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The Future of Model Coordination is more than Clash Detection!

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Learning Objectives

- Understand the path Clash Detection has taken
- Learn current capabilities of Coordination
- Explore future possibilities of Model Coordination
- Discuss future technology capabilities

Description

It has been a long road getting from there to here! Here we are again, on the precipice of a technology revolution. What will the future look like? What will the Autodesk Construction Cloud have in store? Most importantly, what will the Construction Industry embrace? Join this class to discuss what Model Coordination will mean, project delivery requirements, automation in the software, automation in the physical world, and the future of VDC roles. We will first time travel back to the beginning of Clash Detection and BIM Software, then we will compare that to current capabilities, and finally we will step into the future to explore the impact of what current cutting edge technology could have and review the tech workflows of the future.

Speaker(s)

Andrell is a Senior Technical Specialist for US CAD, one of the nation's top consultants for the AEC Industry based in Irvine, California. After obtaining her Master's in Architecture from the Savannah College of Art and Design, she worked as a VDC Engineer for general contractors for over 5 years. As a VDC Engineer, she worked on 3D coordination, Field Operations, 4D animations, 5D cost models, and more proposals than she can remember. Then she went to work on the MEP side becoming a Tier 3 Support Specialist that worked directly with Autodesk to resolve issues, develop workflows, and implement various strategies for improved project delivery. She currently provides BIM implementation and training for client's software, including Revit, Navisworks, BIM 360, FormIt, and more. Andrell is a Revit Certified Professional, Authorized Trainer, and has her Certificate of Management in BIM from the AGC of America. She is part of a team of 3 that run the blog: BIM365 - The BIM Life.

The Timeline

The timeline notes the important dates as: Prior to 1997, 1997, 2007, 2009, 2012, 2013, 2016 (yellow dot), 2018, 2019, 2020, and “the Future”

TIMELINE OF THE HISTORY OF CLASH DETECTION

The Historical Stops

Prior to 1997

Sequential Comparison Overlay Process. Light tables were in use when there was any coordination done on a project. There is a lot of history of Master Builders for hundreds of years before splitting into Architects and Contractors. This split led to Design-Bid-Build which is deemed ‘traditional’ despite not being around before the 1940s or so.

Light tables meant hand drawings or printed drawings – more layers meant less legibility. There is a lot to be accounted for: scale, handwriting, plan reading, human error, eye fatigue, and, perhaps most importantly, time. Further, the coordinator needs to understand systems and be able to do math quickly and accurately. It is a very manual process.

PDF Overlay technology did come out and is still in use today. While this alleviates the challenges around handwriting, scale, and items being too small (since a viewer can zoom in and be legible through vectors), it does not alleviate still needing to have the knowledge of systems, reliance on human eyes, and manually calculating numbers.

This process further fell from ideal after the 1970s introduced Central Air Conditioning and OSHA came on the scene. The 1980s-2000s saw an explosion in electrical equipment, technology, and building integration of hi-tech systems. Fire suppression systems, fire proofing methods, and more also had to be incorporated. These more complicated systems and building methods demanded needing a better solution.

1997-2008

Navisworks is introduced by LightWorks. This software took 3D models and automatically found areas that intersected – no math required. It effectively let you prototype a building to improve it. This is where Clash Detection is born. It still took a long time – Upload, Downloads, Run

Reports, Upload Reports, Update Models, Repeat – but the results and accuracy of the solution were undeniable while also being faster than overlay processes of the past. Navisworks was able to open most any file type, making the solution software agnostic. This allowed it to get a foothold in the Industry. Thus is born the concept of Virtual Construction.

There were still many challenges to this solution. Not everyone was modeling in 3D. Using Point Clouds was cumbersome. Model accuracy became very important – and highly suspect. It also made coordinators reliant on the software. No longer did they need to be knowledgeable about the systems or even have construction experience. The software needs the coordinator to 'walk' through the building to visually inspect it because it can only clash what is touching, it won't know a duct below the ceiling shouldn't be there if it isn't hitting the ceiling. Grouping these clashes is also a manual process.

