

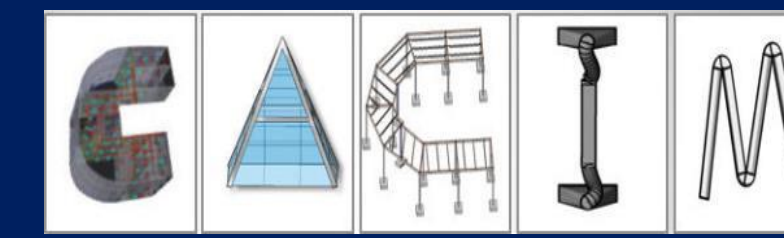


Cognitive Digital Twins in Building Operation and Maintenance



Chady Elias, Ricardo Gallopp R., Isabelle Southern, Kofi A.B. Asare, and Dr. Raja Raymond Issa.

Center for Advanced Construction Information Modeling



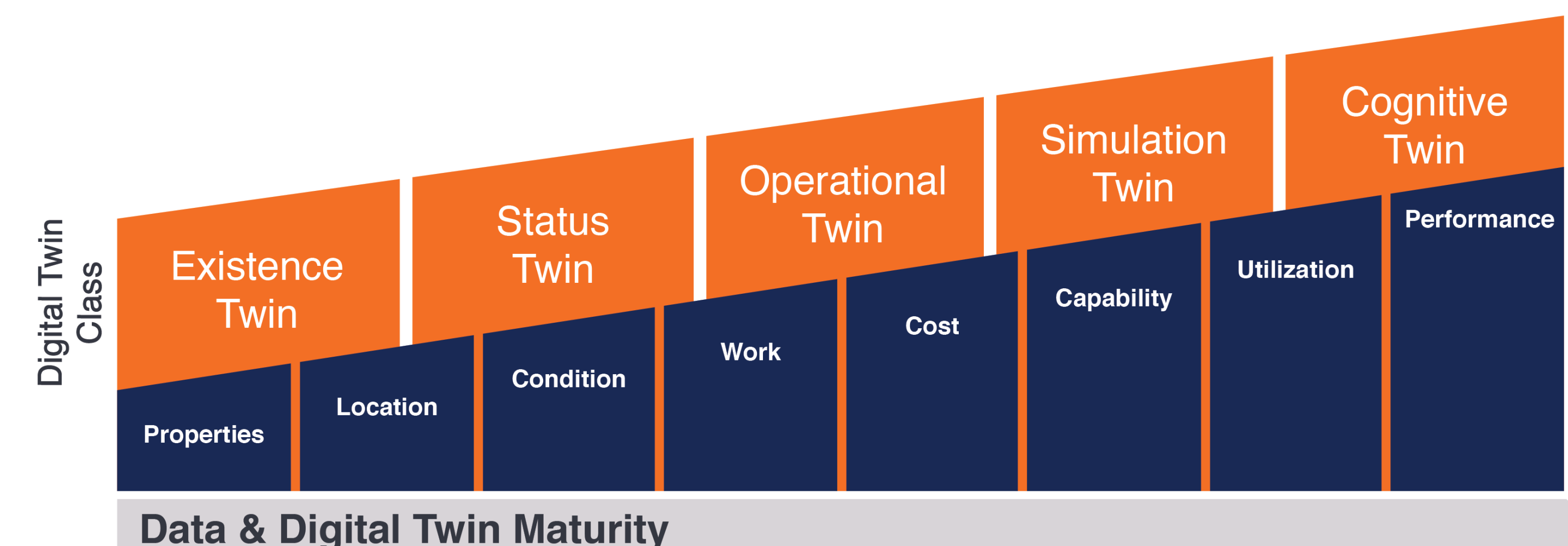
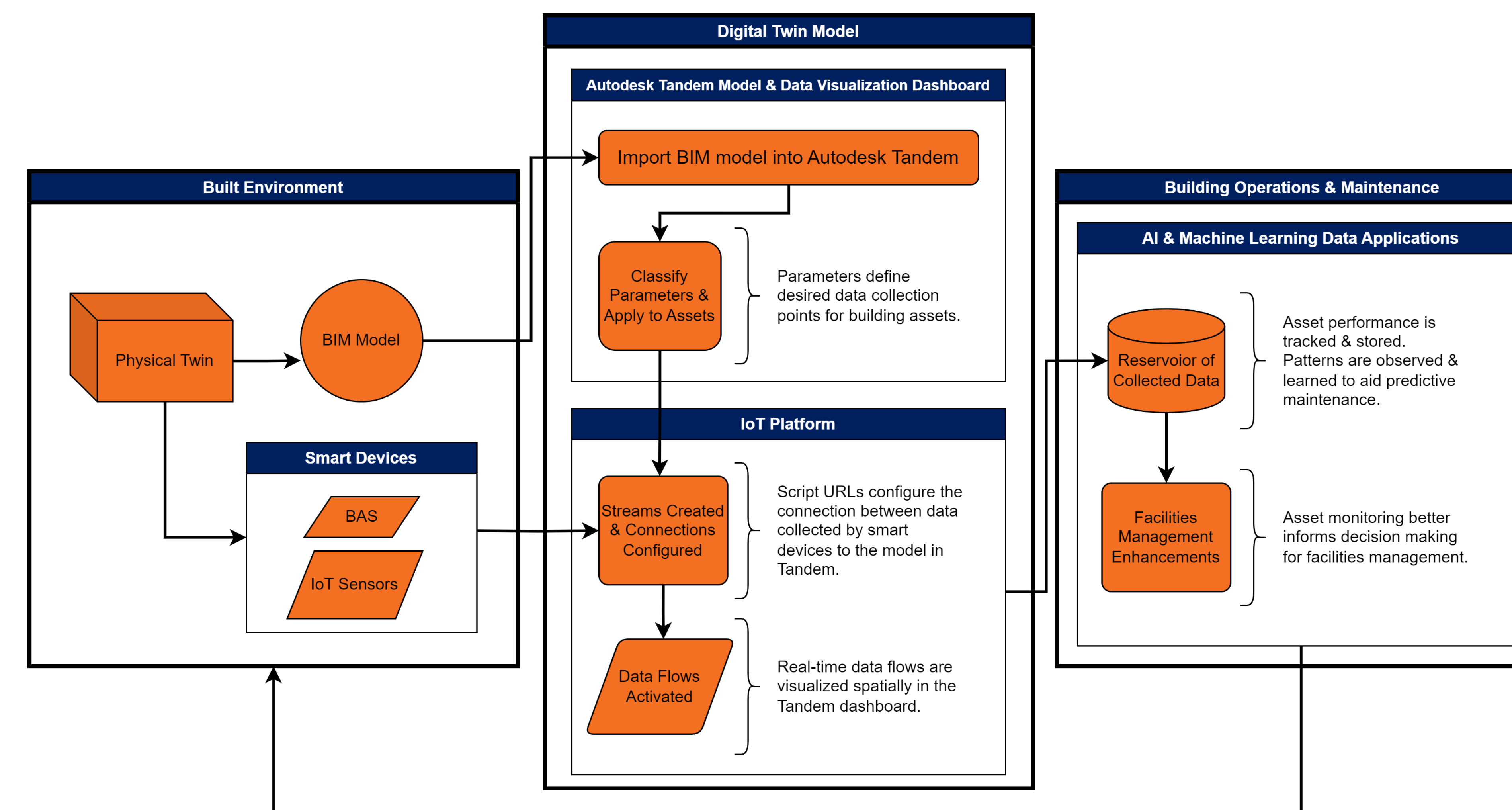
Background

