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How does the interoperability of BIM digital technologies in modern methods of DfMA construction impact the workflows in the AEC sector?

By Shane Coppinger and Kieran O’Neill

Background

This presentation is based on Shane Coppinger's MSc in applied Building Information Modelling & Management capstone paper at TU Dublin.

Capstone Experience enables students to focus intensively on the solution of an industry-based problem or problems while also developing significant research capability.

Paper Objectives

This study looks to explore and evaluate the impact of DfMA, BIM software on the MMC in the AEC industry.

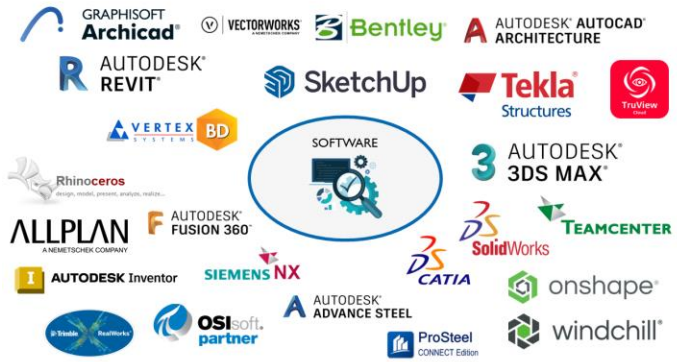
1. Identifying key DfMA BIM software and examining their impact on MMC.

2. Analyse the effectiveness of DfMA software in relation to its interoperability and compatibility with architectural, engineering, and manufacturing design.

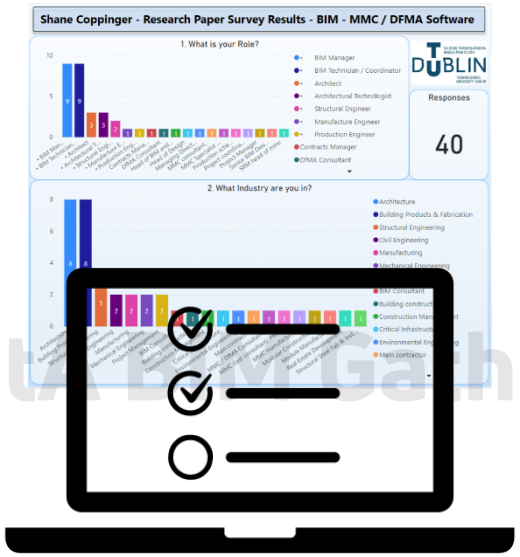
3. Conduct a case study that examines the design of Modular Bathroom Pods using BIM DfMA software in the context of Architectural and Production Manufacturing.