New challenges emerged here with computer hardware, jobsite usage, training, versions, and an IT hatred of BIM was born.

Once Autodesk bought Navisworks in 2007, they did eventually add a feature many were excited for: Switchback. While the concept breathed new life into the potential of VDC/BIM, the execution fell flat as it didn't work. If it did work, it required all designers to have a license of Manage – an expensive proposition. Switchback now works as expected with very few issues.

2009-2016-2018

In 2009, a university developed Horizontal Glue. This was basically Navisworks in the cloud. It was able to Glue together multiple models. It did not have the Clash Detection piece built in, so it essentially was like our "Sequential Compare Overlay Process" but for 3D.

Autodesk bought Horizontal Glue in 2012 and put out the first proof of concept where it could clash as BIM 360 Glue. In 2013, there was an immediate revamp making it more in line with what is expected from BIM 360.

Glue is viewable on the iPad, so it starts to bring models to the field without computer boxes and with significantly less hardware needed. There is no longer a need to upload and download models, but instead Glue and Sync them directly to the Glue viewer. It has automatic Clash Detection and Grouping. Although grouping is only by object. It has a simple user interface and fewer tools for the field personnel to be wary of.

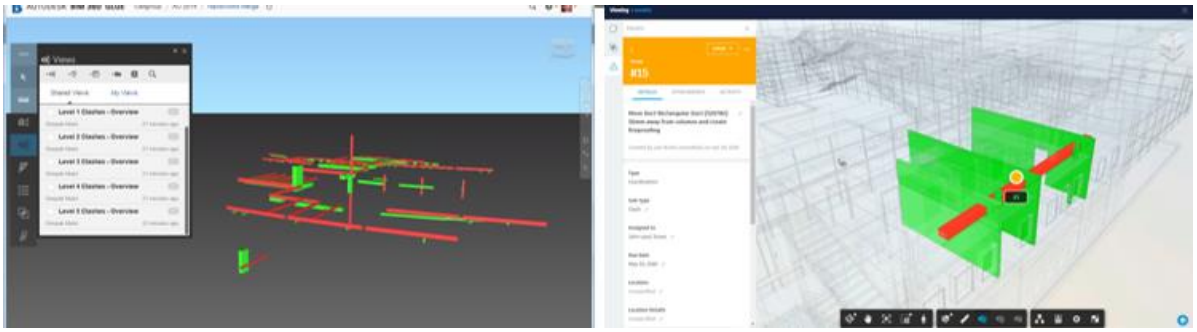
There is some integration with Manage where Views can be set up and shared. However, the Clash Tests do not translate, the appearance profiles do not work in Glue, and there are no Sets.

Glue has three (3) applications: Desktop, App on iPad, and Web. The web viewer cannot create clashes and tests, but the desktop and app can. The desktop and web versions cannot use points, but the app can. Needless to say, this leaves a lot to be desired and creates a giant headache for users.

There is a stop here in 2016. This is the year that Navisworks Manage has its last 'stable release'. Based on the testing done, nothing has drastically changed in the code to warrant

further testing in each new release year. This happens to coincide with about the time Model Coordination starts getting developed enough that whispers about Glue 2.0 coming can be heard.

2018 sees Model Coordination out in the wild.



GLUE VS MODEL COORDINATION

Side by side, Model Coordination has some improvements.

Glue	Model Coordination
- Groups by Object Only	- Choice to group by Object, System, or Type
- 3 Different Applications with different tools	- All Tools available on any Application
- Connection Integration and Shared Views	- Connects to all of BIM 360; Integrates Issues with Manage and Revit; and open API access
- Live Model Copies	- Live Models or Copies

Model Coordination has integration with:

<u>BIM 360:</u>
- Access models within any folder in Document Management to run Clash Reporting on
- Issues are Issues are Issues - regardless of where they are created
- Issues can be RFIs, tied to Meeting Minutes, reported on, and Exported for Record

<u>Navisworks Manage:</u>
- BIM 360 Issues Plugin allows Manage to access the Issues within a BIM 360 Project
- The Plugin also allows for access to a Model Coordination Space – which can then be saved as an NWF
- Can create Issues that BIM 360 will share

<u>Revit:</u>
- BIM 360 Issues Plugin (Beta) allows Revit to import Issues within BIM 360 within that view only
- Cannot create Issues to send up to BIM 360

- Take a Clash from MC or Manage, put an Issue Pin in it, Open Revit, Show Issues, and go right to the geometry that needs to be fixed!

