Synergising BIM and Real-Time Data for Improved Efficiency: An Irish Case Study

Ahmed Hassan Ankur Mitra Alan Hore Mark Mulville

School of Surveying and Construction Innovation,
Technological University Dublin

Synergising BIM and Real-Time Data for Improved Efficiency: An Irish Case Study

Dr Ahmed Hassan,
TU Dublin

Research Background

- BIM is associated with numerous benefits for building projects

Enhanced outcomes – Increased efficiency – Improved collaboration – Cost reduction.

- BIM benefits depend on the quality of acquired data

Accurate – Up-to-date – Timely.

- Digital solutions provide great potential for improving the BIM As-built process

Facilitate conflict resolution – Improve progress monitoring – Enhance knowledge transfer.

- Integrating Visualisation and IoT solutions with BIM is faced with several challenges

Shortage of digitally accessible data – Skills shortage – High cost.

Synergising BIM and Real-Time Data for Improved Efficiency: An Irish Case Study

Dr Ahmed Hassan,
TU Dublin

Study Aim

The study aims to explore the potential benefits, challenges, and perspectives of integrating real-time data capture solution and BIM in Irish construction projects.

Objectives

- Examine obstacles related to data collection in the BIM-As built process.
- Investigate construction personnel's predispositions towards digital data capture tools.
- Determine the demands of construction professionals in relation to data capture tools.

