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A METHODOLOGY FOR SELECTING A DIGITAL TWIN PLATFORM FOR APPLICATION DEVELOPMENT IN CONSTRUCTION

B.P. Arsecularatne[1], N. Rodrigo[2] and R. Chang[3]

ABSTRACT

Digital Twin Platforms (DTPs) are being utilised more frequently to facilitate predictive analysis, energy management, carbon emissions reduction, and building operations. Nevertheless, selecting a suitable DTP remains difficult due to the significant variation in platform capabilities, costs, interoperability, usability, and technical complexity. The study provides a systematic methodology for selecting appropriate DTPs to develop Digital Twin (DT) applications. Academic literature, industry reports, software documentation, and vendor websites were reviewed to identify the key functionalities, characteristics, and requirements of DTPs in the construction sector. 12 currently available DTPs were analysed, and the underlying technology and purpose of each were identified. A set of evaluation criteria was then established. The methodology allows users to assign weightings to an established criterion in accordance with operational priorities and project-specific requirements. The most suitable DTP for the intended application is subsequently determined by calculating weighted scores. The methodology was tested using a building-focused DT case study aimed at improving energy efficiency and reducing carbon emissions. The DTP proposed by this developed methodology for the case study was a simulation-based platform, given the study's emphasis on energy modelling, affordability, ease of use, and educational accessibility. The findings demonstrate that the methodology provides a practical, structured approach to selecting DTPs while balancing technical capability, usability, and cost.

Keywords: *Carbon Emission; Digital Twin Platform; Energy Efficiency; Methodology; Sustainability.*

1. INTRODUCTION

The construction industry (CI) represents a significant portion of worldwide energy consumption, including approximately 32% of total energy demand and 34% of CO2 emissions, with operational emissions peaking at 9.8 gigatonnes and embodied carbon estimated at 2.9 gigatonnes (United Nations Environment Programme, 2025). The sector

[1] PhD Candidate, School of Civil Engineering and Construction Management, Adelaide University, Australia, buddhika.arsecularatne@adelaide.edu.au

[2] Senior Lecturer, School of Civil Engineering and Construction Management, Adelaide University, Australia, navodana.rodrigo@adelaide.edu.au

[3] Associate Professor, School of Civil Engineering and Construction Management, Adelaide University, Australia, ruidong.chang@adelaide.edu.au

is not on track to meet net-zero carbon and climate resilience targets by 2050, as progress is slow and scattered (United Nations Environment Programme, 2025). Integrating sustainability considerations with developing technologies, like DT, allows for real-time decision-making and performance optimisation throughout a building's life cycle (Kaewunruen et al., 2020). DTs were initially used in aeronautics but are now widely used in other industries (Ferr et al., 2022). The CI has experienced a substantial increase in the use of DT applications, with this trend more pronounced since 2023 (Arsecularatne et al., 2025), but DT applications were not widely adopted in the CI until 2018 (Opoku et al., 2021). DTs are currently being applied across a wide range of purposes in CI, including real-time structural health monitoring, cost estimation, greenhouse gas emissions tracking, on-site safety monitoring, and off-site construction management (Han et al., 2025; Liu et al., 2023; Moghimi et al., 2026; Wang et al., 2026). Apart from that, by facilitating the simulation of design possibilities, evaluating their impact on time constraints and costs, and fostering collaboration among stakeholders, the utilisation of DT improves project planning and management (Arsecularatne et al., 2024). DT also plays a significant role throughout the building lifecycle, mainly in the operational phase by improving energy efficiency, reducing carbon emissions, enhancing occupant comfort, optimising building performance, and supporting predictive maintenance strategies (Geng et al., 2026; B. Arsecularatne et al., 2024; Sayed et al., 2025; Bibri & Huang, 2025; de las Morenas et al., 2025). When using DT technology, it's important to consider how to design a fit-for-purpose solution (Dodero et al., 2025).

