfilled first.
    - o Find which needs you may experience after you fulfilled your current ones.
- It can serve to map out a BIM adoption plan across the entire hierarchy that reaches out far beyond the needs that are currently apparent.
- It may help you to choose tools that are compatible with your organization, fulfil your needs, and have the ambition to be future proof.

As the industry moves toward a digitalised workflow, we all have needs for model checking. And there are many reasons, just like there are many people filling various positions in various companies with different priorities. They all have in common that they need tools which unburden their workload in a tough industry. These tools need to simplify the complexities of BIM, establish trust between parties, and invite everyone to gain insights and add value. Model-checking helps people build better, together.

Meet the contributor

Dr. Christian Friedrich
Product Owner
Verifi3D by Xinaps

WHICH PATH WILL YOU TAKE?

PATH 1

MANUAL CHECKING

Step 1

Manually load files

Step 2

Import files locally

Error prone and time consuming

Step 3

Load models to check

Step 4

Create filters

Step 5

Create rules

Time consuming and expert based

PATH 2

AUTOMATED CHECKING WITH VERIFI3D

Step 1

Sync models with CDEs

Quick and accurate

Step 2

Load filter templates

Step 3

Load rule templates

Quick and easy to do

PATH 1

MANUAL CHECKING

Step 6

Visualise checks

Step 7

Verifying checks are real issues

Step 8

Report issues

Step 9

Export results to an excel

Outcome

Repetitive manual checks are prone to errors and are time-consuming.

PATH 2

AUTOMATED CHECKING WITH VERIFI3D

Step 4

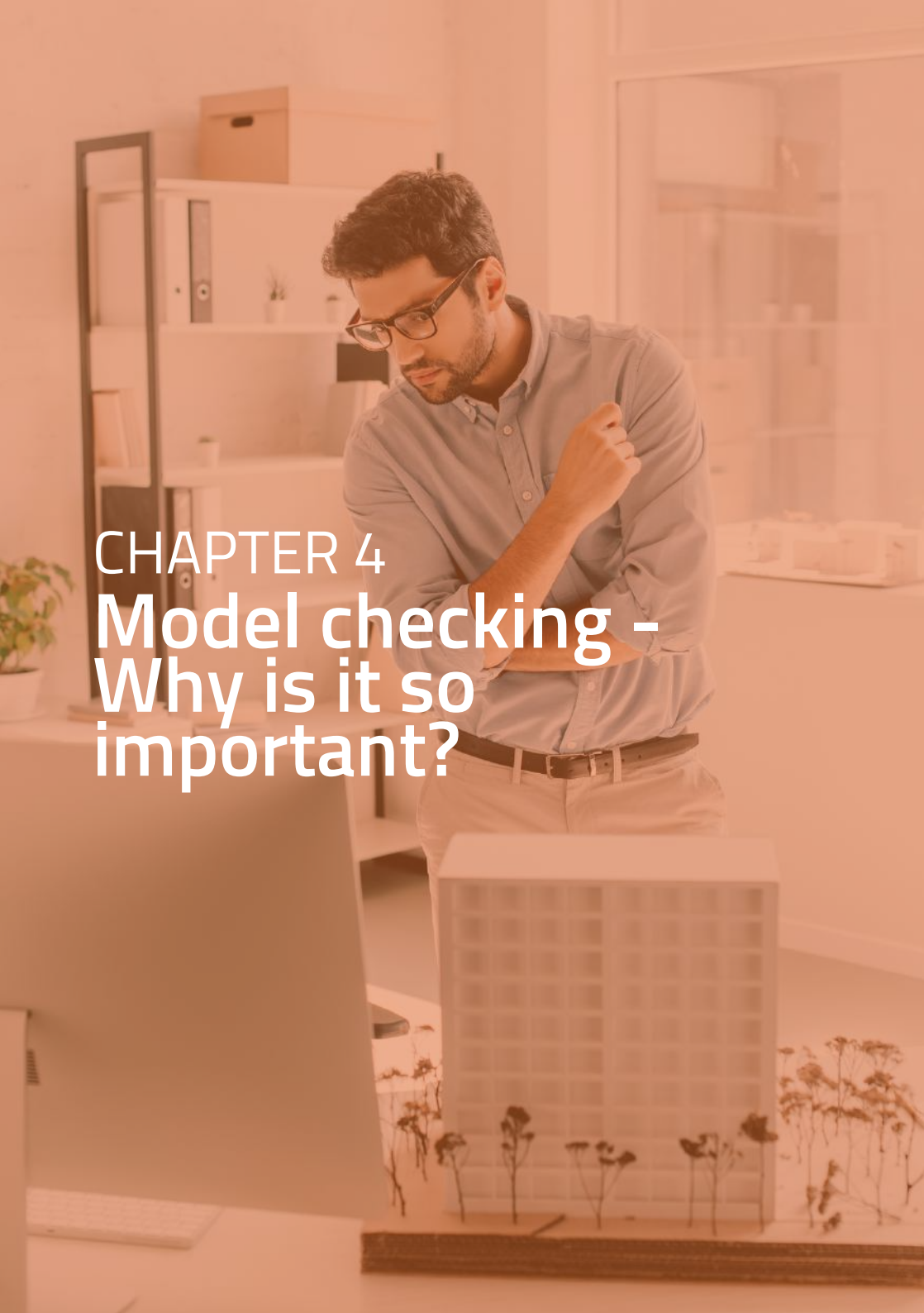
With filters, all checks are specific

Step 5

Report, assign and track issues and sync them with issue trackers of your choice

Outcome

Optimize and automate your workflow and save up to 40% of your time.



CHAPTER 4

Model checking - Why is it so important?

European perspective

In the European construction industry, things are changing. Digitalisation is seen as a vital component in the transition to more efficient and sustainable work practises. The[1] desired transition to digital workflows in the construction industry is being facilitated by the implementation of BIM (Building Information Modelling). To perpetuate and encourage better digital work practises for BIM the European union is advocating the creation of common standards. These standards are the focus for improved performance, energy efficiency and cross-border competitiveness within the European public sector. EU Policy encourages that construction partners from alternate member states use the same (BIM) digital language, be familiar with the same standards and have the same ideas about (the management of) BIM processes if the transition to more sustainable work practises are to be achieved. For everyone to be able to speak the same language, a common language is needed. For the European construction industry, this language is BIM. By adopting and implementing BIM standards within construction projects the EU identifies the need for a common language in which modelling can be checked against project requirements. If the transition to more sustainable working practises is to be achieved, the quality of the data being produced needs to be optimised. Verifi3D is a browser-based, model–checking software which truly understands the need for more flexible approaches to interpreting and validating this language.

Sustainable construction industry

The European construction sector is obliged to meet energy reduction targets in accordance with the European Performance in Buildings Directive and the Energy Efficiency Directive. In total, 40% of energy consumption and[2] 36% of CO_2 emissions come from[3] the built environment. These consumption patterns cannot continue and action is being taken thro[4]ugh policy to counteract this trend. The convergence of the CEN/TU 442 BIM Modelling and CEN/TC350 Sustainability of Construction standards committees, both i[5]nitiated in 2016, highlight the link between BIM (Building Information Modelling) and

1 European Industrial Strategy. European Commission (2021) **https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en**
2 EPBD, "European Performance in Buildings Directive." 2010.
3 EED, "Energy Efficiency Directive." 2009.
4 I. WBCSD, "Cement technology roadmap 2009: Carbon emissions reductions up to 2050.," 2009.
5 BIM Loket NL – EU BIM Standards **https://www.bimloket.nl/p/153/CENTC-442-Building-Information-Modelling**

sustainability objectives within European policy. The EU's industrial strategy[6] emphasises that;

"Europe's future is determined by the successful achievement of the twin digital and green transitions."

Through the standardization of BIM processes, the production of digital information becomes a direct input to sustainable objectives within the European construction industry. BIM has long been highlighted as a means to provide not only a more efficient design process but also more sustainable built outcomes. For this transition to take place model checking software such as Verifi3D becomes increasingly important. Flexible, browser-based model checking software needs to be augmented by project-specific model checking templates which emancipate the checking process from expert-based silos.

EU BIM Task Group & ISO 19650

EU policy relating to sustainability converges with BIM policy through standards such as the ISO 19650[7]; The ISO 19650 standard is an international standard for managing information over the whole life cycle of a built asset, from project initiation right through to facilities management and beyond, using BIM. The standard aims to facilitate better environmental performance through improved decision-making. The standards have been advocated by the EU BIM Task Group who are tasked with aligning Europe's approach to standardisation within the European construction. The EU BIM Task Group was set up to inform and encourage the implementation of BIM on European construction projects. One of its key aims is to improve the sustainable competitiveness of the European construction industry. It is predicted that BIM can predict and inform decisions regarding carbon footprints, material choices, waste, operations and maintenance, documentation of environmental impact and Post Operation. Evaluation (POE.) One of the key barriers to BIM implementation within the EU has been the absence of a common process which guides the production, administration and delivery of information models within projects. Through the ISO 19650 guidelines, European construction companies have an opportunity to collaborate in coherently structured common data environments. At each point in the model checking

6 EU Industrial Strategy **https://ec.europa.eu/growth/industry/strategy_nl**
7 ISO 19650 **https://www.bsigroup.com/en-GB/iso-19650-BIM/**

process, the deliverables and associated tasks and responsibilities are clearly assigned.[6] With these environments, delivery moments are dictated by the roles of lead and task-appointed parties. Verifi3D is ideally suited to facilitate team-based model checking for project stages. Experts and novices can use browser-based coordination sessions to clash discipline-based models and identify issues in a collaborative environment. Coordination sessions can now be about team building rather than assigning blame.

Model checking – Making it accessible!