- Digital Twin is defined as a digital replica of a real-world asset. (Segovia & Garcia-Alfaro, 2022)
- Cognitive Digital Twins are expected to forecast and enhance system performance, which involves employing models and machine learning techniques. It becomes feasible to anticipate future system behaviors and enhance process efficiency. (Merino, et al., 2022)
- Operations and maintenance are the longest and most resource-consuming phases of the building lifecycle, accounting for 65% of annual facility management costs (Eastman et al., 2011).
- Cognitive digital twins integrated into facility management software offer a more comprehensive approach to identifying, quantifying, and predicting buildings' operational and maintenance needs.

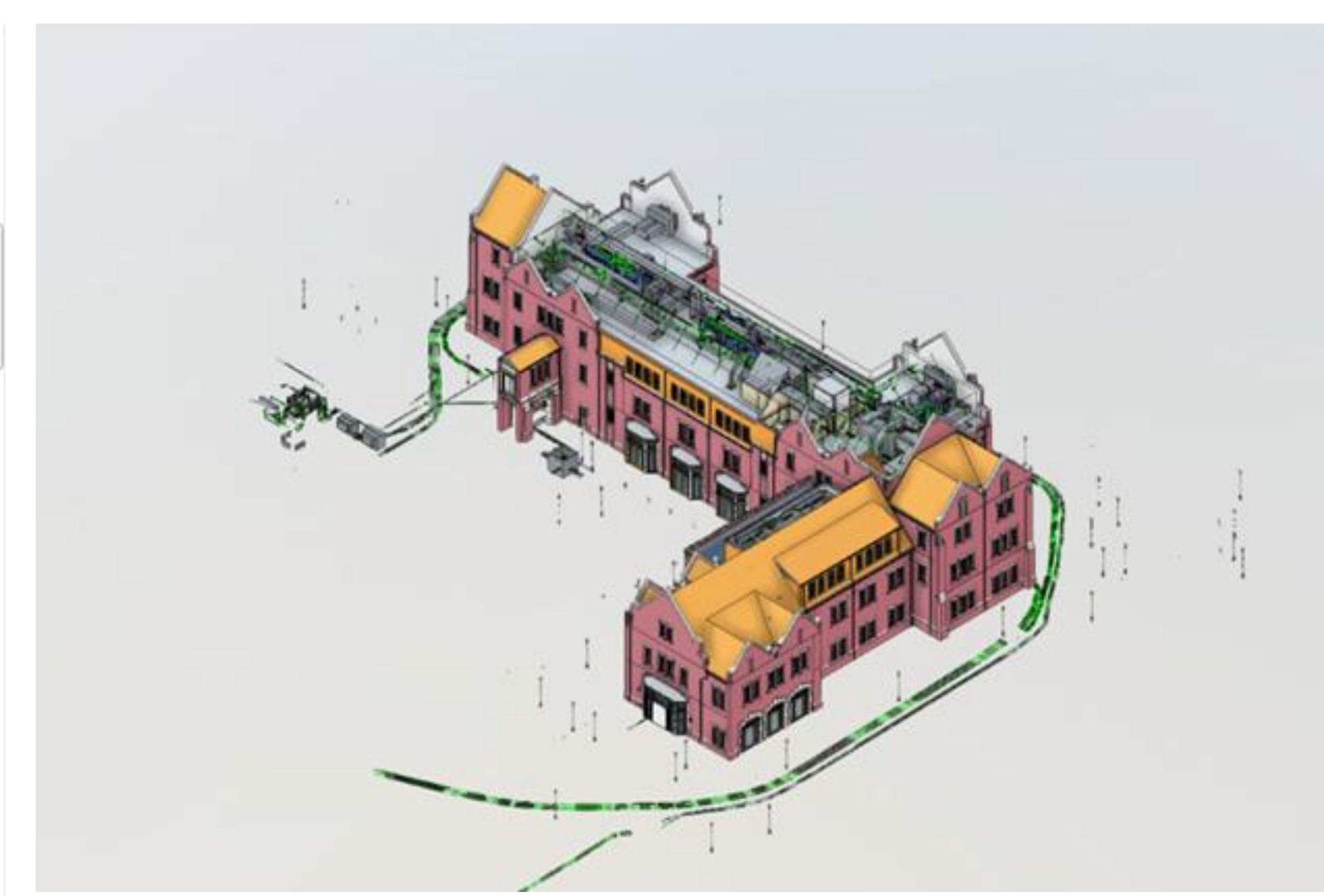
Objective

- Investigate the application of Digital Twins in Building Operation and Maintenance.
- Develop and test an implementation workflow to transform a BIM model into a Status Digital Twin.
- Integrate AI/Machine Learning techniques to mature the Status Digital Twin into a Cognitive Digital Twin.
- Illustrate the application of the Cognitive Digital Twins workflow in buildings' operation and maintenance by monitoring key parameters and predicting future system behaviors and needs.