Off-the-shelf DT solutions for the construction sector are becoming more widely available from software suppliers, building information modelling (BIM) providers, and equipment manufacturers. Examples are Autodesk Tandem (Autodesk, 2026), Bentley Digital Twins (Bentley, 2026) and ProtoTwin (Prototwin, 2026). However, some level of work is usually required when deploying a DTP. Despite the growing availability of DTP in the CI, there is still a lack of a structured methodology to guide researchers and practitioners, particularly those without extensive technical expertise, in selecting the most appropriate platform for their specific project requirements. In light of this, this study aims to develop a methodology for choosing an appropriate DTP for construction applications by accomplishing the following objectives: (1) review the existing literature on DTPs and platform features; and (2) identify and assess the primary factors influencing the choice of DTPs. By accomplishing these objectives, the study hopes to provide researchers and professionals in the construction sector with a systematic understanding of DTPs, their mandatory selection criteria, and their suitability for various construction-related requirements. This will facilitate better decision-making when choosing appropriate DTPs for infrastructure and building applications.

2. LITERATURE REVIEW

This section provides a complete summary of the findings from the content analysis conducted for this study. The section describes the range of existing DTPs available for construction-related use cases

The DT is regarded as the next generation of modelling, simulation, and optimisation approaches since it can accurately represent the dynamic mapping between physical objects and their digital equivalents (Rosen et al., 2015). DTs consist of three primary components: the physical asset, its virtual representation, and the communication link that enables data exchange between the two (Wagg *et al.*, 2020; Abdelrahman *et al.*, 2025).

In addition to them, it encompasses (4) real-time capabilities, (5) real-time synchronisation of the digital system with the physical system, and (6) decision support capabilities (Deren et al., 2021; Boschert & Rosen, 2016). The virtual component of the DT is developed and managed within a dedicated DTP, which provides the tools and environment required for modelling, simulation, visualisation, and data integration (Ibrahim et al., 2023). DTPs needed to have features such as configurability, scalability, modifiability, and extendibility for DT models, data, algorithms, IoT connectivity, interaction, simulation, and visualisation, and should be comprehensive, universal, and developmental to meet the different needs of users (Tao et al., 2024). The DTP selection was based on an evaluation of its capabilities, including synchronisation, real-time behaviour, interoperability, physical twin convergence, connectivity, data security, modifiability, reusability, and domain expert involvement (Lehner et al., 2022). DTPs heavily relied on data from multiple sources to build accurate and comprehensive DT models (Kandemir et al., 2024).

Major software companies and leaders in the manufacturing industry have increasingly introduced DTPs to support the development and operation of DTs. These platforms are available in both commercial and open-source forms, offering varying levels of functionality, flexibility, and accessibility to meet different user requirements (Khalifa & Marzouk, 2025). DTPs vary considerably in their intended use, ranging from engineering and manufacturing applications to building management and infrastructure monitoring. Table 1 summarise a few of the DTPs available for CI.

Table 1: Digital twin platforms

Platform	Usage	Free trial	Subscription details	Focused Technology	Source
Ansys Twin Builder (P1)	Simulation-driven digital twins for engineering, product design, and operational optimisation	Trial duration varies	Subscription-based pricing, with various plans depending on simulation complexity and support services	Simulation	(Ansys, 2024)
Autodesk Forge (P2)	BIM, digital twin visualisation, and integration with other Autodesk tools	Trial for 90 days	Subscription-based on API usage; various plans available	BIM	(Autodesk, 2024)
Azure Digital Twins (P3)	IoT integration, building management, real-time monitoring, and predictive maintenance	Trial period details vary	Pay-as-you-go model; pricing based on usage of instances, messages, and queries	Internet of Things (IoT)	(Microsoft, 2024)
Bentley iTwin (P4)	Infrastructure digital twins, asset performance, and	Trial duration varies	Usage-based pricing model, with different tiers depending on data	BIM + IoT + Simulations	(Bentley Systems, 2024)