Within EU policy BIM has been leveraged as the medium for digitalising the construction industry. However, it is not currently having the desired effect. There are a multitude of reasons for this, the most important of these relates to the predominance of SMEs (Small and medium-sized enterprises) within the European construction industry supply chain. For example, 99% of the companies involved in the European construction can be classified as SMEs (>250 employees).[8] The complex operational environment of SMEs has not been adequately addressed by European BIM policy. Added to this, there is a growing body of evidence to suggest that existing technological solutions are not facilitating the desired transition to digital workflows due to a number of organisation-based barriers[9] such as;

- **Cultural change required**
- **Resistance to change**
- **Lack of skill and in-house personnel**
- **Lack of training and education**
- **Lack of BIM implementation guidance**
- **Lack of new or amended forms of construction contracts.**

These findings highlight that BIM implementation struggles to be obtainable for the majority of European construction companies. The report also highlighted the existence of a digital divide between larger and smaller firms within Europe, between those who can afford to implement BIM and those who cannot. Worst still, this divide is forecast to grow as larger organisations continue to refine their BIM processes while smaller firms struggle with the transition. Being able to engage with European policies is expensive and necessitates a balance

8 https://www.eulerhermes.com/en_global/news-insights/economic-insights/construction-companies-in-europe-size-does-matter.html

9 Charef, R., Emmitt, S., Alaka, H., & Fouchal, F. (2019). Building information modelling adoption in the European Union: An overview. Journal of Building Engineering, 25, 100777.

between complex financial, social and technical factors. **Verifi3D makes room for everyone in construction who would like to undertake model checking. Those beginning their journey, the novices. Those well on their way, the experts. And everyone in between! The unique interrelationship between user access roles (Company, Project & General) supports an approach to data validation which encourages knowledge sharing between organisations within project-based groups.**

Model checking – The catalyst to success!

A recent report from the EU commission[10] highlights that new technological solutions for the construction industry need to address the underperformance of the European construction industry in relation to digitalisation. The areas identified as needing more attention within in this report were;

- **Scalability**
- **Climate risk**
- **Technology that supports life-long learning**

The barriers to digitalisation within the European construction sector are numerous and complex, but what is clear is that innovative technologies which remove unnecessary constraints for the BIM process are needed. There has been acknowledgement of the importance of standards to enable a unified BIM language within Europe. However, most European construction companies are yet to obtain a level of proficiency with their BIM processes that allow them to undertake data validation in accordance with these standards. A further report by EU BIM Task Group[11] highlights that model checking has the greatest potential to benefit the European construction industry through;

- **Savings related to early clash detection**
- **Savings related to prevention of changes in the construction phase**

What is clear from the report is the added value of digital information in the construction sector is vital to the future of the construction sector and its sustainable objectives. In relation to the European construction sector, BIM as a

10 European Commission, Directorate-General for Communications Networks, Content and Technology, (2020) Shaping the digital transformation in Europe. Publications Office. **https://data.europa.eu/doi/10.2759/294260**
EU Task Group (P.19)
11 **http://www.eubim.eu/wp-content/uploads/2021/10/Handbook-BIM_WEB_oct21_compressed.pdf**

language is being standardised and guidelines for collaboration are being provided. Now the importance of "correct" data becomes increasingly important, or as the EU report on Digitalisation in the construction sector states (p.54)[12];

" data analysis is needed to give meaning to all the data gathered and deliver tangible improvements and benefits….. BIM is more and more utilised in the construction sector, thanks to the important benefits it brings in terms of cost-saving, better cooperation among stakeholders and, more generally, improved project performance. However, it is still too limited to the design phase of big projects. Its diffusion to smaller projects and to the maintenance phase of buildings is the next challenge."

Verifi3D – Removing the current barriers

Verifi3D's unique customer-centric approach provides all users with a coherent framework for their model checking. There is huge potential for rule-checking applications for building models to boost the productivity of the AEC&FM industry. However, the potential has yet to fully materialize in practice. Most efforts have been dedicated to dealing with the complexities associated with formalizing rules related to building designs for computability.

To make automated rule-checking applications successful, data availability and accessibility are critical components that must be addressed. **Verifi3D has been conceived as a solution to address these issues. Interoperability and improved collaboration are explicit focuses of the EU approach to BIM standardization. The improvements aim to make the BIM language the common "tongue" of the European construction sector. Data validation through model-based checking becomes a vital enabler to achieving sustainability objectives set out in European policy such as the Green Deal.**[13]

Verifi3D – Classifying

Verifi3D proposes a new way of working. Our emphasis is on collaboration and

12 Digitalisation in the EU construction industry **file:///C:/Users/Hugh/Downloads/ECSO_AR_Digitalisation_2021.pdf**
13 **https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en**

knowledge sharing at the coordination phase of projects. All project stakeholders have the common aim of minimising risks, removing mistakes & delivering high-quality information at relevant project stages. To allow this the visualisation and analysis of information within BIM files need to be easier. Verifi3D proposes a thematic approach to model checking which simplifies the process and removes it from expert-based silos. One of these themes is Classifying.

Classifying is a way to quickly identify value parameters from a BIM file and filter those value parameters into a view and tabulate this information into results (which can be passed to issue trackers or QTOs via excel).

Classifying can involve:

- Visually evaluating the model using data which is colour-coded based on the data itself rather than the original model colours. Visualising the data differently makes it easier to view and understand. Filters and Filter sets can be used to do this.

- Providing criteria based on project information requirements which can be used to categorise elements to be ready for rules. This can be achieved with Filter templates.

- Evaluating the quality of 3rd party information by using value parameters to check for built-in parameters such as assembly codes. Assembly code entries reference a text file installed within Revit and are a good indicator of the quality of the information which has been received. Alternatively, within IFC formats IFC entities can be used to verify the correctness of the data assigned to properties in relation to predefined values. This can be checked with Smart filters & filtersets.

- Providing a picklist against which you can check values, i.e. ensure that all values have a specific classification value. This makes checking easier, for you only have to check that the relevant elements in the classification are defined. This can be achieved with Classification Filters.

Conclusion

Model-checking has been identified as the missing piece in European BIM policy. The current silo-based approaches to data validation have prevented model checking from happening earlier and more regularly on construction projects. Existing technological solutions within the market enable experts to step away from the information flow and remotely check project information in isolation. This approach is counter-productive. Experts have little engagement with their project teams and project beyond the production of issue reports. Coordination of project information should be an opportunity to collaborate and engage with project stakeholders from within and outside project teams. A culture of early and regular checking should enable coordination sessions to be friendly opportunities for team building and knowledge exchange. Verifi3D identifies these opportunities and proposes and an alternative way of model checking which unites project teams in achieving shared goals!

Meet the contributor

Hugh Geoghegan
Product Specialist
Verifi3D by Xinaps

From the very early days of the design and construction of the built environment around us, 2D drawings and specifications have been an intrinsic necessity to communicate how a design idea will be transformed into a real-world asset. However, as part of the evolution of AEC the digitization of the design process is meaning how we communicate design intent being changed forever.

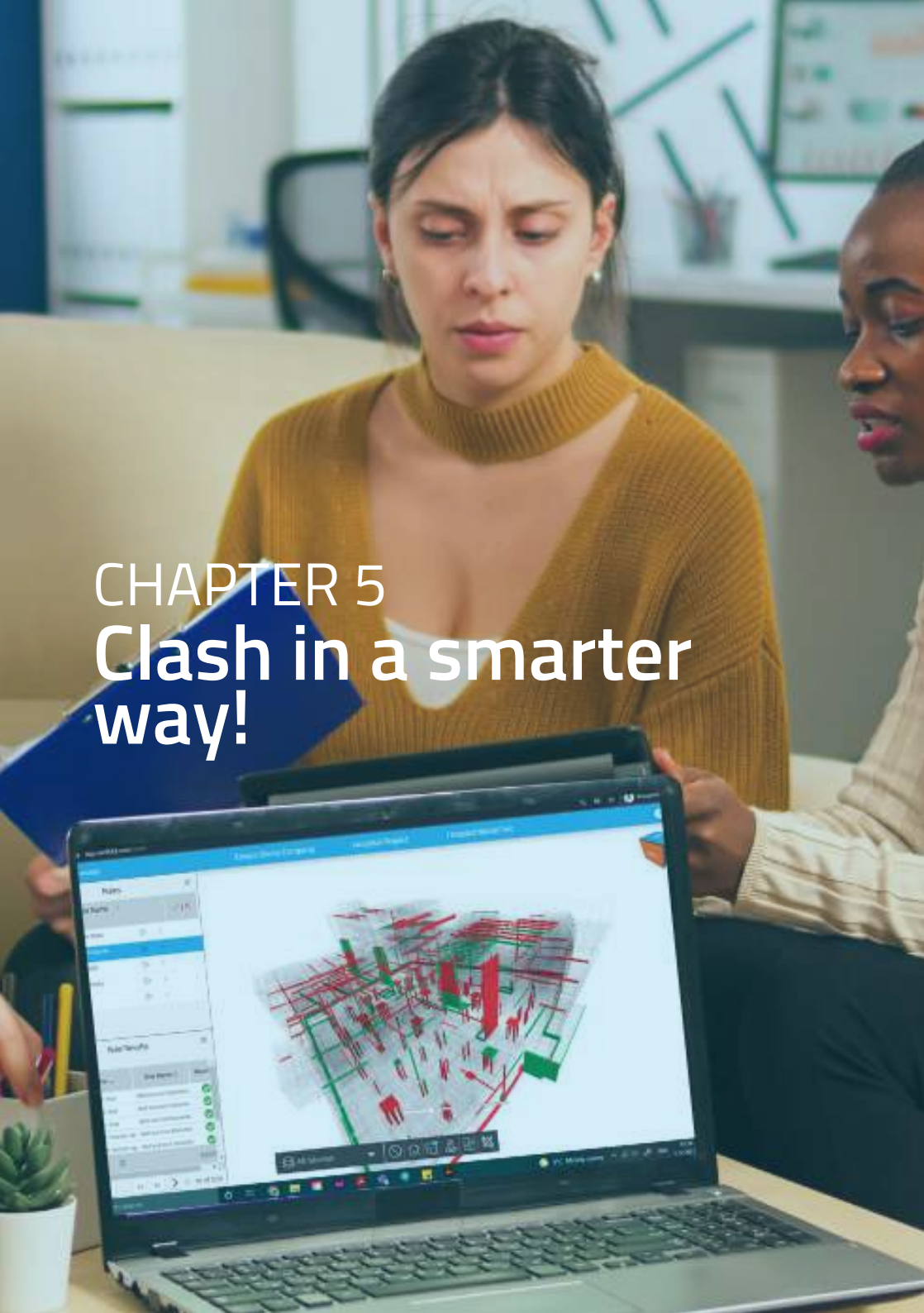
2D representations will continue to exist, but virtual 3d representations of the real-world assets is where we are heading. It will remove ambiguity and increase potential value by allowing to embed more data about an asset. As a consequence, the amount of available information will exponentially grow and with-it complexity. The question therefore is, how will we validate this digital information accurately and where could it be improved?