Synergising BIM and Real-Time Data for Improved Efficiency: An Irish Case Study

Dr Ahmed Hassan,
TU Dublin

A-EYE Project Consortium

Construction Visualisation Experts

Technological University Dublin

GagaMuller Group

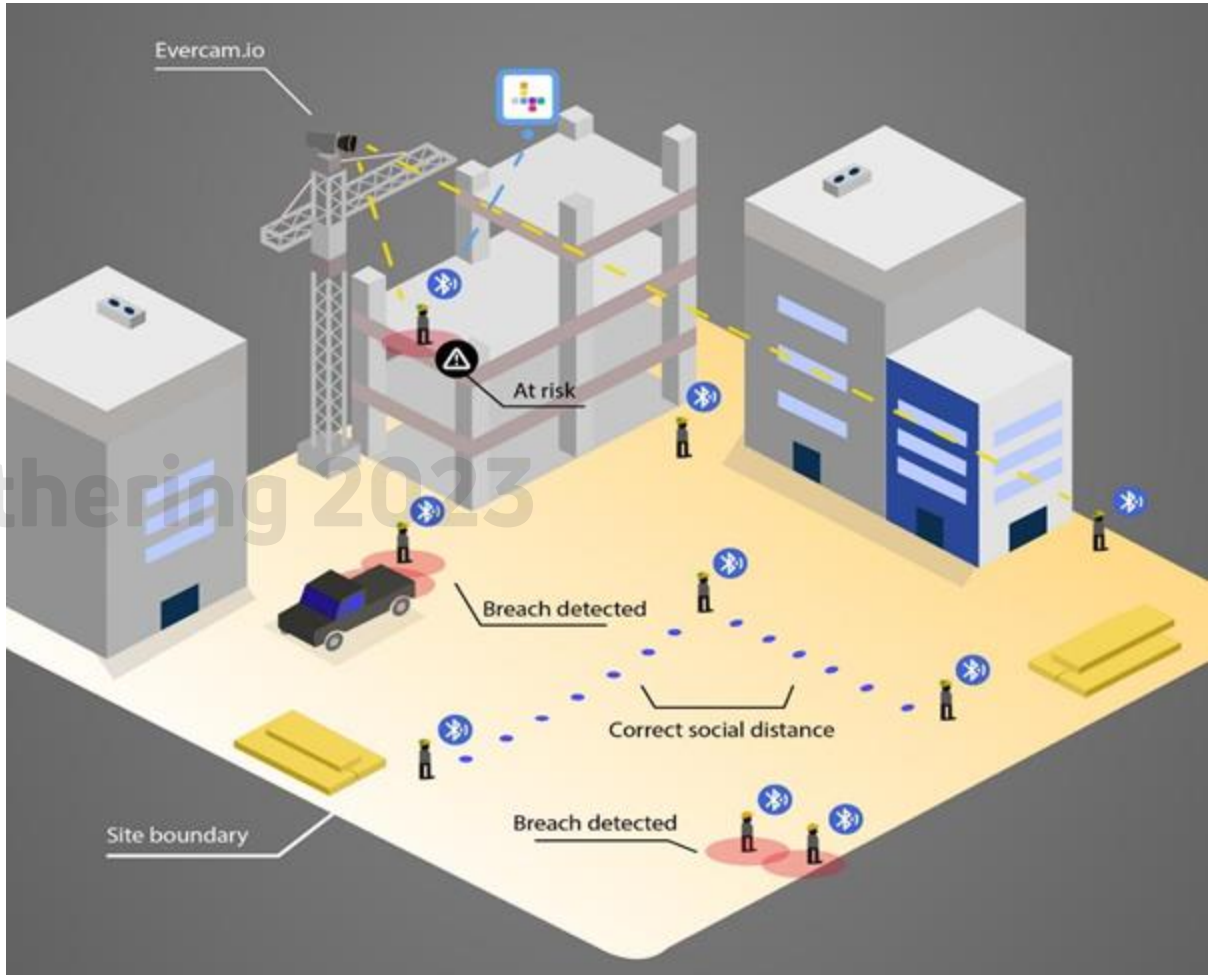
Innovate – Disrupt – Integrate

Synergising BIM and Real-Time Data for Improved Efficiency: An Irish Case Study

Dr Ahmed Hassan,
TU Dublin

A-EYE Technology Demonstration

- BIM Integration.
- Real-time Scheduling and Resource Control.
- Matching Billing Process with On-site Progress.
- Safety Monitoring.