While Model Coordination certainly has it going on, there are still challenges. The Clash Tests between Manage and Model Coordination are not connected. There is no free viewer. Sets and Appearance Profiles do not translate. To set up Coordination Spaces, the VDC/BIM coordinator needs Project Admin rights.

Let's get back to why Model Coordination is not Glue 2.0 and why it goes beyond Clash Detection. When Autodesk set out to make the Next Generation version of Glue, they decided to toss out everything and start from scratch: why do you need to detect clashes? To coordinate models! What do you need to do that? They took these answers and surveys and client testing results, mixed them together, and came out with Model Coordination. It will view clashes, it will assign them to give a trackable and visible solution to the accountability issues of Manage, and it will let you change how clashes are grouped. Autodesk is going a step further and adding Machine Learning. Eventually, Model Coordination will automatically sort chunks of clashes into what is and is not an issue. Machine Learning will open up a few new features that will be discussed in additional sections, but this is starting to build the picture of why Model Coordination is not Glue 2.0 and will eventually be worthy of the name Model Coordination.

Plugins

These additional tools exist to plug some of the workflow gaps that currently exist.

Clash Status

These plugins help add additional grouping options, set priorities of clashes, and gives additional color and status options. BIM Track is an example of such a solution.

Construction

These plugins help connect Manage and BIM 360 to additional construction management software outside of Autodesk. Procore is an example here.

Management

These plugins help manage the thousands of clash results across a project. From tracking to workflows. iConstruct and Revizto are good examples of this.

Prefab Status

These solutions tell you what the status of a fabrication model spool is. It allows for better clash resolution with information on cost and schedule impacts. MSuite is such a solution.

The Now Future

"The number of transistors that can be packed into a given unit of space will double about every two years" – Gordon Moore 1965. Moore's law

In the 2010s, we bent this law. We are able to double this faster than every 2 years.

In the 2020s, we will break this law. The physical capabilities of our current technology will max out.

This leaves us with some stagnation as we wait for breakthrough technology – and an open-ended future potential. Will the future breakthrough be on the cloud side? Implants?

The Bleeding Edge

Spot: a laser scanning robot by Boston Dynamics. This robot will save on labor and schedule impacts while being able to record existing buildings or throughout the construction process. This will impact safety and litigation.

Up/Down: a clash resolution solution from BIMSoft Solutions. It is an add-in that will automatically solve your MEP Clashes by moving one system up or down over the other.

Tridify: open any IFC in the cloud. This app is affordable with an incredibly simple User Interface that views federated models.

Openings: automatic openings generated in any host system within Revit. Hi-Tech Company and BIMSoft Solutions both have add-ins that do this. Openings will be inserted at any interference point between specified models based on rules set up. This will create Penetration drawings and serve to help create true clash-free models