To undertake this process of review in a repeatable way, to a high standard of accuracy, in the shortest possible time, requires a methodology to bring decision making and stakeholders collaboratively. At Arcadis, due to the variety of projects and geographies that our teams work on, technology is central to how we tackle data complexity. It allows model data to be available to all, in an easy way and be used to effectively and systematically check the quality of the data to bring value and added insights to all parties involved.

Andrew Victory

Global Digital Transformation Lead – D&E,
The United Kingdom

ARCADIS



CHAPTER 5

Clash in a smarter way!

Introduction:

Building Information Modeling is a method of achieving collaboration and coordination in the implementation of design and other aspects of a construction project. Engineering design is a dynamic field that necessitates effective coordination among a variety of stakeholders to achieve desired results. Building design project entails multiple stakeholders, including structural engineers, architects, contractors, suppliers, and vendors, which can make the project completion process extremely complicated and complex. Furthermore, the entire building design and construction ecosystem are confronted with the difficulty of project completion on schedule. Precision and accuracy are key aspects throughout the design phase in such a circumstance.

Clash detection is a term used frequently by AEC firms. Three-dimensional drafting of computational models allows for this type of early detection of discrepancies in the design process. Detecting discrepancies is critical because they can have a significant impact on the construction process, resulting in delays, design changes, material costs, and budget overruns.

Clashes are typical in construction projects with multidisciplinary teams working on a single construction project. Clashes can be geometric, with one structure passing through where it shouldn't, or schedule-based, with elements occurring concurrently rather than sequentially.

There are three types of clashes: hard clash, soft clash and workflow clash. Many hard and soft clashes, as well as workflow clashes, occur when designs from various disciplines are combined on a shared platform. If such model coordination is not done properly this can result in significant rework. By evaluating the constructability or operations of the structure, BIM effectively assists contractors and construction engineers in discovering these clashes.

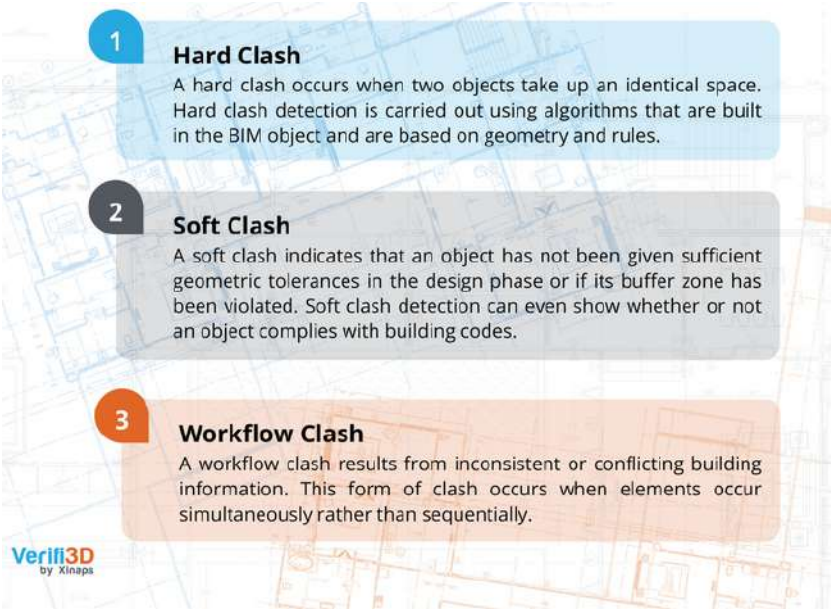
Clashes existed even before the advent of building information modeling methodology in older construction projects. Their detection, on the other hand, was time-consuming since it was mostly done manually. Construction crews would lay out the 2D blueprints and manually check for any potential clashes.

Working as part of a multidisciplinary team might be difficult due to the high level of BIM model coordination and administration that is required. Modern

clash detection techniques have the advantage of detecting clashes early and resolving them before the design is built. As a result, a large sum of money can be saved.

Types:

The term clash detection encompasses a variety of clashes. There are three types of clashes: hard clash, soft clash and workflow clash.



Why do clashes occur?

Clashes are usually discovered and resolved in BIM coordination, at a moment in time when a model or several models together are handed over to other parties. If so, they are resolved only when the model itself is already considered finished. Clashes used to be discovered when the models of all contributing parties were considered to be final.

The causes of clashes are multiple. Only some clashes may occur because of technical errors. The most obvious causes are plain design or modeling errors. But beyond that, the modeled components clash because of differences in the modeled level of detail, or there may be differences in the geometric represen-

tations between different software and model formats. More common causes come down to the process, due to the fact that digital models necessitate completeness and precision even when the design is still in development.

When multiple parties contribute models, they all have insufficient information about the final design. Insufficient information will necessitate them to place placeholders with exaggerated geometries. In other cases, the model may express not definitive geometry but merely design intent. These models may nonetheless persist even into the detailing phase. Finally, lack of (specificity in) design rules will cause parties that model concurrently to intrude into one another's design space. Quintessentially, clashes are a
symptom of the siloed nature of construction project teams, where partners from multiple disciplines work isolated from one another. Even when cloud-based common data environments are available, they might not (sufficiently) support clash detection, and there may be a need for but lack of experts who can execute the checks.

To some extent, to expect no clashes at all could be considered even unrealistic, because all parties must submit their work due before deadlines, regardless of the complexities of the design. In that case, clashes are an opportunity for a project team to become aware of unresolved design issues and to adjust their planning to accommodate for previously unknown challenges before they grow out of hand or are even passed down to the next phase.

How to spot clashes?

Verifi3D supports clash detection in three forms: manually, automated, and assisted.

Manual clashing is supported by simple to use, easy 3D navigation. Using Section Box and Measurement Line tools, and either element orbit or first-person view, the user can visually inspect clashes. Selective display supported by features such as Element browser, Filters, context-dependent Smart Filters, and the innovative ghosting slider allows the user multiple ways in which they can classify the building information and obtain displays of the information they need in order to find clashes.

While time-consuming, manual clashing well done is an efficient way for the

human user to gain a higher-level understanding of the underlying causes of clashes that occur in the models and allows them to formulate their findings accordingly. Challenging our desire to automate everything, this process is very suitable in the design phase, where the relative truthiness of the digital models depends on many factors that are hard to grasp for computers and may elude even the most complex algorithms.

Automated clash checks can be set up by using one of Verifi3D's built-in clash algorithms to create parametrically defined Rule Sets. Catering to different scenarios, Verifi3D has a hard Clash Check, a soft clash check called "Free Space Check" (upcoming), and intersection checks that test individual and federated models for any occurring intersections. Assisted clash checking can be understood as a hybrid between manual and automated checks, made possible by the simple and interactive user interface in Verifi3D. The aim is seamless transitions from purely manual checking to the use of user-defined filters, to the use of algorithmic checks. In construction projects, there are always edge cases and unforeseen situations. Assisted checking workflows allow the user to make manual checking more efficient, and to make automated checking more meaningful.

How to resolve clashes?

Through integrations with both CDEs such as Autodesk Construction Cloud and Autodesk BIM 360 and issue trackers such as BIM Track, BIMcollab and BIM 360 issues, Verifi3D integrates into your workflow. It allows all users to check their clashes even before they hand over their models.

More frequent checking means that modelers become aware of issues earlier in time and contact their project partners ahead of time if necessary. More frequent checking means fewer issues accumulate. Fast feedback loops between checks and authoring software, allow partners to bring together and align their models in one shared, up-to-date environment with minimal effort.

How to avoid clashes?

Verifi3D comes with all ingredients for avoiding clashes. Once the project team has agreed to work in a BIM workflow that includes model coordination in Verifi3D, it is possible to make use of advanced clash detection algorithms and

to create checking templates to be used by all members of the project team. Then model coordination can take place based on a common data environment.

Checking becomes a distributed, collective activity, executed together by all members of the team, in a shared workspace. This allows for a pro-active, iterative workflow, in which feedback from the data validation tool is constantly available, akin to a spell-checker. This allows designers to gain shared situational awareness and to be better informed and more accurate with their model output.

Conclusion:

As more data in standard formats are combined into models, software tools are likely to become more sophisticated. Working on a single collaborative, coordinated building model rather than numerous models brought together to form a single complete model at key stages should significantly reduce the number of project clashes.

Clash detection is a core feature of any BIM verification tool, and Verifi3D can detect clashes between one or more architectural objects in a BIM model. Save time by automating clash detection and improve the quality of the models by validating data early. Verifi3D provides designers and general contractors with the tools they need to validate BIM data, automate, and reduce clashes in real-time during the model checking process.

Clash detection should be easy. With Verifi3D – we allow more people within the company to get involved earlier in the process. Clash detection should be done collaboratively and in real-time, this is possible in Verifi3D. Clash detection is more than error detection. Verifi3D is providing a much-needed lifeline for an industry beset by thousands of challenges by offering everyone the ability to visualize, evaluate, and eliminate clashes in advance.

Digitized clash detection workflow allows teams to share and collaborate on the same project more easily and efficiently. Clash detection enhances BIM and helps in effectively identifying, inspecting, and reporting potential conflicts and interferences in a construction project model. Prioritize the issues that require immediate attention and assign and sync issues with issue trackers such as BIM

Track, BIMcollab and BIM 360 issues in real-time in the cloud. The high level of collaboration and organization engendered by clash detection reduces the risk of human error during the model inspection and reduces the amount of rework and change orders required, lowering project cost, completion date and quality.