Implementation Workflow

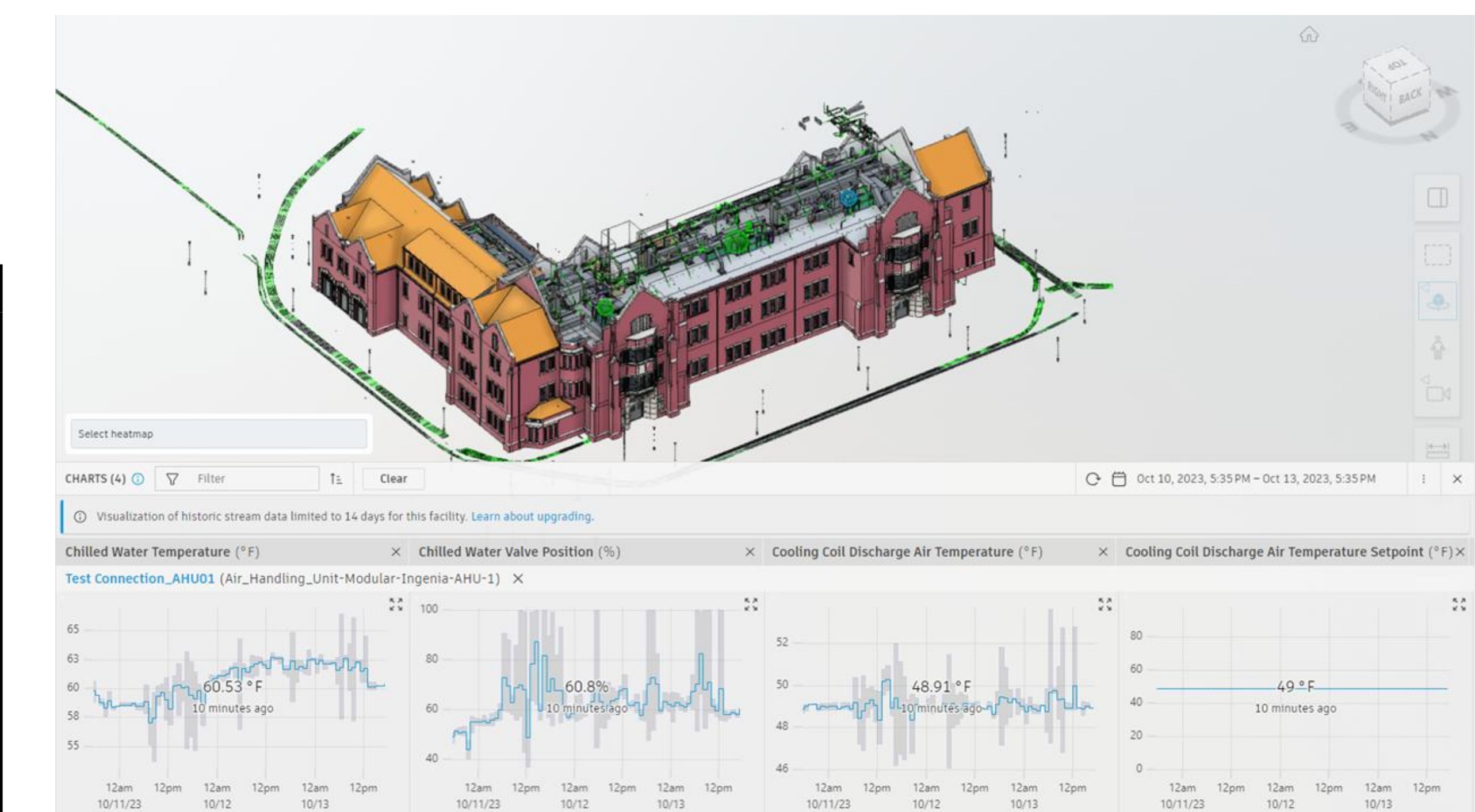


BIM Model

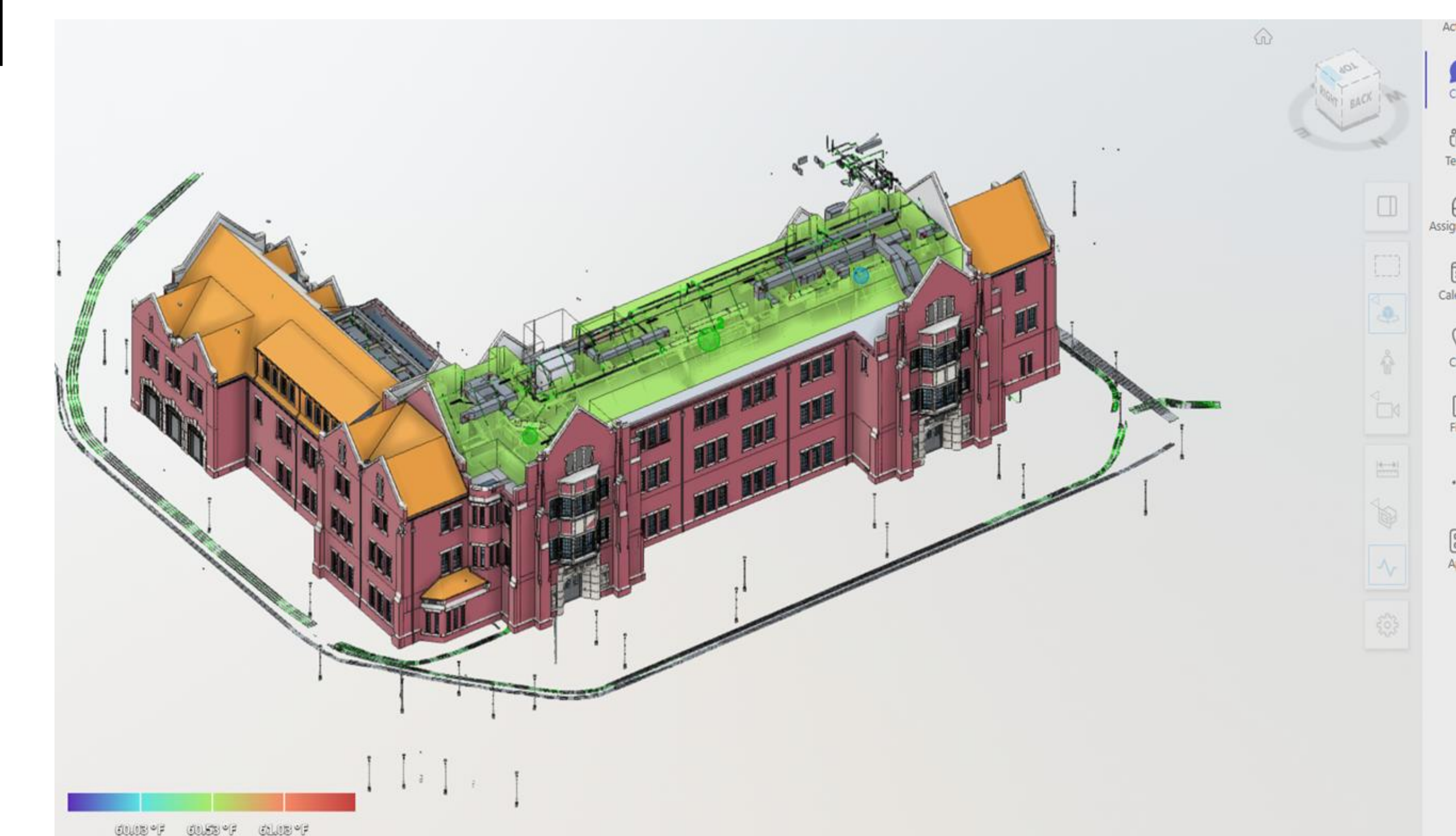


Import BIM Model into Tandem

Results



Real-Time Telemetry Monitoring



Heat Map Display

Conclusion

Transforming BIM models into Digital Twins by streaming data from IoT devices and integrating Machine Learning to predict future behaviors presents an opportunity for enhancing facilities management. This approach not only facilitates real-time monitoring of operational systems but also allows predictive maintenance processes, making it a practical and efficient solution for facility management.

References

- Segovia, M.; Garcia-Alfaro, J. Design, Modeling and Implementation of Digital Twins. *Sensors* 2022, 22, 5396. <https://doi.org/10.3390/s22145396>
- Merino, J., Xie, X., Moretti, N., Chang, J., & Parlikad, A. K. (2022). Data integration for digital twins in the built environment. *Computing in Construction*. <https://doi.org/10.35490/ec3.2022.172>
- Eastman, C. M. (1999). *Building Product Models: Computer Environments, Supporting Design and Construction*. CRC Press: Boca Raton, FL, USA.