Chosen Methodology

Mixed Methodology



BIM DFMA Software Analysis

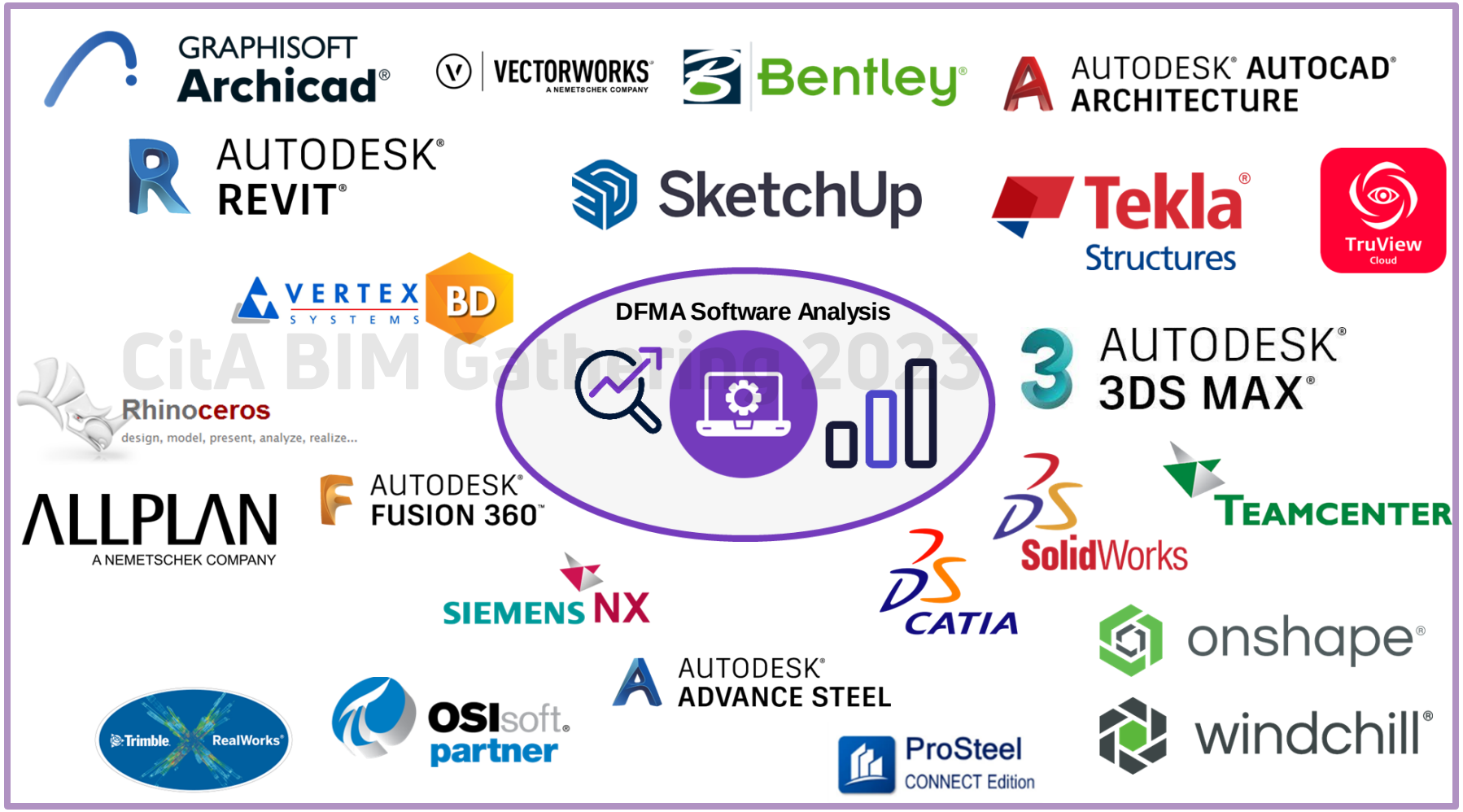


Online Survey Analysis

Interview Analysis

DFMA Software Analysis

All the software packages mentioned in the literature review and in the online survey.

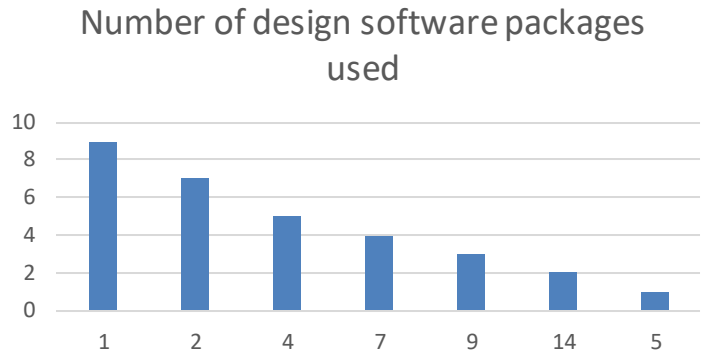


DFMA Software Analysis

The survey highlighted the prevalence of Autodesk's Revit as the most commonly used software with 33 out of 40 using Revit. However, 31 out of 33 used other drawing software packages.

AutoCAD Architecture (19 of 40) and Tekla Structures (15 out of 40) were the second and third most used software.

1 person used 9 separate software packages, with an average of 3 software packages per person.



