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Comparison of BIM Collaboration Paradigms for Digital Twin Readiness: Centralized Files, Decentralized Clouds, and Distributed Blockchains

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Outline



Background



BIM collaboration paradigms



Conclusion & Discussion



Future work



Q & A



01

Background

1 Background



❑ Beneficiaries of BIM

- ❖ All project stakeholders (from BIM collaboration)

❑ BIM is widely used

- ❖ Building Information Modeling (BIM) has been widely used as the information hub and increasingly mandated in the AECO industry

❑ Industry

- ❖ Many building projects in the AECO industry involve complex, multidisciplinary, and multi-stakeholder collaborations and information exchanges

Background

❑ Digital Twin (DT) in the construction industry

- ❖ Real-time data
- ❖ Life-cycle modeling and monitoring
- ❖ For learning and simulation-based analysis
- ❖ Combining BIM and DT technology
 - ❖ Reduce energy demand
 - ❖ Reduce processing and approval cycles
 - ❖ Increasing transparency and collaboration

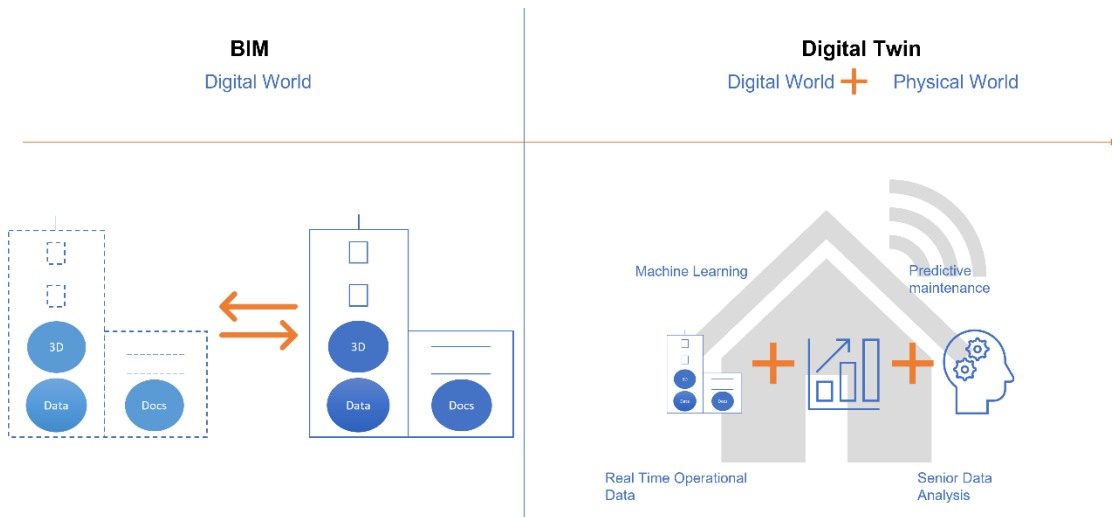
❑ Unresolved problem

- ❖ DT readiness in multi-stakeholder BIM collaboration

1 Background



Example of Building Information Modeling (BIM)



Example of Digital Twin (DT)

Combining BIM and DT technology can significantly improve efficiency in the building industry

Multi-stakeholder BIM collaboration for DT is an **unsolved problem**, interoperability in the construction industry is critical