Clash detection is becoming more common among architectural, engineering, and construction firms of all sizes. 3D modeling with clash detection is a must-have for today's builders and related industries due to the cost savings and efficiencies it provides. Reduce rework for both preconstruction and construction teams by ensuring that the highest-quality designs make it to the site.

Meet the contributor(s)

Dr. Christian Friedrich
Product Owner
Verifi3D by Xinaps

Milu Sini Lal
Marketing Executive
Xinaps

“

Mini-BIM, data-driven discussions and the future.

Data-driven discussions and integral design are my passion. My personal goal is to make everyone in the design, development and construction chain better at their work through these data-driven discussions. If you can translate project goals into tangible BIM milestones, the 3D building model delivers a nice visual translation of the answers to the questions that are asked during the process.

By analyzing the most important goals of a stakeholder in the process, it becomes possible to find the most important parameters. In the case of the (concept) developer, we are talking about things like Grose Floor and Usable Surface, good floor plans, logical relationships concerning accessibility, and quantifying sustainability.

At VORM we call this Mini-BIM: A very abstract 3D building model with the minimum parameters needed to answer the crucial development questions. This small abstract BIM model can be made by any architect because it is globally the actions that an architect has always done in his architectural modeling software.

The better architectural firms in this area can even live models that can be directly linked to the Foundation for cost calculation and revenue., the developer's housekeeping book. In this way, it can be checked during the design and development process whether a project is and remains feasible. Because of my experience, it is also that the moment the case turns out to be less feasible due to errors, this is always at the expense of the architecture.

We are now involved in involving investors, Landlords, property managers, and municipalities in the 3D building model in addition to competing developers and builders. By translating everyone's agenda and steering on it, we can also design parametrically in addition to 3D file creation at the BIM. Good parametric design is

only possible if one knows what the parameters are that must be checked.

Optimizing workflow becomes a priority with the digital transformation of the AEC industry. By executing mini checks, it is helping professionals to streamline their workflow and validate models, thus reducing rework, associated costs and improving the quality of the building. Step 1: everyone in the chain participates in the BIM process and agendas are transparent. Are you ready to take the next step forward?

Pim van Meer

BIM Manager, The Netherlands

VORM

CHAPTER 6

What to achieve with clashing and checking?

Building information models are the data-rich digital representation of a physical artifact. They give a subject matter expert the ability to communicate their design solutions unambiguously for the rest of the project team. BIM also creates clarity on the hierarchy of installation sequences and helps manage the priorities between different systems.

Clash detection and model checking has traditionally been the method of identifying which building parts are overlapping and how severe the interference of systems is. In the traditional use case, the focus in clashing and checking has been on the geometry and constructability of the building.

The traditional approach of clashing and checking has created clarity on the construction and installation sequence as well as on the hierarchy of systems. Coordination of federated models has been important to avoid severe problems during the on-site construction phase.

Structural systems are a requirement BIM. They have priority of way because structural engineering ensures a building or an infrastructure does not collapse. The structural system is often also the most expensive system in a building. Clashing and checking the structural engineering solution is a matter of ensuring the buildings and infrastructures are built strong enough. The structural system needs to be stable enough to resist all appropriate structural loads and keep people safe while ensuring the maximum amount of usable space.

Clashing and checking of MEP systems against the structural systems, or other MEP systems is imperative for cost and schedule engineering. Field coordination of re-routing is both time-consuming and expensive. In the worst-case scenario overlooked clashes create facility management and maintenance problems. Those problems exist until the building, or the structure is decommissioned and demolished.

The logical sequence of systems enables the grouping of systems into optimal installation packages. The logical sequence of systems also enables the pre-manufacturing of cost-efficient installation racks. Fitting the multi-system racks into a building or an infrastructure is not only an opportunity for cost-engineering and eliminating excess. It is also an opportunity for creating

aesthetically pleasing environments where technical systems do not conflict with the building architecture.

An innovative approach into clashing and BIM-based checking of plans is end-in-mind thinking. In the innovative approach, the AEC team is not limiting their collaboration on the digital platforms into design coordination and preconstruction purposes. Teams are taking the approach of the digital building lifecycle.

With the digital building lifecycle approach, the original project team is preparing for future changes of the building artifact. They are resolving for accessible, connected, and secure future with universal design and coordinated clash checking. In this scenario, the project team is designing flexible spaces and transformability of buildings. The future end-users might have different use-cases for the built environment to enable diverse types of end-user experiences.

The future development of the built environment will happen in faster cycles with higher sustainability and accessibility objectives. People want and need smart environments to empower themselves and those connected to them. For the built environment it means more need for additional reserves of installation space and the flexibility of choosing where the additional systems are needed.

The clashing and checking tools of today support the quick study of "what if?". They are not limited to analyzing the new designs when the building is designed and engineered for the first time. The state-of-the-art tools enable clashing and checking of new design vs laser scanning results of existing infrastructure. If the bare necessities of permanent structures are determined for the first construction round, the other systems can be installed freely if they meet the requirements of the current end-users.

In summary, the benefits of clashing and checking aka BIM coordination are realized in accurate cost-engineering, optimal project scheduling, improved communications, increased quality, and highest standards of physical safety. The investments made into digital optioneering of the project are exponentially more affordable than field coordinating issues or dealing with the problems

when the building or the infrastructure is in operation. Data and evidence-based educated decision-making leads to the best outcomes.

Meet the contributor

Salla Eckhardt

Director of Digital Building Lifecycle and Innovation

Microsoft

DO YOU NEED TO VALIDATE YOUR BIM MODELS? WHICH PATH WOULD YOU TAKE?

Existing Model Checkers

1 Desktop-Based

2 Import-Export Required

3 Proprietary File Types

Verifi3D

1 Cloud-Based

2 Sync Real-Time

3 Supports both Revit and IFC

DO YOU NEED TO VALIDATE YOUR BIM MODELS? WHICH PATH WOULD YOU TAKE?

Existing Model Checkers

4 Non Collaborative

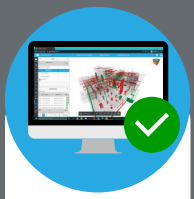
5 Highly Technical

6 Easy to make mistakes

Verifi3D

4 Collaborative

5 Easy to Use



6 Approve model

CHAPTER 7

Simplifying and standardising your workflow with templates

BIM models are checked with high frequency. However, many of the professionals still carry these out completely or partially by hand, resulting in poor quality of the models. Worldwide, there are several national BIM protocols and BIM implementation plans designed to help the construction industry adapt to digital workflows. These guidelines become specific at a project level within the BIM project requirements of these countries.

Consequently, BIM delivery specifications outline the tasks, roles, and responsibilities of those involved in the coordination of discipline-based models throughout the design and construction phase of these projects. How the delivery of these information requirements is specified, checked, and delivered becomes increasingly important for the success of these projects. This is where the role of templates for model checking plays a crucial role as it is increasingly important.

Templates can help to reduce manual errors and automate workflows. The Verifi3D Exchange Portal provides templates that are specific to the geographic locations and disciplines involved in a project.

Verifi3D Exchange Portal

The Verifi3D Exchange Portal provides a library of templates to help make the model checking process easier. Having an integrated toolset that supports and simplifies the model checking workflow can save a significant amount of costs on a project. Xinaps believe in simple workflows, that everyone in the team can access, understand, and benefit from. With templates the productivity of teams doing model checking is boosted, no matter how large or small the projects are.

"The Verifi3D Exchange Portal provides templates for model checking no matter how large or small the project is."

Creating a community

The Verifi3D Exchange Portal focus is on creating a community that can improve workflows through the creation of reliable model checking templates. Creating, managing, and sharing templates for model checking is vital to the creation of Digital Twins and project-based checking. Being able to collaborate in the creation of these templates is also vital to this process of checking. The

technical approaches that dominate existing workflows have perpetuated disciplined based silos by emphasising the role of experts in desktop-based applications. Model-checking workflows should reflect the importance of the social interactions necessary for construction success and the individuals involved in these processes. This is only feasible with a cloud-based workflow that allows real-time collaboration with colleagues from within your organisation and externally.

Benefits of the Verifi3D Exchange Portal

The Verifi3D Exchange Portal contains a library of Verifi3D templates, which are available for all Verifi3D users. By using templates from the Verifi3D Exchange Portal, time spend on setting up standardised information can be saved. The templates increase consistency and make the workload smaller by removing repetitive tasks of setting up the model checking workflow from scratch. By minimising repetitive tasks, the time can spend on the actual model checking instead.

Verifi3D Templates

The Verifi3D Exchange Portal offers a variety of different templates for both IFC and Revit files. These templates are categoried as Filter set Templates, Classification Filter set Templates and Ruleset Templates. Combined, these template types support the entire model checking workflow by offering definitions of filters, property checks, property comparisons, clash checking, intersection checks and so on.

Template Types

- **Filter set Templates** are the foundation for model checking because they allow the team to classify, select and visualize elements within the BIM models. The filters are also used to define element selection boundaries when creating rule checks.

- **Classification Filter set Templates** are filters directly linked to classification systems like Uniclass, UniFormat and SfB. This facilitates checking in accordance with standardised classification codes. Furthermore, project-specific classifications like room numbers and

building names can also be expressed in a classification filter set and used as templates.

- **Ruleset Templates** are collections of rule checks, which allow for validating the BIM models against predefined rules. For example compliance checking against Exchange Information Requirements (EIRs), to validate the correct level of model detail and model information is being provided.

Adaptation of Templates

All templates from the Verifi3D Exchange Portal comes with a use of standard property naming. But because no projects are ever the same, the templates can be modified based on project-specific naming and values. For example, the naming for the classification code property might be differ in different projects, while the classification codes stay the same. The templates are designed, so these changes and additions are quick to make. When templates are customised, they are saved to the company profile making them available for future projets and sharing.