Hot Topics

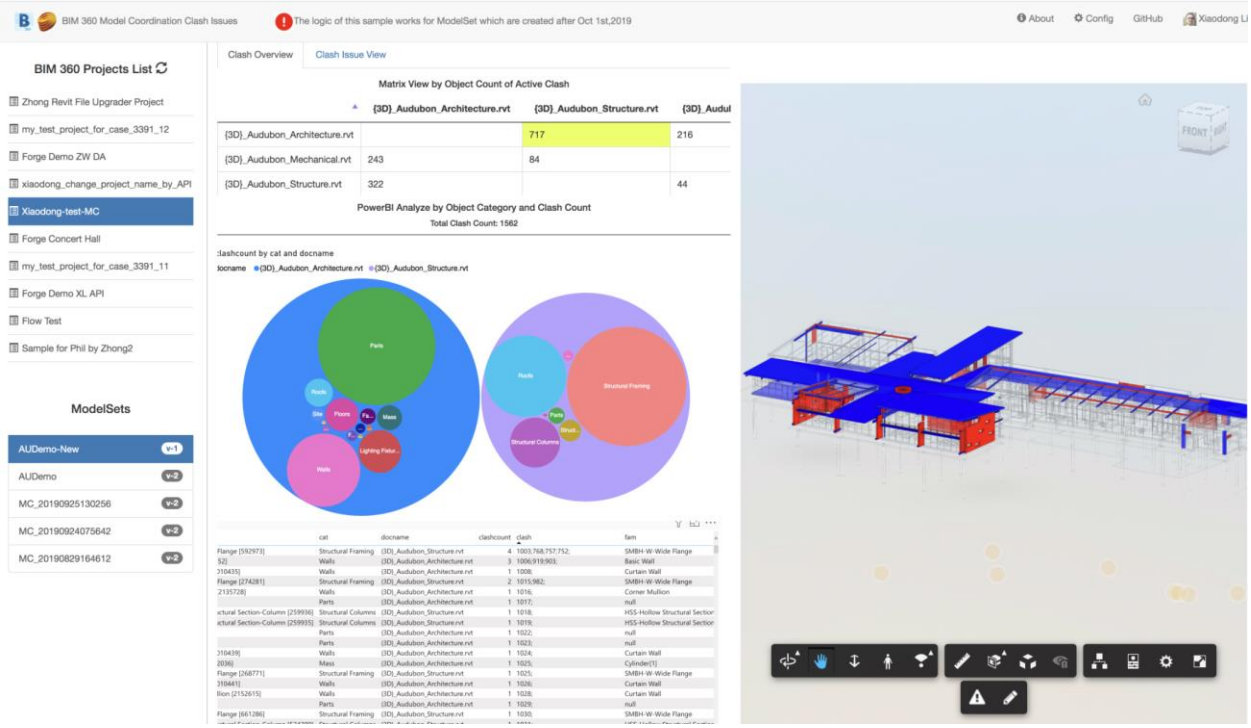
Generative Design: Feed it Rules and it gives you Design Options. Have analysis run on a design and find improvement options.

Automation – Virtual: Machine Learning – the more real-world examples the machine is fed, the more it learns. Low-Value tasks can be programmed.

Automation – Physical: New production methods create new end product possibilities. Brick Laying (paver robot), Measuring and Cutting Pipe/Sticks (MSuite + Tigerstop), and Duct that builds itself (machine cuts, folds, and seals duct shapes).

IOT and Digital Twins: Internet of Things (IOT). Connected Physical Data to the Virtual Model through the IoT will create Digital Twins. Google Maps is an excellent example of a Digital Twin. Jobsite Safety through wearables, Schedule for Record and for Billing through connected data, and Accurate Data for Better Decisions through complete virtualization of a jobsite.

Model Coordination and PowerBI



GITHUB

Exposed API will lead to more tools, more apps, and more integrations! Programmers will become a big part of the Industry – and not just for the software companies.

The Future: 2021 onward

This section is broken up more into VDC (Construction), BIM (Design), and Project Delivery – in that order.