Platform	Usage	Free trial	Subscription details	Focused Technology	Source
	engineering data integration		volume and services		
Cityzenith SmartWorldPro2 (P5)	Urban planning, smart cities, and building management	Free trial for 30 days	Subscription-based, tiered pricing model based on project scale and features	BIM	(Cityzenith, 2021)
Dassault Systèmes 3DEXPERIENCE (P6)	Product lifecycle management, digital twins for manufacturing, engineering, and construction	Trial duration varies	Subscription-based pricing, with different tiers based on the number of users, features, and support levels	Simulation	(Dassault Systèmes, 2024)
GE Predix (P7)	Industrial IoT, asset performance management, and operational efficiency	Trial duration varies	Custom pricing based on usage, number of assets, and data volume	IoT	(General Electric, 2024)
IBM Digital Twin Exchange (P8)	Asset management, predictive maintenance, and operational optimisation	Trial duration varies	Subscription-based pricing, with options for different levels of service and support	IoT	(IBM, 2024)
OpenTwin (P9)	An open-source digital twin software platform primarily for product development, lifecycle management, simulation integration, and collaborative workflows.	Free	Free	Simulation	(OpenTwin, 2025)
Proto Twin (P10)	A browser-based and application-based industrial simulation platform for robotics systems and dynamic systems	Free trial available	Subscription-based, The educational version is free	Simulation	(Prototwin, 2025)
Siemens MindSphere (P11)	Industrial IoT, manufacturing, building automation, and	Free trial for 30 days	A tiered subscription model, based on the number of	IoT	(Siemens, 2024)

Platform	Usage	Free trial	Subscription details	Focused Technology	Source
	energy management		connected assets and data volume		
Willow Twin (P12)	Real estate, smart buildings, and infrastructure management	Free trial upon request	Subscription-based pricing, depending on the number of assets and the scope of services	BIM	(Willow, 2021)

The comparison shows that most DTPs are commercial tools with subscription-based pricing models, limited free trials, and varied levels of support for BIM integration, simulation, IoT connectivity, and predictive analytics. Building management, infrastructure monitoring, energy analysis, and asset performance are all supported by platforms such as Bentley iTwin, Autodesk Forge, Azure Digital Twins, and Willow Twin, which are specifically pertinent to the built environment.

3. RESEARCH METHODOLOGY

This study employs a qualitative and comparative research approach to develop a structured methodology for selecting appropriate DTPs for construction applications. The study largely relies on a structured literature-based comparative evaluation approach to identify, analyse, and assess DTPs. The literature review aims to highlight the essential characteristics, functionalities, and prerequisites of DTPs. Academic papers, industry reports, software documentation, and vendor websites were examined to comprehend the current application of DTPs in the construction sector and to identify the most critical criteria for platform selection. The inclusion criteria focused on studies related to DT implementation in the construction and built environment sectors and platforms, particularly those associated with building operations, energy management, carbon reduction, IoT integration, simulation capabilities, and real-time data synchronisation. In addition, the availability of free trial access, educational versions, or research access was considered to ensure that the platforms could be practically explored and evaluated in an academic research context. To enhance the reliability of the comparative assessment, platform capabilities were cross-checked using multiple information sources, including official platform documentation, published academic studies, technical specifications, implementation case studies, and customer feedback. This helped to minimise potential bias associated with relying solely on vendor-provided information.

Following the literature review, the DTP selection methodology was identified. The proposed DTP selection methodology as shown in Figure 1 follows a structured decision-making process tailored to the operational requirements of the intended DT application. The process begins with identifying the functional and operational needs of the DT. Based on the identified requirements, weights are assigned to the DTP assessment criteria according to their relative importance within the selected application context. The weighted evaluation is then conducted using the Simple Multi-Attribute Rating Technique (SMART) to comparatively assess and rank the DTPs identified. This process enables the identification of the highest-ranked and most suitable platform options for the intended application. Following the ranking process, the operational requirements and practical suitability of the highest-rated platforms are further reviewed. If the highest-ranked platform is considered suitable for the identified DT requirements, the DT development process proceeds using the selected platform. If limitations or incompatibilities are identified during the suitability assessment stage, the next highest-ranked platform is evaluated and considered for implementation.