Benefits of Templates

The benefit of templates is that they can be continuously updated and shared within the team or projects involving 3rd-parties. It is in everybody's interest on a project that data validation is made easier and more accessible for all involved. Coordination sessions do not need to be an adversarial and fragmented affair, instead, they should be opportunities to improve processes and learn from the experiences of the project teams. Mistakes will always be made, but how soon they are spotted and rectified is of critical importance. Templates can help to improve the culture of checking within companies by enabling project teams to start checking earlier and more regularly. If the process of checking is done earlier and more informally, project teams can enjoy a more harmonious working environment, while clients and users can improve project outcomes. Verifi3D aims to support open BIM practises by removing barriers for interoperability and encourage multidisciplinary collaboration on projects.

Conclusion

There is an increasing push for a more open and accessible environment based on industry-agreed standards, with a stronger focus on data relevance and quality in BIM. The built asset business is changing the way it maintains information and data as BIM evolves. The next step is to use this data to embrace digital transformation in order to improve people's lives. The BIM methodology's model coordination enables people and processes achieve unprecedented levels of visibility, coordination, and productivity. To embrace digital transformation, construction must move beyond BIM. Streamlining and optimizing the workflow becomes a priority and with predefined project templates, teams can save time. With the project templates from the Verifi3D Exchange Portal, it paves way for teams to share, amend, and reuse in other projects, making the model-checking process easier and simplified.

Meet the contributor

Hugh Geoghegan
Product Specialist
Verifi3D by Xinaps

Data quality and reliability are essential for efficient digital working. Data quality is only achieved when the data comprises the correct set of data, in the correct formats with the correct provenance details. The built asset industry is in need of reliable methods and tools for validating project data against preset requirements. The data requirement specifications must also be unambiguous and complete.

Open solutions, like the buildingSMART Data Dictionary (bSDD) and the XML-based Information Delivery Specification (IDS) standard, help clients define and publish their information requirements in a consistent way that allows for computer interpretable (automated) checking. Validating a data set consistency with international standards is often overlooked because but is a key step in ensuring data quality. Recently, defining project specific requirements is being seen and understood as a critical missing link in practical data workflows. With the growth of complexity in building and infrastructure projects and the increasing number of project team members checking the information consistency is an increasingly challenging problem. To cover the full life cycle of data exchanges this requires open interoperable approaches. buildingSMART has the validation of data quality as a top priority and is developing solutions based on the combination of linked standards (for example published in the buildingSMART Data Dictionary), unique references, and consistent openBIM data standards (using IFC for example).

Regardless of the challenges, the topic of validation is a must for the industry to address and solve to ensure the success of future projects. Getting this right is an important threshold that needs to be achieved and doing so will open a multitude of new opportunities to manage asset information more efficiently and accurately. This step will be the portal for every stakeholder to gain control over their digital destiny.

Richard Petrie

Chief Executive, The United Kingdom

buildingSMART International

CHAPTER 8

Top 5 reasons why you want to clash and check in the cloud

Introduction:

Cloud computing is a relatively new phenomenon in the construction industry. In recent years, cloud computing has exploded, with businesses of all sizes and across all industries shifting to Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and Software as a Service (SaaS) models.

Cloud computing enables the delivery over the 'cloud' (the internet) of a variety of computing services, such as storage, databases, networking, servers, software, and analytics, giving building professionals access to faster and more flexible resources.

BIM is no exception to this trend.

There are numerous advantages to creating, managing, validating, checking and sharing BIM models in the cloud for the architecture, engineering, and construction (AEC) industry.

Cloud-based BIM in construction projects isn't just about remote work; it's also about dispersed teams and collaboration. Individuals from a variety of organizations, such as architecture firms, engineering firms, general contractors, and specialist subcontractors, make up project teams.

These teams can benefit from cloud-based BIM whether they are working from home, in the office, or on-site. The construction industry is investment intensive due to which they are hesitant to experiment with new technology. While cloud computing has a lot of potential in the construction industry, such applications are not widespread.

There is a knowledge gap that must be filled to assist the construction industry in adopting cloud computing technology. And while the thought of cloud-based software may seem intimidating to those in the construction business who have been utilizing pen and paper, spreadsheets, and other manual methods for communication and project management, there are other construction perks to consider.

Cloud computing – How is it transforming data validation?

Cloud computing is gaining traction in the construction industry as companies realize the advantages of cloud computing such as flexibility, dependability, security, convenience, and efficiency over on-premises solutions. **The 5 most important ways cloud computing is changing data validation in the construction industry are as follows:**

1. Improved model coordination:

A significant part of the classification and checking of building models is still performed manually, costing a lot of time, effort and is prone to error. Although every project is different, the most common challenges are model coordination and the lack of interdisciplinary coordination between designers, engineers and contractors.

These challenges lead to rising demand for better model coordination between teams, as the industry is still lacking an integrated workflow. Verifi3D bridges the gap between the design and the construction stage. Through an integrated workflow, Verifi3D empowers customers with a set of options that can help them classify their input data, validate and visualize their building model, report possible flaws and share them in real-time with the whole team. Teams can manage

the whole model coordination workflow including classification, rules and checks, and issues management in one environment.

Manage clashes and assign issues using issue trackers such as BIM Track and BIM 360 Issues to various members of the team. All the teams need in one great cloud solution! With improved model coordination, find and resolve conflicts between building components before they become costly to change orders.

2. Better collaboration:

There are several stakeholders with whom project-related updates need to be shared. To meet project deadlines, it is also necessary to collaborate with different teams at the same time. In today's highly competitive business world, lost productive time equals lost money. This is where the cloud can come in handy.

Through browser-based interfaces, all interested parties can promptly and securely access and work on the same cloud-based file from their location at any time using PCs, laptops, and tablets. All you need is access to the internet. For example, using Verifi3D enables project managers to easily share content with subcontractors, vendors, building owners, and investors to keep them in the loop about a project's progress.

As a result, each of them can work more efficiently to complete the project on time. Additionally, architects and engineers can collaborate on a BIM project that is being carried out in an architectural and engineering firm's office using cloud computing, even if they are at different locations.

3. Enhanced data security:

Project data must be handled carefully, whether it is related to a construction site design, frequent updates, or concerns that arise. It is an important component of a project's timeline till it is completed. Keeping this information on the office's local computers renders it vulnerable to situations like system failure, data theft, and so on. The loss of data connected to a construction project is a mistake for the contractor who is working on it. To keep the clients' data safe and secure, most cloud service providers employ data security technolog-

ies such as data encryption, intrusion detection and firewalls. With Verifi3D users can load models locally or sync models automatically with Common Data Environments (CDEs) such as Autodesk Construction Cloud and Autodesk BIM 360. Having all the project data in one place simplifies analysis and reporting while also increasing accuracy.

Housing the data in the cloud as a backup ensures that they are protected in any situation and are only accessible to authorized users. Furthermore, cloud-based systems process data at a faster rate than on-premises systems, saving project managers time and allowing them to quickly and easily share results across teams and regions.

4. Lower costs:

Cloud computing's versatility allows businesses to select the storage, processing, and sophisticated services that best suit their needs. Firms can invest in their digital infrastructure rather than purchasing computers and backup drives, which depreciate quickly. The best thing is that when technology advances, new software versions and updates are provided in real-time through the internet, allowing companies to take advantage of them right away. The exorbitant expense of hardware is eliminated with cloud computing. For example, Verifi3D offers three packages which are monthly subscriptions that can be activated anytime. Choosing the best cloud solution based on needs will result in a higher return on investment and increased productivity.

5. Save time:

One of the most compelling reasons to migrate a business to the cloud nowadays is the ease with which specialist software/solutions can streamline the data migration process. Businesses that sign up for a specialized platform receive support during the move and can contact service teams at any time. With cloud computing, time spent updating and patching software, distributing client solutions to end-users, and other more tedious IT activities is significantly reduced.

The cloud enables businesses to significantly reduce the requirement for full-time IT workers and, in some situations, get more work done with fewer resources. Savings can be realized nearly immediately.

Furthermore, because there will be considerably fewer service outages, employees will save time and be more productive.

Conclusion:

Aside from the previously mentioned advantages of cloud adoption, cloud computing has a promising future in the construction industry. Not only can cloud computing help cut costs, but it can also increase collaboration between teams, management, and stakeholders, allowing for speedier decision-making and more efficient resource utilization. As a result, construction projects are completed faster, with lower overhead and higher profitability.

Companies in every industry, including construction, are turning to the cloud for these reasons. Verifi3D by Xinaps is the spell checker of your BIM models. It is cloud-based and tackles many of the issues by providing pre-construction teams with model coordination, automated clash detection, and workflow integration that simplifies collaboration and minimizes manual work.

With an intuitive and easy interface, Verifi3D is web-based and eliminates the need to purchase software or manage IT infrastructure. It helps professionals deliver work in quality and time, reduce rework, and leverage their teams, so they can focus on bigger tasks.

With the implementation of CDEs such as Autodesk Construction Cloud and Autodesk BIM 360, and added integrations with BIM Track and BIMcollab, teams can manage the model coordination workflow, including clash detection, validation, and reporting in one environment.

Verifi3D by Xinaps's vision towards digitalization is very simple: enhanced model coordination in the cloud, better collaboration and best-in-class quality. In short, Verifi3D helps to build a better building by keeping the whole team up to date, improving building performance and eliminating the need for rework.

The construction industry is evolving stronger than ever, thanks to the integration suppliers such as Autodesk, Nemetschek, Hexagon, Trimble, Bentley. The integration suppliers play a major role in providing cloud-based collaborations services, making API's publicly available to create an ECOsystem quicker, thereby facilitating solution providers in the AEC industry to come up with specific solutions.

Cloud services are inevitable for the construction industry as it strives to digitize its processes through the use of BIM- enabled applications resulting in the emergence of new business models, allowing construction companies to conduct business in a new way.

Cloud computing will become a cornerstone as the construction sector embraces digital transformation, enabling more efficient back-office processes and making it easier for project managers to keep costs under control and projects on schedule. The sooner companies accept and use cloud-based solutions, the better equipped they will be to tackle the issues that lie ahead for the construction industry!