Automatic Clash Resolution

Detect and Group Clash

- Model coordination grouping
- Group all items to help determine which geometry to move

Use Existing Tools to Adjust Model

- Up/Down or Auto MEP Clash Resolve Tools
- Will update model using database and existing parts in the model

Machine Learning to Choose Solution

- Pictures of what is modeled compared to what was built
- Verify what was installed/spooled already
- Weigh costs of changes for best outcome

Connected Cost Data

Assets will be connected to Costs

- Any item can be an Asset in BIM 360*
- Assets are tied to a Manufacturer
- This connection will be live

Data will come from the manufacturer

- Manufacturers can update their pricing as needed
- Data will disseminate to tagged items in Assets

Estimators will Adjust and Track

- Estimators will be able to take those costs from Assets into Cost Module
- Add Labor, Overhead, Profit, etc
- Get a full project cost picture

3D Printing

Custom shapes

- Printing parts makes shapes possible that were previously unable to be made
- Printers can produce 24/7

Whole building structures

- Modular buildings or rooms
- Complete with cutouts for systems, components, and more

Building components

- Steel or Concrete Structures of custom shapes
- In-place furniture
- Hosted items

Automatic Schedules

Connected Devices

- Trackers
- Scanners

Status trackers

- Update progress: Modeled, Fab, Install, Test
- Helps determine % complete and % billable

Laser Scanning

- Scan what is installed
- Compare to what is modeled
- % Complete and Project Status

VDC Future Roles

Downstream results and data usage managers

- No Clash Detection
- Programming: either manage or create
  - PowerBI or Super Excel at a minimum
- Basic IT – still required
  - Jobsites will not be down waiting for IT to come from HQ
- ROI Tracker
- Virtual and Augmented Reality Specialist
- Robotics Technician: troubleshoot and basic repair of connected devices, scanners, drones, and wearables
  - Jobsites cannot be down waiting for repair people for *basic* issues
- R&D: supplemented out to Tech Companies – must manage the process and make decisions
- Process Manager: implement new technology and workflows
- Broad knowledge scope to connect all pertinent data

Basic Design Automated

Generative and Iterative Design

- Generic Design outlines
- Start modeling from these concepts
- Detailed designs flushed out via programming

Machine Learning

- Data from real world on fail rates
- Material costs and sustainability scores

Building Improvements

- Performance data
- Costs and Schedule impacts per design option
- User ratings

Project Consistency

Manufacturer Content Checked

- Keep models safe
- Consistent visuals
- Mapped parameters

Library and Template Management

- Save time and rework
- Reduce training and modeling workload
- Manage in one place

Library and Data Management

- All document types for projects
- Content managed including information per phase
- Data and Integration feed automation
  - As you model, the project should start to fill in typical details

LOD Upgrading

Level of Development

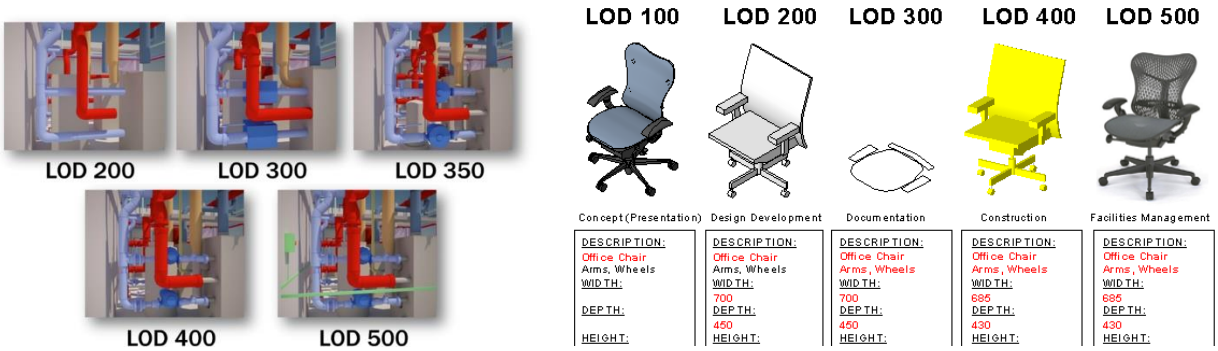
- How much is modeled
- Accuracy of what is modeled

Level of Detail

- How much information is attached to the object
- How much the object represents the real-life version of itself

Automatic Upgrading

- Per project phase
- As a designer models in lower LOD, machine learning can feed real life parts reducing rework and suggesting improvements



LEVEL OF DEVELOPMENT VS LEVEL OF DETAIL BY LANMAR SERVICES

AI Interns

No more need to prep files, upload or download from FTP sites, etc.

