Department	School of Engineering and the Built Environment
Supervisors	Dr.Nirodha Fernando, Dr. Timothy Olawuni and Dr. Suha Jaradat
Project Title	Digital Twin and BIM-based prediction model for whole-life carbon assessment in the early stage of the building projects

PROJECT DESCRIPTION

Digital Twin (DT) technology is reforming by linking data from human experts with machine intelligence to drive the evolution of work in new and unexplored ways. With the introduction of DT, some sectors have reached new levels of efficiency. DT has recently gained attention in the construction industry. A DT in a construction project is an exact digital replica of a construction project or asset that spans its lifecycle, which can aid the design and improvement of the physical structure. Furthermore, DT enables new perspectives on creating zero-carbon buildings spanning the entire life cycle from planning, design, and construction to ongoing operational management.

The whole-life carbon assessment includes embodied and operational carbon from the cradle to the grave. DT can be updated in near real-time to include data from sensors or other inputs that affect the building's performance and maintenance. This provides data for calculating the operational carbon emission happening during the physical use of the building. However, Building Information Modelling (BIM) allows users to view and collaborate on a digital 3D model of a given project throughout the project's duration. Using the BIM model, embodied carbon calculation can be conducted. Combining these two technologies can facilitate the development of the whole-life carbon assessment for existing buildings. Based on the data gathered from existing buildings, an early-stage prediction model can predict future building projects and reduce the carbon footprint accordingly. Therefore, the project's overall aim is to develop a methodology for a systematic whole-life carbon assessment prediction model during the early stage of the building using DT and BIM technology.

Perspective applicants are encouraged to contact the Supervisor before submitting their applications. Applications should make it clear the project you are applying for and the name of the supervisors.

Academic qualifications
A first degree (at least a 2.1) ideally in Built Environment background with a good fundamental knowledge of Digital twin and BIM applications.

English language requirement
IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. [Full details of the University's policy](#) are available online.

Essential attributes:
- Experience of fundamental of built environment-related research
- Competent in Digital Twin and BIM application
- Knowledge of the concept of whole -life carbon assessment
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

Indicative Bibliography	Chen, C., Zhao, Z., Xiao, J. and Tiong, R., 2021. A Conceptual Framework for Estimating Building Embodied Carbon Based on Digital Twin Technology and Life Cycle Assessment. *Sustainability*, *13*(24), p.13875. Zhang, J., Zhao, L., Ren, G., Li, H. and Li, X., 2020. Special Issue "Digital Twin Technology in the AEC Industry". *Advances in Civil Engineering*, *2020*. Shen, K., Ding, L. and Wang, C.C., 2022. Development of a Framework to Support Whole-Life-Cycle Net-Zero-Carbon Buildings through Integration of Building Information Modelling and Digital Twins. *Buildings*, *12*(10), p.1747. Fokaides, P., Jurelionis, A. and Spudys, P., 2022, September. Boosting Research for a Smart and Carbon Neutral Built Environment with Digital Twins (SmartWins). In *2022 IEEE International Smart Cities Conference (ISC2)* (pp. 1-4). IEEE.
Enquiries	For informal enquiries about this PhD project, please contact Dr. Nirodha Fernando, N.Fernando@napier.ac.uk
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process