Meet the contributor

Milu Sini Lal

Marketing Executive

Xinaps

CHAPTER 9

Trends shaping the AEC industry

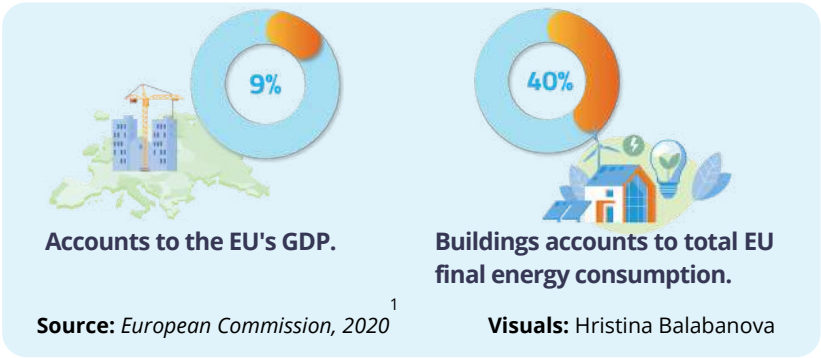
The AEC industry is integrating digital technologies throughout the construction life cycle, supported by technology, big data, Internet of Things (IoT), cloud, and AR/VR, which give immersive solutions that easily sync with BIM. Technology that undergoes rapid technical transformation and mainstreaming enhances easy decision-making and enhanced productivity.

Thanks to the growing digital trend, BIM is becoming increasingly popular in the construction industry. BIM is used in building applications to help reduce project timeline delays by reducing cost and time overruns. The high initial cost of BIM, on the other hand, has stifled the market for building information models.

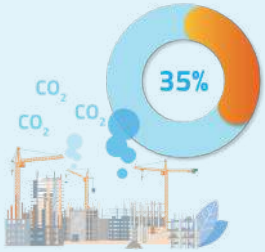
AEC is a pioneer in the development of new technologies and infrastructure, but its online business leaves much to be explored and developed in terms of new technology models and opportunities.

While several important trends will affect the AEC industry in 2022, technology appears to be the front-runner. Given the importance of buildings in human existence and safety, it is understandable that improved technologies are needed to ensure that construction keeps up with the needs of the times.

Nonetheless, the construction industry is critical to the EU economy. The sector employs 18 million people directly and accounts for around 9% of the EU's GDP. 40% of total EU final energy consumption is consumed by buildings and emit around 35% of all greenhouse gas emissions. By 2050, buildings may be able to achieve a 90 percent decrease in greenhouse gas emissions.



1 European Commission. 2020. Construction. [online] Available at: <https://ec.europa.eu/growth/sectors/construction_en> (Accessed 9 March 2022).



Contributes to all greenhouse gas emissions.

Decrease in greenhouse gas emissions by 2050.

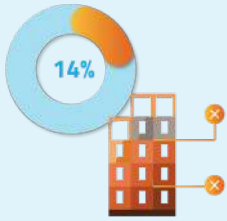
Source: *European Commission, 2020*[2]

Visuals: Hristina Balabanova

The building information modeling market is expected to reach USD 10.7 billion by 2026, up from USD 5.4 billion in 2020 and USD 5.9 billion in 2021. The global AEC market grew 7.84 percent in 2013 and is predicted to increase at a CAGR of 12.5 percent over the next five years. Several factors are driving the market, including accelerated urbanization, increased infrastructure projects, the benefits of BIM to the AEC industry, and increased regulatory regulations for BIM implementation.

According to a recent report conducted by Transparency Market Research, global construction waste will reach 2.2 billion tons by 2025. Moreover, as megaprojects become more popular, McKinsey discovered that 77 percent of them are delivered at least 40 percent late. In 2020, bad data cost the global construction industry over $1.84 Trillion. Not to mention, bad data is responsible for 14% of all rework in the construction industry globally.

Global construction waste will reach 2.2 billion tons by 2025



Rework in construction is caused by bad data

Source: *Thomas and Bowman, 2021*[3]

Visuals: Hristina Balabanova

2 European Commission. 2020. Construction. [online] Available at: <https://ec.europa.eu/growth/sectors/construction_en> (Accessed 9 March 2022).

3 Thomas, E. and Bowman, J., 2021. HARNESSING THE DATA ADVANTAGE IN CONSTRUCTION. [online] Autodesk. Available at: <https://a.storyblok.com/f/64835/x/137c281eda/harnessing_the_data_advantage_in_construction.pdf> (Accessed 9 March 2022).

77% of them are delivered at least 40% late

Bad data cost the global construction industry over $1.84 Trillion

Source: *Thomas and Bowman, 2021*[4]

Visuals: Hristina Balabanova

Construction managers benefit from AEC's assistance in gathering data and information from various disciplines and communicating more efficiently. Increased construction productivity is combined with improved data transmission and coordination among numerous stakeholders, architects, and construction supervisors to give AEC users a competitive advantage.

Although the software segment dominated the total AEC market in 2020, this trend is projected to continue throughout the years. This is due to an increase in construction projects and software used in the AEC industry, such as building information and modeling software.

In addition, the high implementation of AEC creates the need for services in the market, which is expected to drive the market. Most construction and infrastructure companies have begun to use these solutions to integrate all construction processes to boost the overall project productivity. However, the services segment is expected to grow the most in the coming years due to an increase in service adoption among end-users as it ensures the proper operation of AEC software and platforms. Furthermore, the widespread adoption of AEC creates a demand for services in the market, which is projected to propel the market forward.

3 Thomas, E. and Bowman, J., 2021. HARNESSING THE DATA ADVANTAGE IN CONSTRUCTION. [online] Autodesk. Available at: <https://a.storyblok.com/f/64835/x/137c281eda/harnessing_the_data_advantage_in_construction.pdf> (Accessed 9 March 2022).

Autodesk Inc. and Nemetschek AG, two larger AEC companies, offer on-premises software to their customers in the industrial, infrastructural, and residential sectors. The cloud segment, on the other hand, is predicted to develop the most in the next years because it does not require any capital investment and has low maintenance requirements, making it the preferred choice of mid-sized financial institutions. The rise in adoption of cloud-based architecture among large and mid-sized enterprises as a result of the COVID-19 epidemic propels the market's growth.

Engineers and designers, for example, use AEC software and building information modeling (BIM) software to collaborate digitally. Contractors and engineers all over the world are re-optimizing schedules and re-planning projects utilizing augmented reality and virtual reality simulations. Integrated digital-twin solutions are also being developed for end-to-end project support from design to implementation.

The adoption of digital tools such as augmented reality (AR/VR) simulation, real-time progress tracking, enhanced schedule optimization, and digital workflow management has skyrocketed. Similarly, the industry has seen a surge in R&D spending to develop new standardized building systems to automate and speed up design and construction processes.

Digital construction is the industry's new normal. Cloud services will become a cornerstone as the construction industry embraces digital transformation, allowing for more efficient back-office processes and making it easier for project managers to keep costs under control and projects on schedule.

Meet the contributor (s)

Milu Sini Lal
Marketing Executive
Xinaps

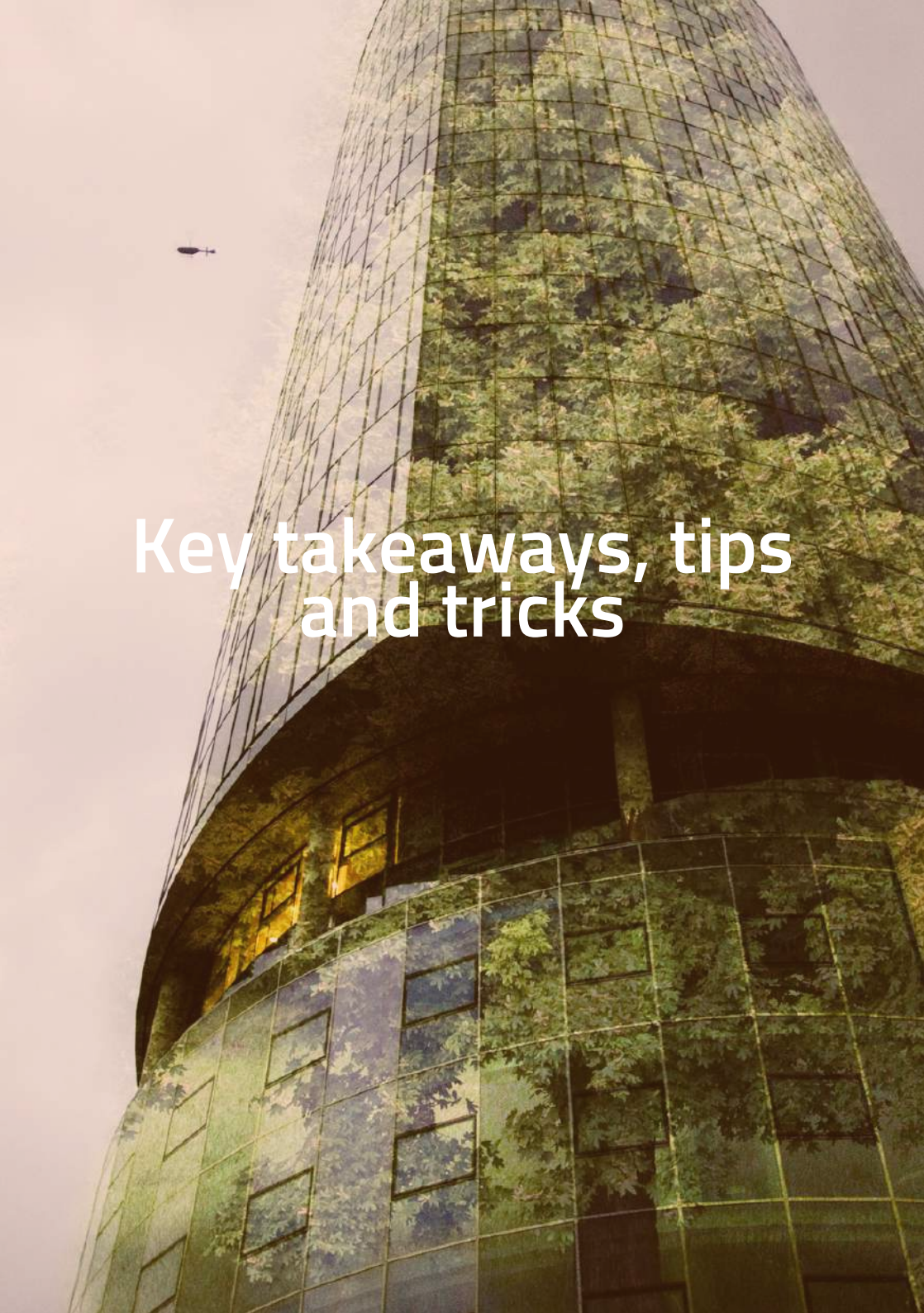
Paul Varghese
BIM Consultant
Xinaps

Today there are many innovative solutions to model checking – like automated clash detection, for example – that can reduce human error and enhance model quality. Not only do BIM and VDC professionals save time by leveraging these technology solutions, but other stakeholders can more confidently rely on the project models for their respective functions as well.