Online Survey Analysis Results

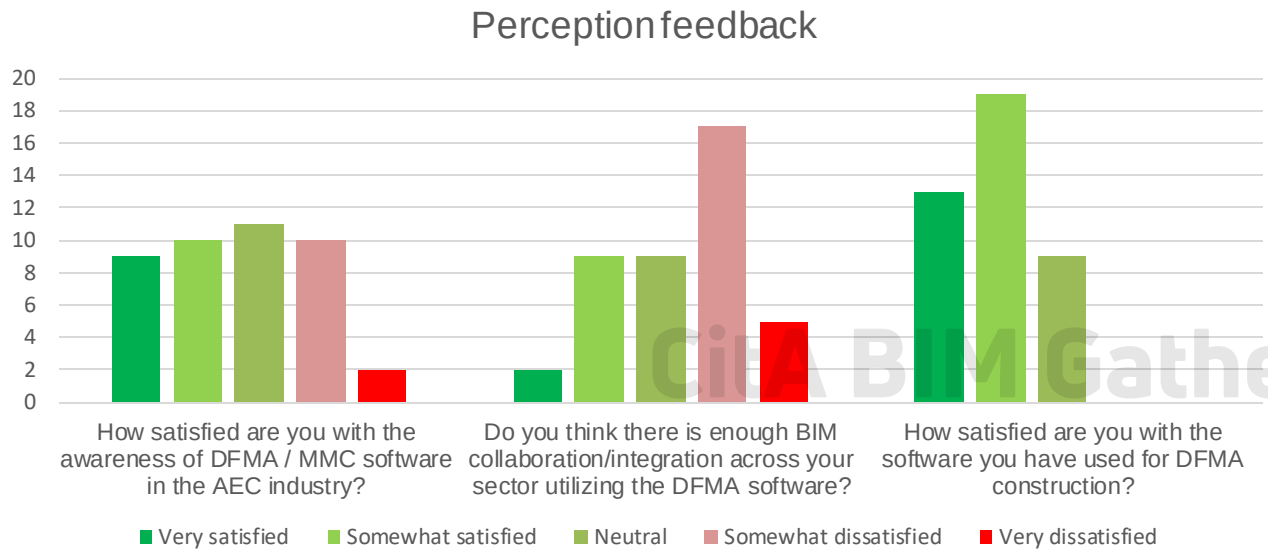
The survey targeted a specialised audience of MMC/DfMA designers, technicians, consultants, advisors, and specialists who possessed extensive BIM knowledge in the AEC industry.

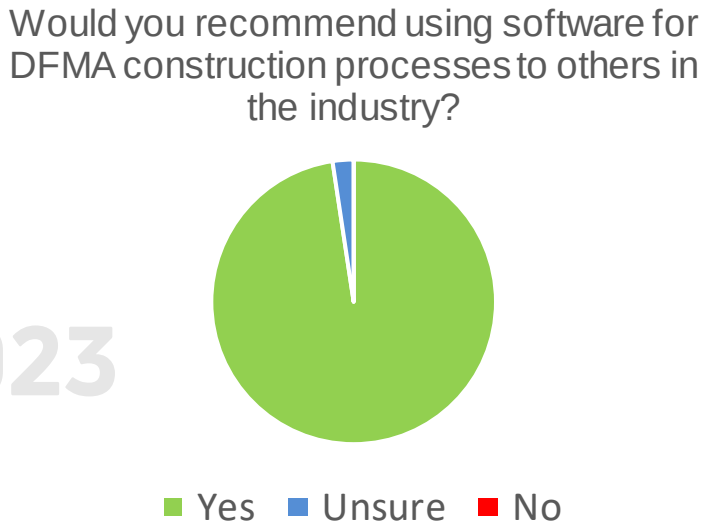
MMC Ireland, assisted in narrowing down the list of companies to survey.