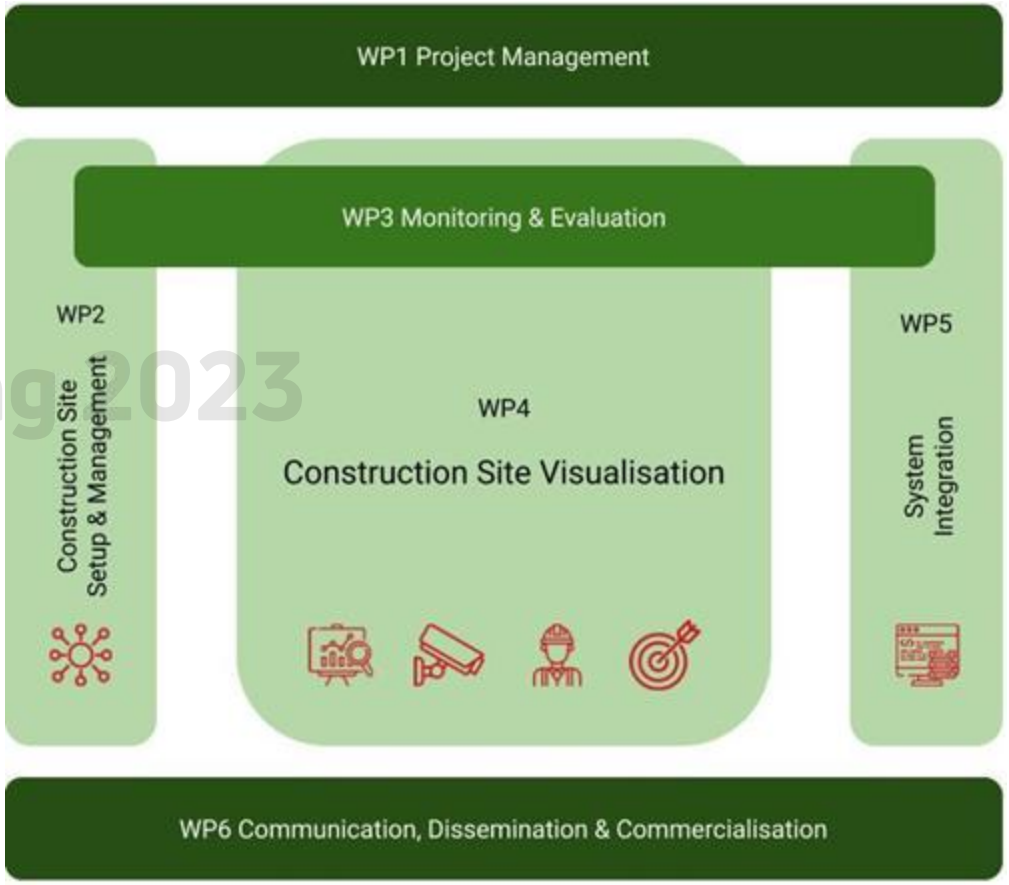


Synergising BIM and Real-Time Data for Improved Efficiency: An Irish Case Study

Dr Ahmed Hassan,
TU Dublin

Project Details

- Project Duration: 3 years.
- Commencement Date: 1.12.2021
- Budget: €3.78 million
- Enterprise Ireland (DTIF) Contribution: €2.09 million
- User-Experience Research



Dr Ahmed Hassan,
TU Dublin

Profiles of the Study Participants

Participant	Position	Practical Experience (years)
A	Construction Director	> 20
B	Structural Engineer	> 5
C	Quality Engineer	> 10
D	Quantity Surveyor	> 15

Synergising BIM and Real-Time Data for Improved Efficiency: An Irish Case Study

Dr Ahmed Hassan,
TU Dublin

Data Collection and Analysis

- Semi-structured interviews.
- 4 Participants.
- Thematic Analysis.
- 67 Codes.

No	Theme	Relevant Codes
1	BIM Process	•BIM applications •BIM benefits •BIM limitations
2	Current Methods of Data Capture	•BIM development procedures •Data capture challenges •BIM & Skills shortage
3	Inter-team Communication	•Progress communication •Transparency •Limitations of digital tools in use
4	A-EYE Opportunities	•Potential advantages •Commercial benefit •Supporting collaboration
5	A-EYE Challenges	•Staff resistance •Skills deterioration •Learning curve

Dr Ahmed Hassan,
TU Dublin

Findings - BIM Process

- BIM use is primarily limited to Visualisation purposes.
- Detailing and Clash detection are usually conducted manually by examining 2D drawings.
- Digital skills shortage and Resistance to change are the primary barriers to upgrading BIM maturity.
- As-built development is a continuous process that requires accurate and timely information concerning

Structural components – Geometric Attributes – Equipment – Materials – Operation – Maintenance.

Dr Ahmed Hassan,
TU Dublin

Findings – Current Methods of Data Capture

- Data capture process mainly rely on manual methods: Physical inspections – Checklists.
- The data capture process is:

Outdated – Lacking accuracy – Time-consuming.

- Levels of satisfaction with used digital tools, Drones and Laser scanning, are very low.
- Issues with used digital solutions are that they were not:

Fit for purpose – Customised to unique construction projects – User-friendly.

Dr Ahmed Hassan,
TU Dublin

Findings – Inter-team Communication

- Digital solutions enhanced communication between project teams.
- Improved collaboration is evident through the Design, Planning, and Procurement stages.
- Communication is getting automated during the execution phase with respect to Task assignment and Inspections.
- The primary challenge to using digital solutions for communication is the Lack of transparency due to the absence of Visual proof of events.

Dr Ahmed Hassan,
TU Dublin

Findings – A-EYE Opportunities

- There is a great potential for AI construction visualisation solutions to assist with

Data capture – Progress monitoring – Communication between stakeholders.

- The anticipated benefits of A-EYE are:

Increased productivity – Reducing conflicts – Supporting remote working – Increase outputs quality.

- "*Probably can turn around and save 20,000 worth of day works by looking through a camera at a certain time.*"

Participant D

Dr Ahmed Hassan,
TU Dublin

Findings – A-EYE Challenges

The primary challenges to Construction Visualisation solutions are:

- Resistance to Camera solutions.
- Resistance to change.
- Time pressure.
- Uncertainty about user-friendliness.
- Precision of A-EYE external fixed-position cameras to capture fine building details.