Anna Lazar

Strategic Alliances & Partnerships,
Unites States

AUTODESK
CONSTRUCTION
CLOUD™ PARTNER



Key takeaways, tips and tricks

Key takeaways:

- The importance of "model-checking", cannot be stressed enough. Resolving coordination issues in the digital model, before executing work on site, is the least expensive, least disruptive, and safest place to resolve problems, and that is why we need to strive to complete as much of the information in the digital model as possible, and check it thoroughly, before trying to execute the work on site.

- Making a good plan in advance of your project gives everybody on the team a clear insight into how the coordination process will be carried out and how models will be checked. Make sure to add this to the BIM execution plan of the project.

- There are many valid reasons for engaging with model checking, as there are different priorities for different people and organizations. Just be aware that, regardless of what your current needs in model checking are, they will change as your organization grows. In order fulfil certain needs apparent to you, other stakeholders in your organization must have more basic needs covered first. And ultimately, it might be possible to map out a BIM adoption plan that reaches out far beyond what is currently apparent.

- Coordination of project information should be an opportunity to collaborate and engage with project stakeholders from within and outside project teams. A culture of early and regular checking should enable coordination sessions to be friendly opportunities for team building and knowledge exchange.

- Clash detection is a core feature of any BIM verification tool. Save time by automating clash detection and improve the quality of the models by validating data early.

- Digitized clash detection workflow allows teams to share and collaborate on the same project more easily and efficiently.

- Clash detection enhances BIM and helps in effectively identifying, inspecting, and reporting potential conflicts and interferences in a construction project model. Prioritize the issues that require immediate att-

ention and assign and sync issues with issue trackers.

- The high level of collaboration and organization engendered by clash detection reduces the risk of human error during the model inspection and reduces the amount of rework and change orders required, lowering project cost, completion date and quality.

- The benefits of clashing and checking aka BIM coordination are realized in tight cost-engineering, accurate project scheduling, improved communications, increased quality and highest standards of physical safety.

- To embrace digital transformation, construction must move beyond BIM. Streamlining and optimizing the workflow becomes a priority and with predefined project templates, teams can save time.

- Data quality and reliability are essential for efficient digital working. Data quality is only achieved when the data comprises the correct set of data, in the correct formats with the correct provenance details.

- Cloud computing has a promising future in the construction industry. Not only can cloud computing help cut costs, but it can also increase collaboration between teams, management, and stakeholders, allowing for speedier decision-making and more efficient resource utilization. As a result, construction projects are completed faster, with lower overhead and higher profitability.

- Cloud services are inevitable for the construction industry as it strives to digitize its processes through the use of BIM- enabled applications resulting in the emergence of new business models, allowing construction companies to conduct business in a new way.

- Digital construction is the industry's new normal. Cloud services will become a cornerstone as the construction industry embraces digital transformation, allowing for more efficient back-office processes and making it easier for project managers to keep costs under control and projects on schedule.

Tips and tricks:

- Model-checking is not limited to your company, the whole supply chain is involved. So team up with your partners, subs, and suppliers.

- If you want to start, think big, but start small. Don't role out a solution over the team as a whole. Find an internal "Champion" first, create small success and make the rest of your team curious.

- Don't wait until the next project. You can already start with older projects to experiment with.

- Think about re-evaluating your workflow, and make sure you have a standard. Be prepared.

- Start in the right order, validating makes no sense if you don't classify first.

- Structure your data/BIM files. Make sure your partners' and suppliers' work conforms to your standards.

- Minimizes data loss in the handover process from design-build to operations.

- Improve model quality and save time with automated clash checks.

- Reduce costs by more quickly identifying issues and streamlining workflows.

- Use predefined templates and filters and easily modify them to meet your project standards.

- Before adopting new tools check to see if your business or project goals can be met with it. Within the BIM sector, this can be done via the use of a BIM Execution Plan (BEP). As the BEP defines the goals for the adoption of BIM and its tools within a project, as it addresses the requirements set by all stakeholders within the project or business.

- Sometimes it is wise to set up a BEP plan with a software vendor as it will

give you the opportunity to contribute your ideas towards the development of the application.

- Within the BEP do include a pilot phase where new solutions can be tested for adoption by a small group of employees or team members. The pilot though needs to have a clear scope of requirements defined. Such that all involved stakeholders know of the current statutes and deadlines within the pilot program.

- When selecting the staff members who will be part of the pilot program do ensure that the members are open-minded towards the adoption of new tools and are keen on finding out smarter and more efficient ways of working.

- To ensure that your team always works on the latest version of a BIM model do ensure that each BIM file is synchronized to a Common Data Environment (CDE).

- Additionally, the CDE must contain the previous visions of the BIM Project. Everly linked assets must also be clearly defined and stored within the CDE.

- Do ensure that the various supplier and vendors within the project supply their BIM models to you as per the project requirements (eg. Revit and IFC files).

- Always check your BIM project and the models within it after every revision. Do ensure that this is done against the Project Requirements and Building Code.

- Do ensure that errors and issues detected are always reported, easily identifiable and are assigned to the relevant party.

- Invest in tools that enhance collaboration, coordination and productivity of the team.

- Allocate funds to educate and train employees.

- Invest in integrated workflow solution which helps in eliminating data loss.

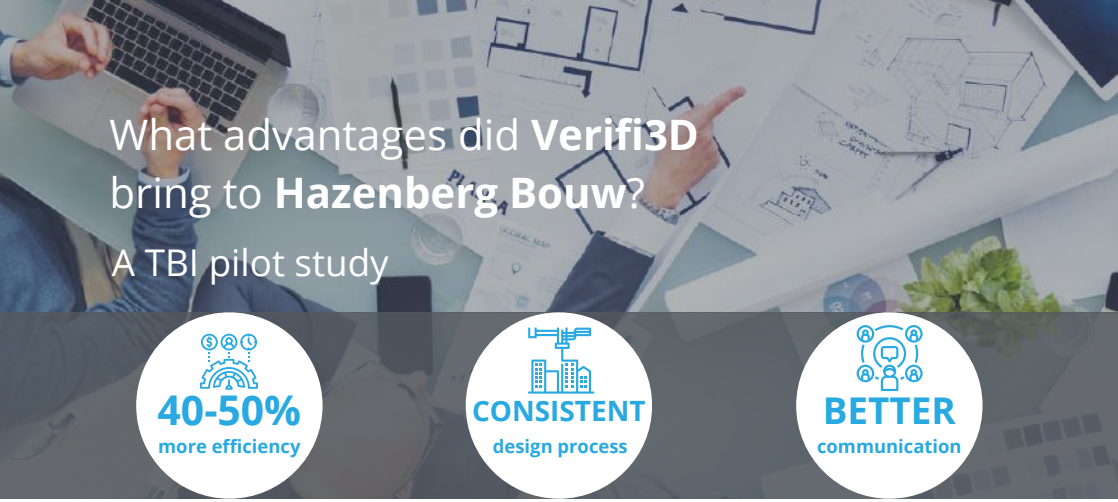
- Use gamification tools to engage employees and collect their feedback.
- Experiment with a Pilot Project.
- Strive for innovation and adopt new technologies at a manageable pace.
- Audit your model and eliminate unnecessary data. The more reliable the data, the better the quality of the building data.
- Provide feedback to the solution provider so that they can improve, amend and increase the efficiency of the solution.
- Reduce rework and reduce cost by investing in scalable cloud solutions.
- Centralise your data source and control your data efficiently.
- With the right technology free up project teams to focus on their work, producing quality work on time and within budget.
- Always access the best tools and latest releases, technologies and fixes so you won't fall behind your competitors.


Verifi3D

PRACTICAL EXAMPLE

A TBI Pilot Study

hazenberg | TBI



What advantages did **Verifi3D** bring to **Hazenberg Bouw**?

A TBI pilot study

40-50%
more efficiency

CONSISTENT
design process

BETTER
communication

Overview

TBI is the leading Dutch construction, technology, and infrastructure giant. As Makers of Value, development builder Hazenberg Bouw, a subsidiary of TBI is always looking for future-proof innovations that contribute to LEAN method of planning. The company has been operating in the Netherlands for over 100 years. A key player in the Dutch construction industry, they are one of the most innovative and sustainable companies within the construction industry.

Hazenberg Bouw is at home in the southern Dutch market for new-build housing and non-residential building construction, existing building transformation and making more sustainable and long-term maintenance. Making sustainability accessible is at the core of Hazenberg Bouw.

Challenges

Tommy van Beem, BIM Manager for Hazenberg Bouw, began working with Hazenberg Bouw in 2015. A pioneer in model checking using Open BIM standards, Tommy challenges himself and Hazenberg Bouw to reach the highest standards with each new project. As an experienced professional in the field of model checking, Tommy is in charge of ensuring compliance with building regulations and sustainability requirements on large-scale housing projects.