Participants.
Senior Management (9), Production/Project Mrg. (5), BIM Manager (10), Architect /Eng./Arch Technologist (9), BIM Technician / Coordinator (9)

*" **77%** said they make use of DfMA software on a daily basis ."*

Online Survey Analysis Results



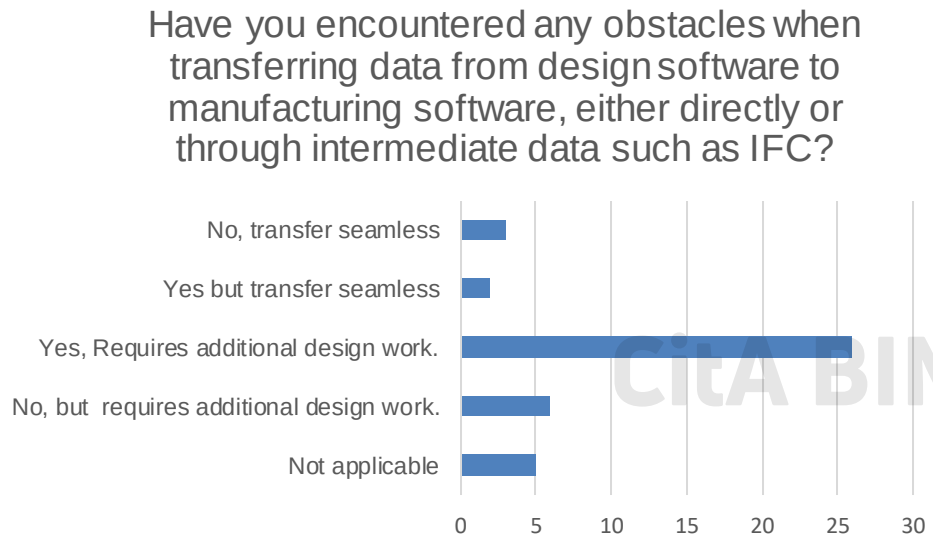


Mixed reaction regarding their awareness of DfMA/MMC software in the AEC industry.

*" **52%** of the respondents somewhat dissatisfied that there isn't enough BIM collaboration/ integration".*

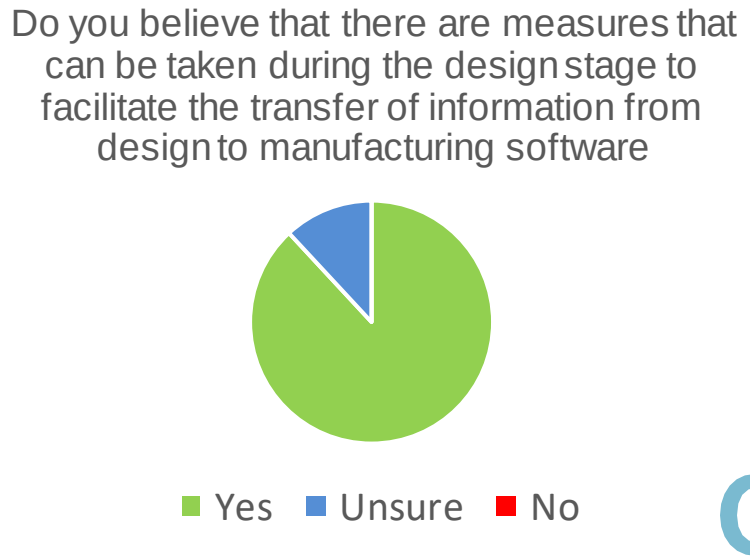
***97%** recommend using software for DFMA construction processes to others in the industry*

Online Survey Analysis Results



Respondents generally satisfied with their DfMA software.
*" **76%** said that the process of transferring data from Design to manufacturing requires additional design work for the manufacturing process."*

88% *believe there are measures that can be taken during the design stage to facilitate the transfer of information from design to manufacturing software.*



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Online Survey Analysis Results