Automatic Documentation

- MSuite and others currently do this
- Send drawings/Models right to next stakeholder with BIM 360 Integration

Issues As Redlining

- BIM 360 Model Coordination
- Machine Learning warnings
- Suggestions from real life buildings

Family and Detail Creation

- Manufacturers are modeling families
- Limited number of items to create

- Scan to model capability

BIM Manager Future Role(s)

Ability to keep up with technology, training, and legal requirements

- Keep Data connected
- Reduce rework
- Manage cloud projects
- Basic IT
- Virtual reality specialist
- Integrate technology solutions and keep updated on new options
- Understand what technology needs to go into the buildings to make Smart Cities
- R&D: partner or outsource
- Be able to Program at a basic level
- Training: designers on generative design, PMs on management options, and users on Apps/New Features

Model Based Project Delivery

Complete Models

- No fake parts
- Connected data including GIS for Cities
- Full Prototype

Buildings Built Better

- Issues rectified earlier
- Buildings produced faster due to streamlined processes and decisions

Unforgiving Market

- Owners get a clearer picture of what they are getting and who they are working with
- No room for Pretty BIM

Modeling in the Cloud

Cloud Revit: BIM 360 Modeling

- No more single processor
- Everyone in the ‘same’ model
    - Increased stakeholder cooperation

Integration

- Connected Data without add-ins
- Stakeholder communication

Computer setup Changes

- No need for heavy duty machines
- More touch enabled capability

Machine Learning

More information than ever

- There is now more information than a person can consume available
- Supplemental support frees our brains

Complex problems

- 'Run simulation': cannot design simulation
- Humans are 'outside of the box' while machines are fact checkers and number crunchers

Improve End User Knowledge

- As a user sees more solutions, they will start creating fewer problems to solve
- While we are a small community, there is still a whole world of experience out there

We often see things and go 'wow, how did we not know that or think of that' – so while BIM is a small community, it still encompasses the world.

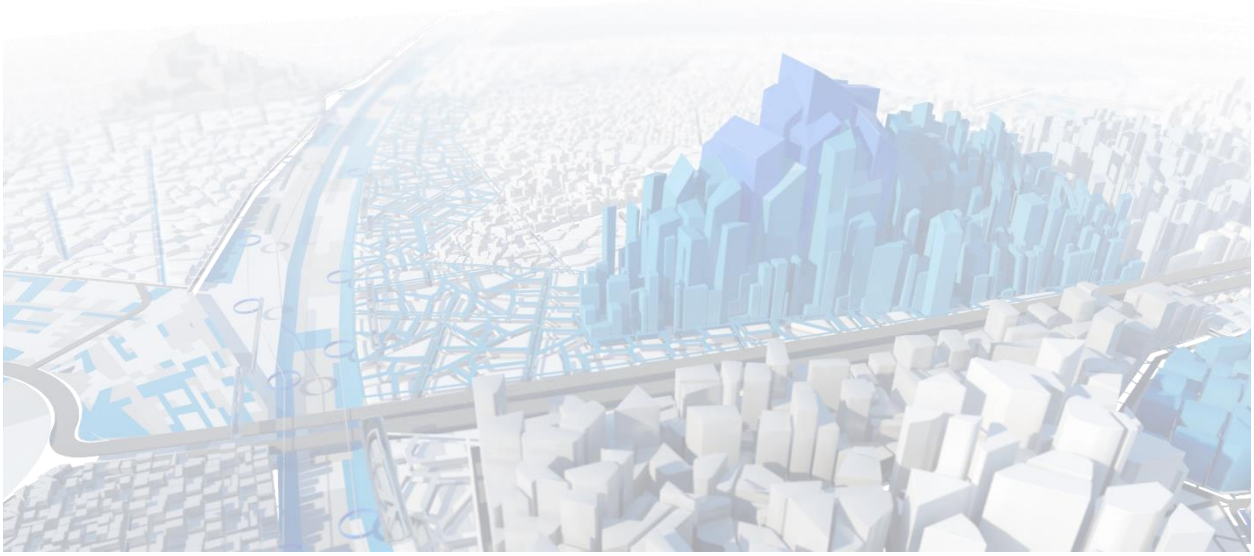
Real-world knowledge doesn't get lost (what is in someone's head is in the machine before they retire – no lost information).