02 BIM Collaboration Paradigms

2 BIM Collaboration Paradigms



a. Centralized Network



b. Decentralized Network



c. Distributed Network

Three type of network model

1970s **Centralized files**



2010s **Decentralized clouds**



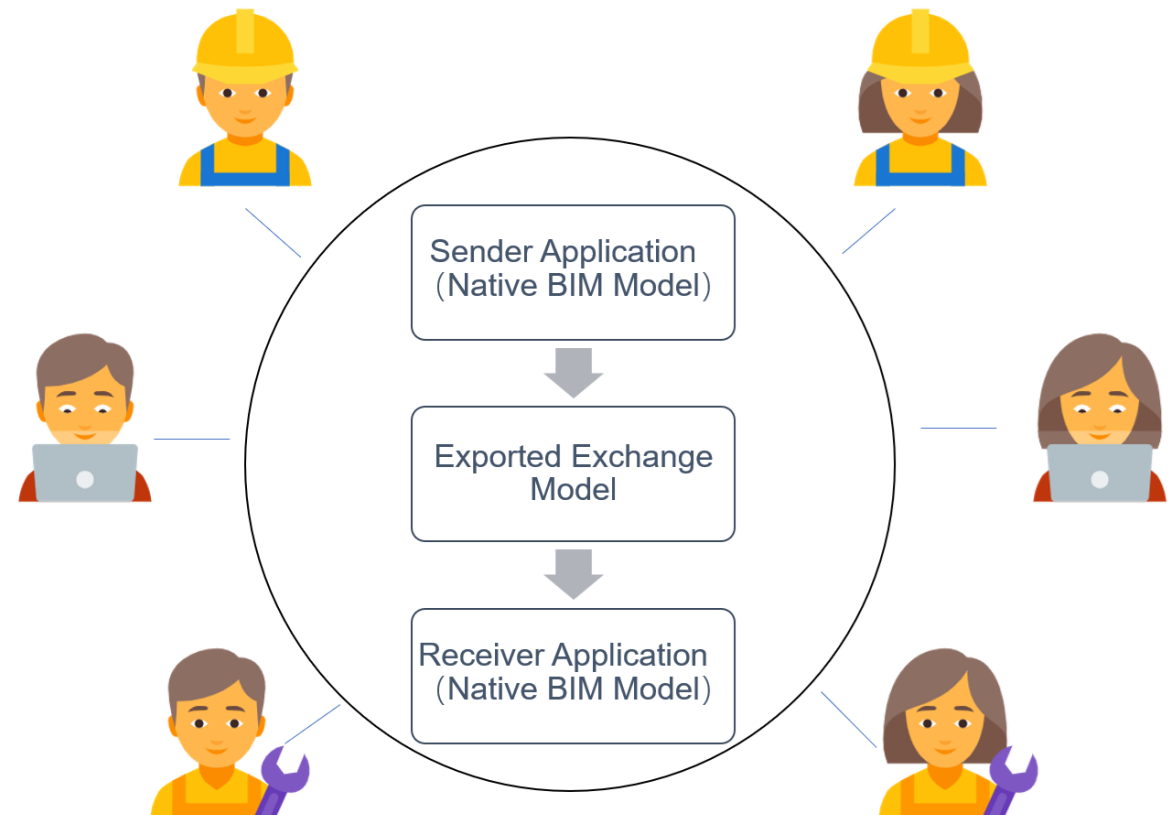
2016 **Distributed blockchains**



2 BIM Collaboration Paradigms

Centralized files

- Conventional collaboration
- File-based transfer
- Industry Foundation Classes (IFC) data model
- Via e-mails or other communications