Based on literature DTPs were classified based on their principal functioning and construction significance. Platforms can be categorised as BIM-oriented, IoT-driven, simulation-focused, or fully integrated digital twin environments, based on underlying technology (Refer to Table 1). These platforms were selected based on their relevance to building operational management, accessibility for research and educational purposes, availability of free trial or educational versions, interoperability capabilities, IoT integration support, simulation functionality, scalability, visualisation features, and applicability to energy and carbon management scenarios. This DTP classification helps to identify the advantages and drawbacks of various platforms based on their intended use. As a first step, a set of criteria for platform selection was formulated. Criteria were formulated because the platform evaluation was conducted using a multi-criteria decision-making method, namely the SMART. There are several studies, such as Nanayakkara et al. (2021), and Dodero et al. (2025) that have used SMART when evaluating and selecting the most suitable platform for an application. The criteria were chosen for their relevance to the construction industry, ensuring alignment with essential requirements across all stages of the building life cycle and within the project budget. The criteria contain BIM compatibility, IoT integration, real-time data synchronisation, interoperability, scalability, visualisation capability, simulation support, energy and carbon modelling capability, artificial intelligence integration, user-friendliness, licensing costs, and educational accessibility. These criteria aim to establish a systematic methodology for evaluating DTPs pertinent to both scholars and practitioners. The DTP selection methodology is shown in Figure 1.

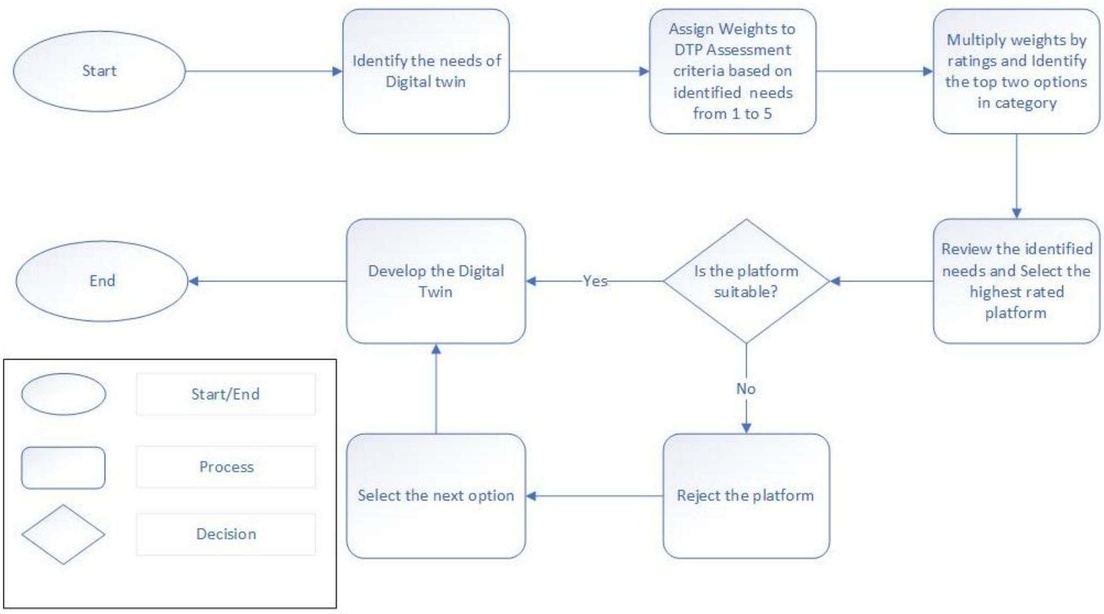

Figure 1: DTP selection methodology

Following the identification of the assessment criteria (DTPs assessment criteria), ratings were assigned to each criterion based on DTPs, software documentation, and user feedback. To test and demonstrate the proposed methodology, a university classroom was selected as the case study environment, with particular emphasis on improving operational energy efficiency and reducing carbon emissions. The university classroom was considered an appropriate case study due to its variable occupancy patterns and intensive daily use. Based on the characteristics and operational requirements of the selected classroom environment, the key functional requirements of the DT were identified. Based on that, weights were given to the criterion in the assessment criteria (Refer to Table 3). Subsequently, weighted scores were given to each platform (Refer to Table 4), followed by relevant calculations (See Table 5 and Table 6) to select the most suitable DTP for developing the DT model.

This Methodology aims to assist future academics and practitioners in making informed choices when selecting digital twin platforms that align with their specific project objectives, technical specifications, and resource constraints.

4. FINDINGS, RESULTS AND DISCUSSION

This section presents the study's findings and results. Firstly, the study developed a comprehensive set of assessment criteria, organised into distinct categories, to assist stakeholders in selecting an acceptable DTP. The criteria were established by studying the research conducted by Dodero et al., (2025). This guaranteed a relationship between user needs and platform functionalities.