Dr Ahmed Hassan,
TU Dublin

Conclusion

- Data capture is an integral part of the process of BIM as-built development.
- Data capture for BIM as-built is a complex and time-consuming process.
- Overreliance on traditional methods for data capture causes

Data loss – Reduced data quality – Time waste.

- 3D visualisation solutions can support automating the A-built BIM development workflow by

Raising efficiency – Enhancing data precision – Fostering collaboration – Supporting remote working.

- Resistance to change and Time pressure are primary challenges to A-EYE solution.

Dr Ahmed Hassan,
TU Dublin

Future Research

- Post pilot phase.
- Explore A-EYE Functionality – User-friendliness – Complexity.
- Compare future results with existing findings to evaluate A-EYE viability.

Dr Ahmed Hassan,
TU Dublin

References

[1] Tang, S., Shelden, D.R., Eastman, C.M., Pishad-Bozorgi, P., & Gao, X. (2019) 'A review of building information modeling (BIM) and the internet of things (IoT) devices integration: Present status and future trends', Automation in Construction, 101, pp. 127-139.

[2] Wang, J., Sun, W., Shou, W., Wang, X., Wu, C., Chong, H., Liu, Y., & Sun, C. (2015) 'Integrating BIM and LiDAR for Real-Time Construction Quality Control', Journal of Intelligent & Robotic Systems, 79, pp. 417-432.

[3] Onungwa, I., Olugu-Uduma, N., & Shelden, D.R. (2021) 'Cloud BIM Technology as a Means of Collaboration and Project Integration in Smart Cities', SAGE Open 11.

[4] Oesterreich, T. D., & Teuteberg, F. (2016) 'Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industry', Computers in Industry, 83, pp. 121–139.

[5] Afsari, K., Eastman, C.M., Shelden, D.R. (2016) 'Cloud-based BIM Data Transmission: Current Status and Challenges', 33rd International Symposium on Automation and Robotics in Construction (ISARC 2016).

[6] Lu, W., Fung, A., Peng., Y. & Liang, C. (2014). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), pp. 77-101.

[7] Staub-French, S. and Khanzode, A., (2007). 3D and 4D modeling for design and construction coordination: issues and lessons learned, ITcon 12, pp. 381-407.

[8] Matthews, J., Love, P. E. D., Heinemann, S., Chandler, R., Rumsey, C., & Olatunji, O. A. (2015) 'Real time progress management: Re-engineering processes for cloud-based BIM in construction', Automation in Construction, 58, pp. 38–47.

[9] Shahinmoghadam, M., & Motamedi, A. (2019) 'Review of BIM-centred IoT deployment: state of the art, opportunities, and challenges', 36th International Symposium on Automation and Robotics in Construction (ISARC 2019).

[10] Sacks, R., Girolami, M., & Brilakis, I. (2020) 'Building Information Modelling, Artificial Intelligence and Construction Tech' Developments in the Built Environment, 4, 100011.

[11] Government of Ireland (2019) 'Project Ireland 2040: Build Construction Sector Prospects 2019'. Available at https://assets.gov.ie/6659/3312cd28edf04f4c83666ac76b534c45.pdf (Accessed: 18 April 2023).

[12] Neuman, W. (2000) Social research methods qualitative and quantitative approaches. (4th ed.), Allyn and Bacon: Needham Heights.

[13] Saunders, M., Thornhill, A., & Lewis, P. (2009) Research Methods for Business Students, (5th ed.), Prentice. Hall: New Jersey.

[14] Shah, N. (2011). Ethical issues in biomedical research and publication. Journal of Conservative Dentistry, 14(3), pp. 205-207.

[15] Guest, G., MacQueen, K., & Namey, E. (2011). Applied thematic analysis. Sage Publications: California.

[16] Braun, V. & Clarke, V., (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), pp. 77-101.


Gathering23
Accelerating BIM adoption
CitA
Thank You