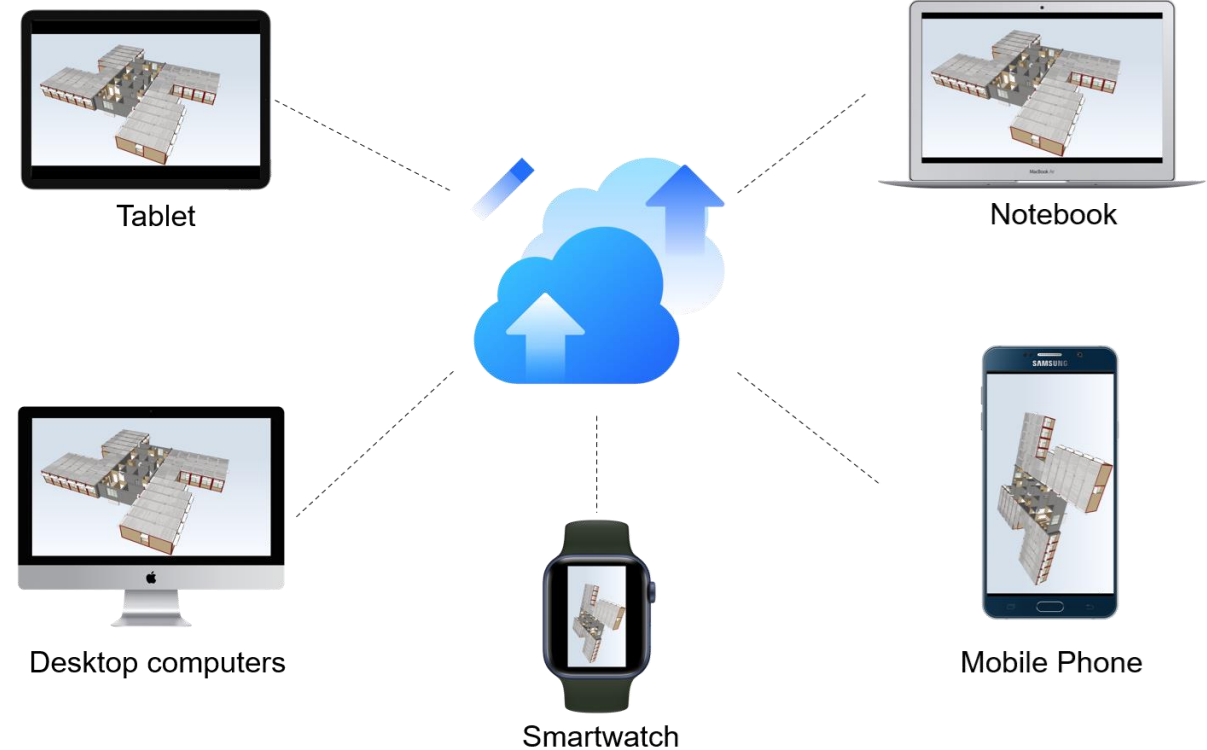
Centralized BIM collaboration process

2 BIM Collaboration Paradigms



Decentralized clouds

- Cloud computing is a paradigm
- Shared pool
- Cloud products
 - Software-as-a-Service (SaaS)
 - Platform-as-a-Service (PaaS)
 - Technology-as-a-Service (TaaS)
- Hybrid clouds
 - Public cloud
 - Private cloud