Table 2 presents the key evaluation criteria for assessing DTPs. These criteria give a formal basis for assessing different platforms in terms of their technical functionality, usability, and applicability for research and industrial applications.

Table 2: DTPs assessment criteria

Criteria	Key Items to Assess
BIM compatibility (A)	IFC support; Revit integration; CAD/BIM model import; asset metadata handling; clash detection capability
IoT integration (B)	Sensor connectivity; MQTT/API support; device compatibility; cloud platform integration; real-time sensor dashboards
Real-time data synchronisation (C)	Live data streaming; refresh frequency; bidirectional updates; latency performance; historical data logging
Interoperability (D)	Open standards support; API availability; third-party software integration; database compatibility; cross-platform connectivity
Scalability (E)	Ability to manage multiple buildings; support for large sensor networks; cloud scalability; multi-user access; performance under high data loads
Visualisation capability (F)	2D/3D visualisation; dashboard customisation; immersive/AR/VR support; real-time graphical updates
Simulation support (G)	Energy simulation; occupancy simulation; scenario testing; predictive modelling
Energy and carbon modelling capability (H)	Energy consumption analysis; operational carbon tracking; embodied carbon assessment; net-zero scenario testing; sustainability reporting

Criteria	Key Items to Assess
DTP category (I)	Main platform purpose; dominant technical capabilities; typical application areas; level of visualisation and analytics support; degree of integration and operational functionality
Artificial intelligence integration (J)	Machine learning support; predictive analytics; anomaly detection; optimisation algorithms; automated decision-making
User-friendliness (K)	Ease of navigation, dashboard usability
Licensing costs (L)	Free trial availability; subscription cost; enterprise licensing; educational discounts
Educational accessibility (M)	Student version availability; academic licensing; tutorials and documentation; community support

In the subsequent stage, users are required to have a comprehensive understanding of the assessment criteria delineating the DTP as specified in Table 2. This entails meticulously analysing the specified criteria, after which users must assign weights to these factors using a weight matrix on a scale of 1 to 5, where 1 denotes minimal relevance and 5 denotes maximal importance. Weightages will vary across users based on individual requirements. After evaluating assessment criteria in detail, weightages were assigned as per the requirements of the case study. The assigned weightages are illustrated in Table 3.

Table 3: Weightages assigned based on the case study

Criteria	Weights
BIM compatibility (A)	4
IoT integration (B)	4
Real-time data synchronisation (C)	4
Interoperability (D)	3
Scalability (E)	3
Visualisation capability (F)	4
Simulation support (G)	4
Energy and carbon modelling capability (H)	4
DTP category (I)	5
Artificial intelligence integration (J)	3
User-friendliness (K)	5
Licensing costs (L)	5
Educational accessibility (M)	5

After setting weightages, users should evaluate each DTP's ratings using the assessment criteria. By entering these ratings into the weight matrix and multiplying the allotted weights by the ratings, users can calculate the total score for each DTP as demonstrated in Table 4.

Table 4: Ratings - DTPs assessing criteria

Platform	A	B	C	D	E	F	G	H	I	J	K	L	M
P1	2	3	4	4	4	3	5	4	5	4	3	2	3

Platform	A	B	C	D	E	F	G	H	I	J	K	L	M
P2	5	3	4	5	4	5	2	3	2	3	4	2	4
P3	2	5	5	5	5	3	3	3	3	5	3	3	3
P4	5	4	4	5	4	5	3	4	3	3	4	2	3
P5	4	4	4	4	4	5	2	4	2	3	4	2	3
P6	3	3	4	5	5	5	5	4	5	4	3	2	3
P7	2	5	5	4	5	3	4	3	4	4	3	2	2
P8	2	4	4	4	4	3	3	3	3	4	3	3	3
P9	4	3	3	4	3	4	4	3	5	3	3	5	5
P10	2	3	4	3	3	5	4	2	5	3	5	5	5
P11	2	5	5	5	5	3	4	4	4	4	3	2	2
P12	4	5	5	4	5	4	3	4	3	4	4	2	3

The assigned scores were not intended to represent absolute performance measurements, but rather the relative suitability of each platform for building energy and carbon management applications within the context of the study. The evaluation was conducted by reviewing official platform documentation, technical specifications, vendor resources, publicly available implementation examples, and practical platform accessibility, including free trial and educational versions where available. ProtoTwin was selected as an example platform to explain how the weightages and comparative scores were assigned to each evaluation criterion.