Streamlining and simplifying the existing workflow by minimizing redundancy and maintaining accountabilities for all stakeholders was

a priority for Hazenberg Bouw. Tommy was looking for a solution that is simple, reliable, and easy to use for his team with little to no training involved. As a leading innovative company, there is no room for mistakes. To simplify and optimize their existing workflow, Hazenberg Bouw needs a solution that is smart, innovative and sustainable.

Hazenberg Bouw is looking to lead the market in relation to model checking based on the implementation of IFC-based workflows. They are being challenged by the existing solution and are looking to maximize the value of data compliance for their existing workflow. As a team leader, Tommy understands his role and he wants to facilitate all of his team in using the best available tool in the market. Certain team members are customed to certain workflows and have certain preferences for their model checking solution. Critical information was scattered across multiple platforms and data was lost during translation. Tommy realizes that simple is better and he wants to combine the most important features of each of his team's workflow in a flexible, browser and cloud-based solution. This has led him to pilot with Verifi3D.

Solution

Hazenberg Bouw is an early adopter of Verifi3D. Since Verifi3D's conception, Tommy has been a passionate advocate for Verifi3D and is passionate about model checking. As an expert in an industry dominated by novices, Tommy understands that not everybody can be an expert. He realizes that if Hazenberg Bouw can develop a standardized easy to follow approach to model checking, they can encourage a culture of checking earlier and regularly more within their project.

Hazenberg Bouw is the last line of defense against mistakes before they go live on site. Tommy understands the importance of constantly refining his workflow in accordance with the most cutting-edge model-checking solutions on the market. He believes that Verifi3D offers a new approach to model checking which simplifies the complexities associated with their existing workflows and allows more people in Hazenberg Bouw to engage in model checking early on. The team at Hazenberg Bouw sees Verifi3D as having the potential to encourage people to check more during the design phase and removing the possibility of errors earlier which otherwise can be costly.

When working in a large company, it is hard to communicate and access the latest version of a model in real-time. Often that requires many professionals to be physically present in the same room. The cloud structure of Verifi3D overcomes these obsolete patterns and brings the working flow to a different level.

And we haven't even unlocked its full potential yet.

- Tommy van Beem, BIM Manager at Hazenberg Bouw

Result

Tommy sees Verifi3D as a partner in model checking. As an innovative company, Hazenberg Bouw cannot afford to make mistakes with its designs. Tommy has already devoted a significant amount of time to developing Verifi3D because he understands the value of the product. An existing workflow can get even better with Verifi3D and is seen as a medium that can reduce complexity, cost and ultimately reduce rework on projects.

Next Step

The unique technological implications provided by Verifi3D have demonstrated promising capabilities to boost Hazenberg Bouw and other business units to reach their goals while overcoming the industry challenges leading to a higher quality of building models. Hazenberg Bouw is confident that Verifi3D will be a game-changer for the AEC industry!

Hazenberg Bouw develops, builds and transforms. We create value both now and in the future. How? We listen to our clients' wishes and questions. Make time to understand their challenges. We invite them to brainstorm with us, make suggestions and surprise them. We think ahead with them: proactively, practically, innovatively, sustainably and 'out of the box'. And we solve problems. Everything to make their dreams and plans come true.

hazenberg | TBI

Quality should start in your office. Too often firms search for errors and design faults at a late stage in the process. Firms that didn't have strong in-house standards with 2D drawings can get themselves in much greater problems when switching to BIM. A solid internal quality manual and training will lessen all sorts of downstream problems, when it comes to sharing data, clash detection and leveraging the data within BIM to Cobie and beyond.

Automated rules-based checking is an extremely important tool to have within an organisation, not just to check models before handing them on, but also to examine the quality of the design, to ensure it matches the original brief – the right areas, spaces, space around essential equipment, disabled access, fire evacuation routes. Is the design fit for purpose and would it pass current building regulations? One can always assume there will be human error in checking the work of design teams and these get expensive the closer to, or during construction. Quality checking and design verification can be automated and run regularly to inform design teams of outstanding issues.

All the most popular quality checking tools are still desktop products, some are decades old. In a modern collaborative workflow, having this all running on the cloud makes a lot more sense than pushing files around between companies. Nearly all these old desktop applications were designed for when models were a lot smaller than BIM projects tend to be today. For design checking and verification, this essential process really should be done in the cloud.

As the whole industry digitizes, we are heading to a stage where urban planning and approvals will increasingly rely on the design data generated in the design and build process. It's therefore essential to ensure the quality of the data, not only matches what was built but includes all the data which relates to multiple vertical specialties, such as fire planning, maintenance and carbon usage.

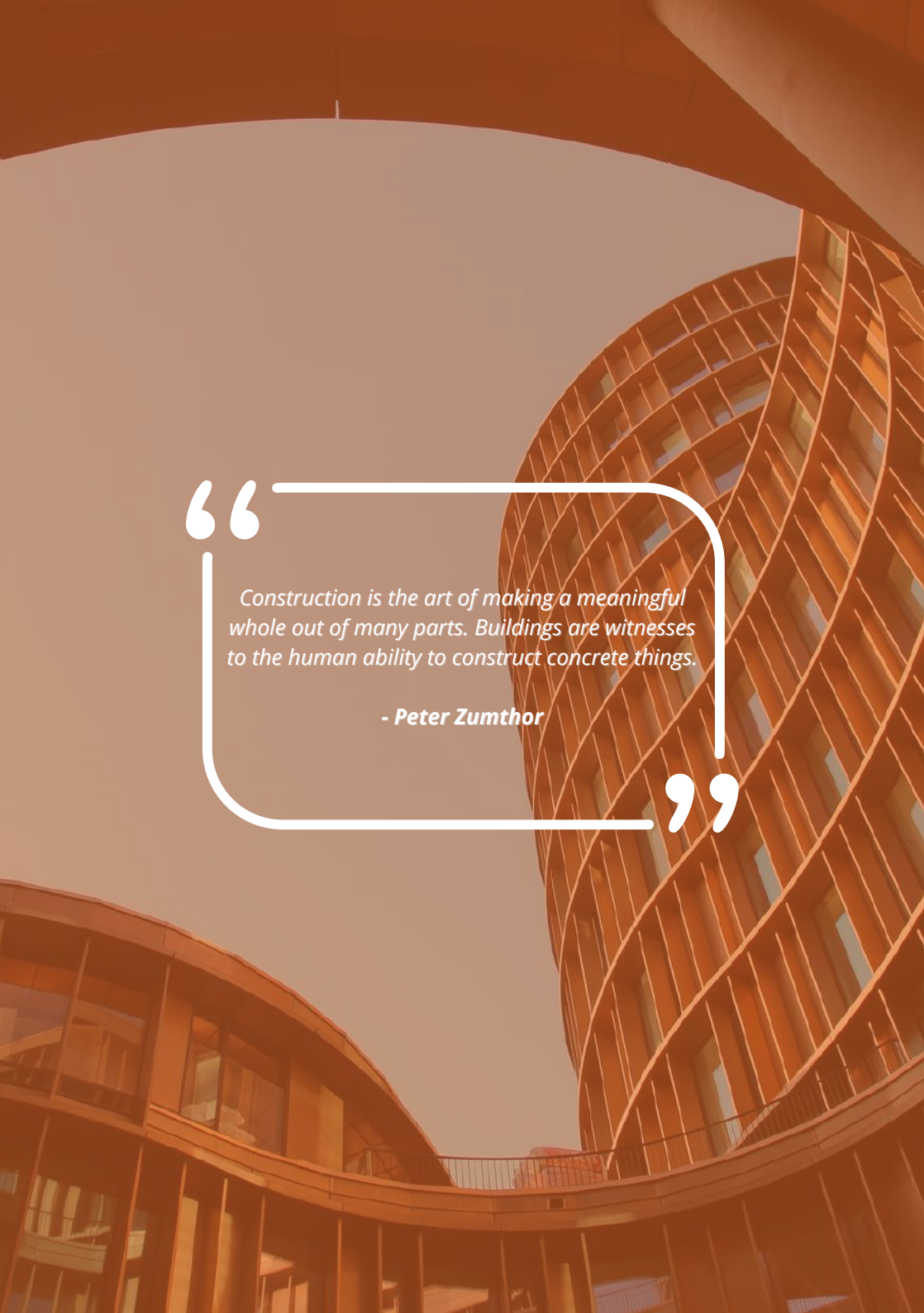
It's time to ensure both the geometry and the information in BIM are useful throughout the build and operation.

While there are many aspects of a model which immediately can be identified as being incorrect, should that be a clash or a missing detail, the biggest challenge is identifying the information which is missing, it can't be seen. Here, quality checking is essential in ensuring that important metadata is included and not lost in the process. For those using Cobie, this is especially important.

Martyn Day

Co-founder and Consulting Editor
The United Kingdom

AECMAGAZINE


Construction is the art of making a meaningful whole out of many parts. Buildings are witnesses to the human ability to construct concrete things.
- Peter Zumthor

Thank you!

Thank you!

The world is a better place, thanks to people who want to develop, help and lead others.

There are plenty of people who helped bring this book to fruition, and we are grateful to them. Without the experiences and support from them, this book would not exist.

We would like to thank all our readers who have taken time out of their day to read this book! We are sure that by focusing on the keytakeaways from this book, the readers will be able to lead and take their model checking to the next level.

Should the readers have a topic in mind or would like to have a webinar session, please feel free to share via e-mail: info@xinaps.com

Cheers,
Xinaps Team

Verifi3D by Xinaps

About Xinaps

Excellence by technology: We believe in building better.

We believe that the design building process can be simplified and optimized with the power of technology. That's why we created Verifi3D, the spell checker for BIM models. Verifi3D simplifies the model coordination process and enhances professionals' workflow through classification, validation and reporting - real-time, in one solution in the cloud.

Together with you, the innovators in AEC, we would like to accelerate the adoption of smarter, more future-proof design methods and active collaboration in the built environment.

Xinaps

Where to find us

verifi3d.com | xinaps.com | XinapsSoftware | Xinaps | xinaps | xinaps

+ 31 (0)85 043 67 52 | info@xinaps.com | Molengraaffsingel 10, 2629 JD Delft, the Netherlands