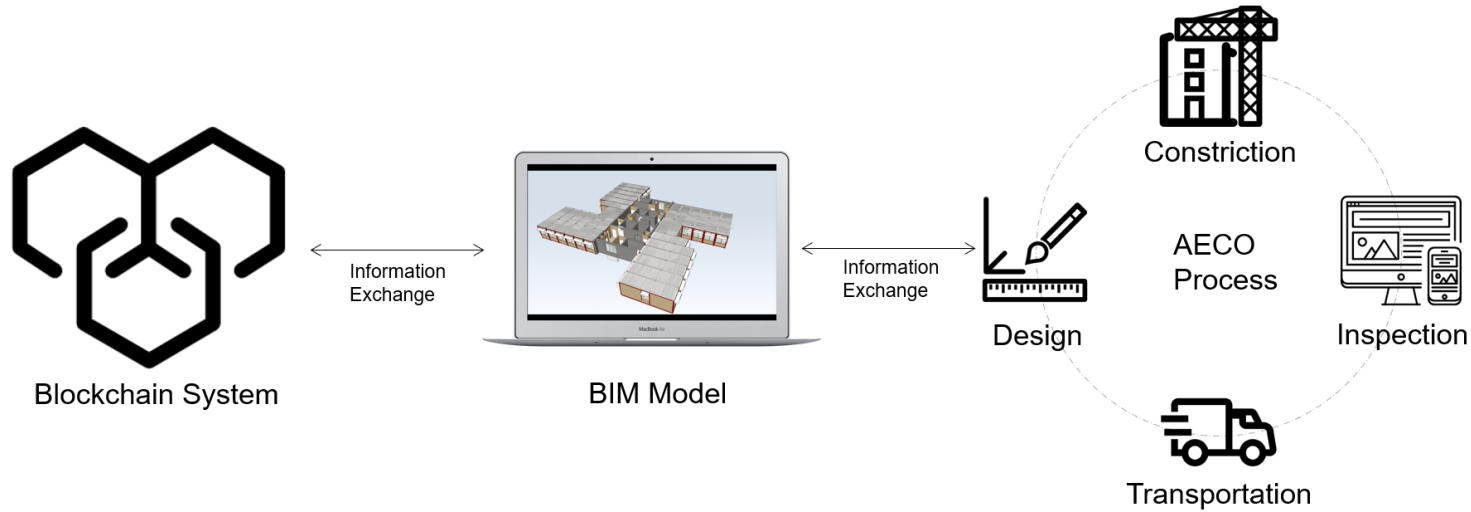


Devices for cloud BIM collaboration

2 BIM Collaboration Paradigms

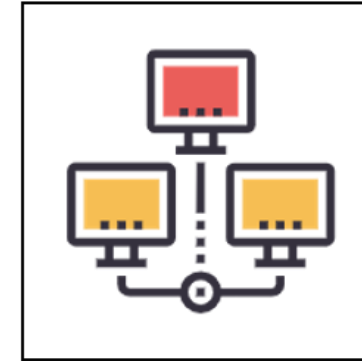
Distributed blockchains

- Distributed file system
- Permanent record of modification operations
- BIM data is reliable and unchanging



Blockchain-based BIM collaboration

Shared Ledger



Encrypted Data



Consensus



Smart Contracts



Components of Blockchain



03

Discussion & Conclusion

3.1 Discussion

Comparison of the three paradigms



	Centralized Files	Decentralized Clouds	Distributed Blockchains
Advantage	<ul style="list-style-type: none">• Easy to use	<ul style="list-style-type: none">• Savings in IT resource• Decentralized environment	<ul style="list-style-type: none">• Openness and transparency• Data unchangeable
Disadvantage	<ul style="list-style-type: none">• Human error, missed or untraceable• Data Missing or untraceable	<ul style="list-style-type: none">• Security threats and business secrets• Lack of cloud-specific BIM standards	<ul style="list-style-type: none">• Vulnerable to cyber attacks• Defective code will lead to irreversible damage

3.2 Conclusion



Existing Problems

- AECO industry needs DT-ready BIM collaborations.

Aim

- Compare the DT readiness of **the three paradigms**(File-based, Cloud-based, Blockchain-based) based on the network models of information exchange links.
- Discusses the findings and possible future directions.

Result

- Presents a **systematic overview** of existing BIM collaboration paradigms for **DT readiness**.