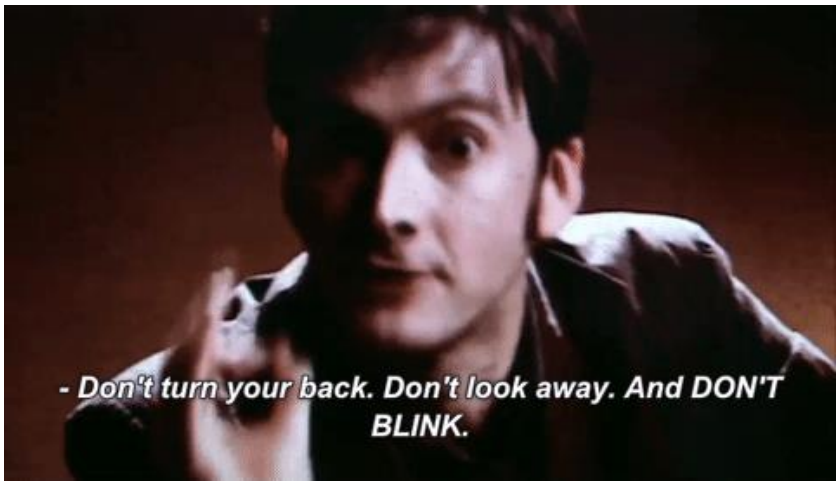
Final Thoughts

At this point, Clash Detection is gone. Model coordination is about designers working with higher LODs, trades having automatic clash resolution for basic clashes, having data for better routing and part decisions, and bringing the whole building to life virtually as a test drive.

Watch the BLEEDING edge to stay on the LEADING edge.

Instant, accurate data allows for the swiftest responses which saves time, energy, and money with the best outcome in quality and lessons learned.





DOCTOR WHO, BBC AMERICA – 10TH DOCTOR DAVID TENNANT

Since this presentation started off with a timeline and the time getting shorter and shorter, at this point in the future, I'd say aside from real world case studies reliant on buildings being completed, this is the best advice I can give you.

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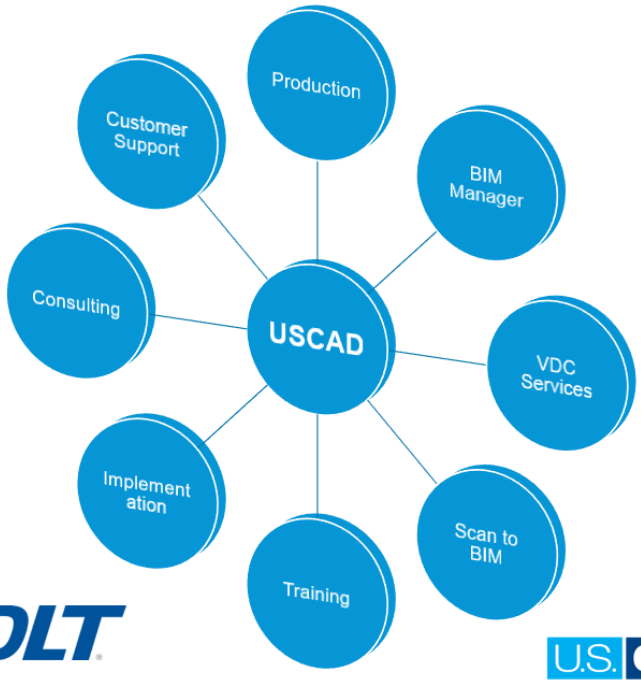

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