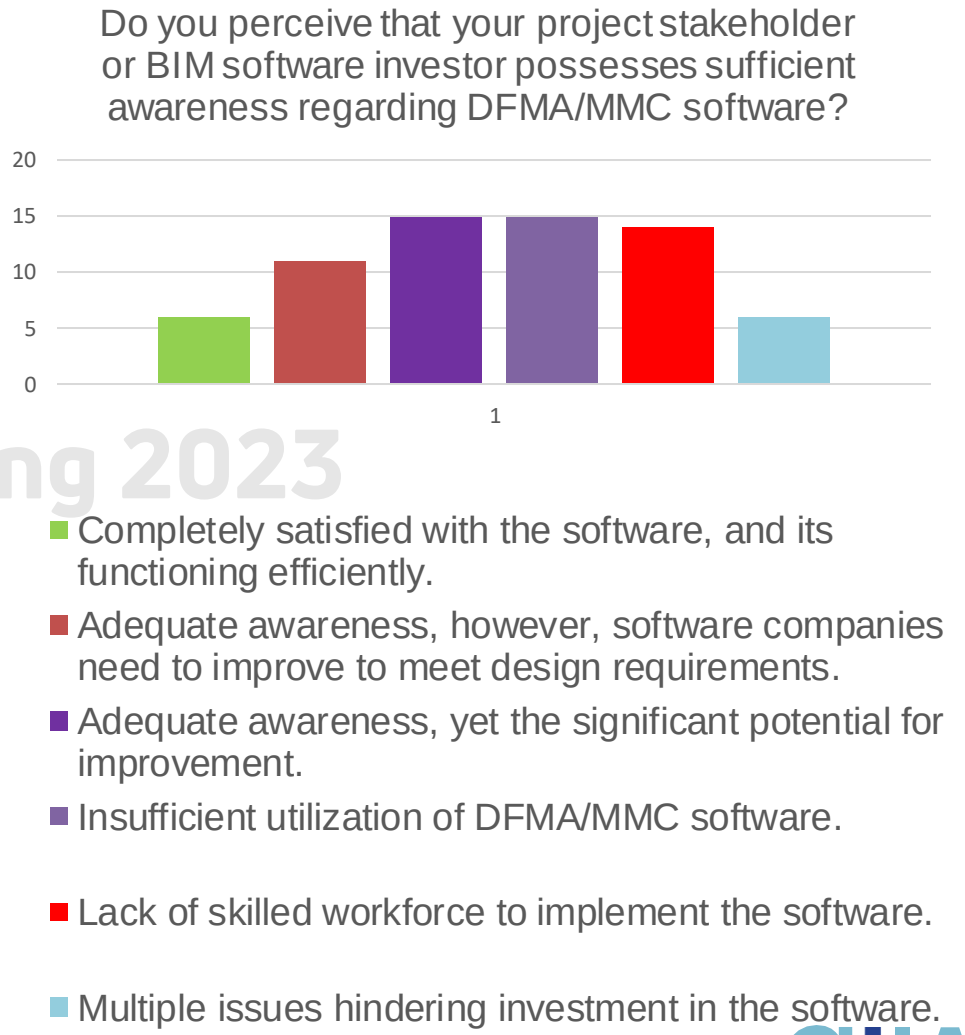
Is there enough awareness regarding with project stakeholders or BIM software investors?

80% *believe there is Adequate awareness, yet the significant potential for improvement*

79% *believed that their companies were somewhat or very likely to invest in additional software tools for DFMA construction processes in the future*

40% *said there is insufficient utilization of DFMA/MMC software*

35% *said there is a Lack of skilled workforce to implement the software*



Online Survey Analysis Results

In conclusion,

- *the data analysis indicates that DfMA software is a commonly used tool in the construction industry.*

- *however, the findings also suggest that there is a need for further improvement and education in maximising the benefits of this software.*

- *This indicates an opportunity for companies to invest in better training and education for their employees to optimize the use of DfMA software and improve construction processes.*

- *The results of the literature review and the online survey analysis suggest that BIM and DfMA are effective tools for promoting MMC in the construction industry.*

Introduction to case study

Rational for case study - to assess the obstacles to the adoption of DfMA software from diverse stakeholders' viewpoints.

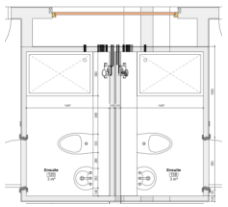
Background - large-scale residential development project comprising of 730 units in five apartment buildings and two duplex buildings.