04

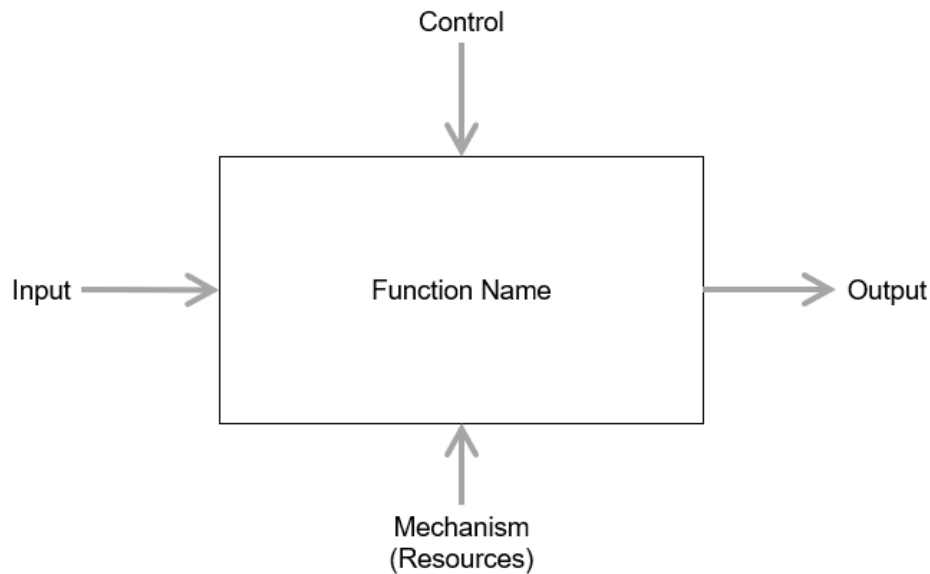
Future work

4 Future work

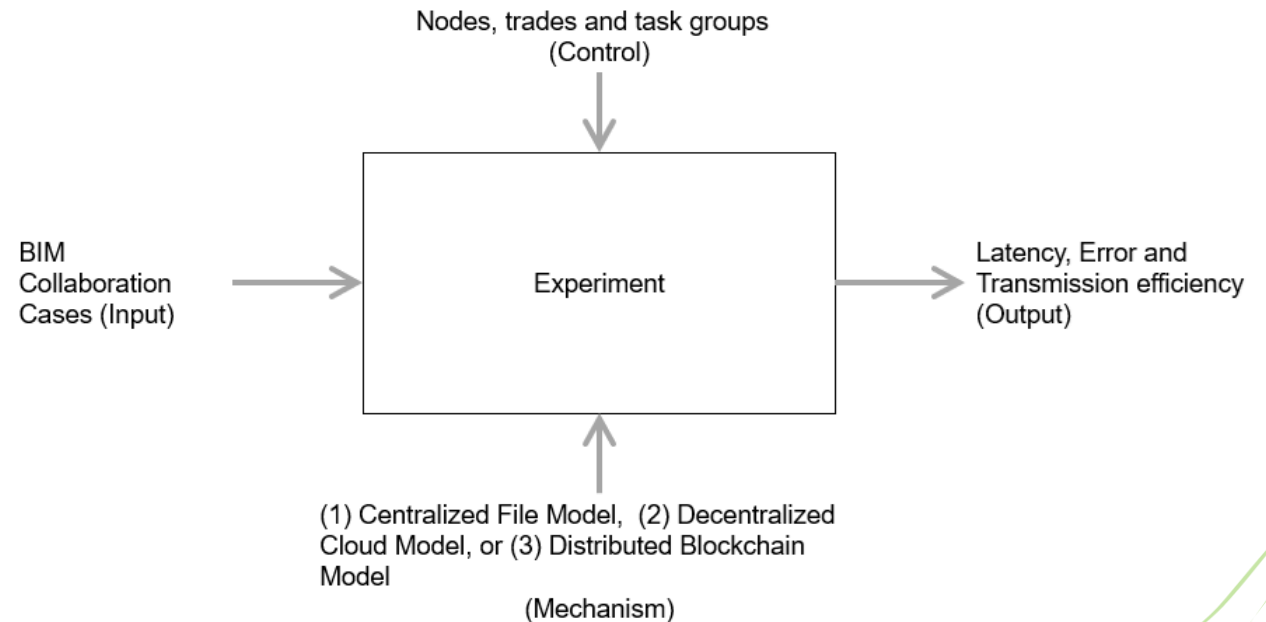


Planned experiment on the digital twin readiness

IDEF0, a compound acronym (“Icam DEFinition for Function Modeling”), is a **function modeling methodology** for describing manufacturing functions.



Example for IDRFO



Planned experiment with IDRFO

The background features a white space with vibrant green abstract elements. In the top-left corner, there are thick, layered brushstrokes. On the right side, numerous thin, curved lines sweep upwards and outwards, creating a sense of movement. At the bottom-right, there are more thick, layered brushstrokes, mirroring the top-left corner.

Q & A



Thanks for watching