MMC aspects

- *prefabricated balconies,*
- *standardized apartment layouts,*
- *prefabricated MEP units,*
- *standardized window types,*
- *prefabricated bathroom pods,*
- *precast panel structural elements*

Methodology – Qualitative
Design & Production Processes

Architect



Bathsystem

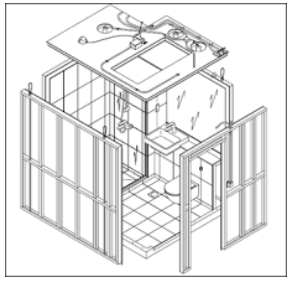
Architect

MEP Engineer

Architect's design intent → **Tender & supplier selection** → **Bath System Pod submittal** → **Review by design lead** → **Secondary Reviewer** → **Comments consolidated by design lead**

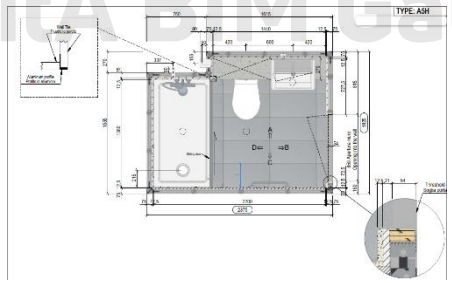
Revit

AUTODESK Construction Cloud



Designed Model

SOLIDWORKS

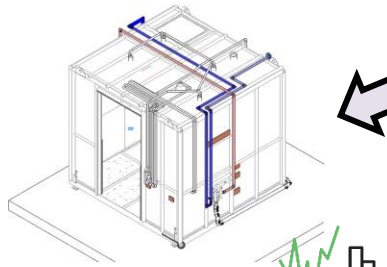


Accepted

Rejected

Approved with Comments

Pod Production Model & Drawings Updated



Issue for fabrication, delivery, installation, commissioning & operation

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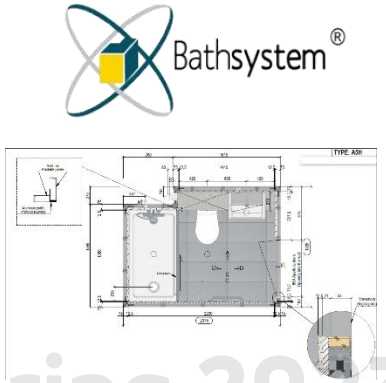
Interview Analysis

Interview with a BIM coordinator / Production Lead at Bath System to gain insight into their use of software in the design and production process.

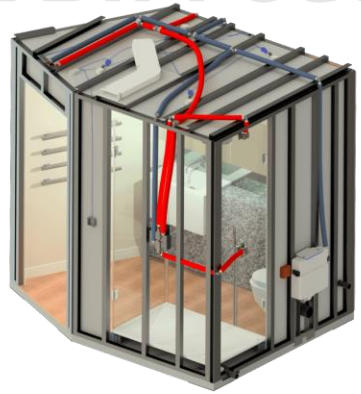
The interviewee expressed,

- Satisfaction with the software, noting that it was user-friendly and intuitive.
- It highlighted its ability to design each component, save time and resources, and reduce errors during the manufacturing and construction phases.



Need for progression of Digital Twins in the Irish Residential DFMA Sector?

Continuous data exchange between digital twin and physical counterpart



Physical Twin

Objects

Processes

Systems

Digital Twin

- Data Analytics
- Representative models
- Data Management

Case study

In conclusion,

- *the interoperability of BIM digital technologies and DfMA MMC has demonstrated a positive influence on workflows in the AEC sector case study, leveraging the traditional submittal review process to ensure alignment between offsite fabricators, the design team and onsite subcontractors.*

- *By enhancing collaboration, communication, accuracy, and quality, the use of BIM and DfMA technologies can significantly reduce costs (including re-work costs) and enhance efficiency in construction projects.*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