ProtoTwin was comparatively evaluated against the selected DTP assessment criteria based on its suitability for building energy and carbon management applications within the selected university classroom case study. The platform received comparatively higher scores for visualisation capability, simulation support, user-friendliness, licensing cost, educational accessibility, and DTP category due to its strong simulation-oriented environment, interactive real-time visualisation capabilities, and accessibility for academic experimentation and pilot-scale implementation. ProtoTwin also demonstrated suitable support for real-time data synchronisation and IoT connectivity through API-based integration approaches, making it appropriate for operational monitoring and DT development in educational and research contexts. Furthermore, the availability of educational licensing and comparatively lower implementation barriers contributed to its higher evaluation in accessibility-related criteria (Prototwin, 2026; Software Advice, 2026). However, ProtoTwin received comparatively lower scores for BIM compatibility, interoperability, and energy and carbon modelling capability when compared with BIM-oriented and enterprise-scale platforms such as Autodesk Forge, Bentley iTwin, and Ansys Twin Builder. Although ProtoTwin supports 3D model integration and simulation-based DT environments, it does not provide advanced native BIM interoperability, integrated building energy simulation, or dedicated carbon analysis functionalities comparable to specialised engineering and building performance platforms (Ansys, 2024; Autodesk, 2026; Bentley, 2026). Therefore, the assigned scores were intended to represent the relative suitability of the platform within the operational requirements, technical constraints, and educational context of the selected case study rather than absolute performance measurements across all application domains.

After weightages were assigned, they were multiplied by the platform ratings. Then the calculated values were added to find the total value for the relevant DTP. In order to show the calculations, Table 5 illustrate calculated values of P1 - Ansys Twin Builder.

Table 5: Weighted score calculation for P1

Criteria	Weightage	Weightage for P1	Calculated value for P1
BIM compatibility (A)	4	2	8
IoT integration (B)	4	3	12
Real-time data synchronisation (C)	4	4	16
Interoperability (D)	3	4	12
Scalability (E)	3	4	12
Visualisation capability (F)	4	3	12
Simulation support (G)	4	5	20
Energy and carbon modelling capability (H)	4	4	16
DTP category (I)	5	5	25
Artificial intelligence integration (J)	3	4	12
User-friendliness (K)	5	3	15
Licensing costs (L)	5	2	10
Educational accessibility (M)	5	3	15
Total for P1 - Ansys Twin Builder			185

Subsequently, this was followed for all DTPs identified in this study. The results are as illustrated in Table 6.

Table 6: Weight matrix (platform evaluation)

Criteria	Weight (w)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
A	4	2	5	2	5	4	3	2	2	4	2	2	4
		8	20	8	20	16	12	8	8	16	8	8	16
B	4	3	3	5	4	4	3	5	4	3	3	5	5
		12	12	20	16	16	12	20	16	12	12	20	20
C	4	4	4	5	4	4	4	5	4	3	4	5	5
		16	16	20	16	16	16	20	16	12	16	20	20
D	3	4	5	5	5	4	5	4	4	4	3	5	4
		12	15	15	15	12	15	12	12	12	9	15	12
E	3	4	4	5	4	4	5	5	4	3	3	5	5
		12	12	15	12	12	15	15	12	9	9	15	15
F	4	3	5	3	5	5	5	3	3	4	5	3	4
		12	20	12	20	20	20	12	12	16	20	12	16
G	4	5	2	3	3	2	5	4	3	4	4	4	3
		20	8	12	12	8	20	16	12	16	16	16	12

Criteria	Weight (w)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
H	4	4	3	3	4	4	4	3	3	3	2	4	4
		16	12	12	16	16	16	12	12	12	8	16	16
I	5	5	2	3	3	2	5	4	3	5	5	4	3
		25	10	15	15	10	25	20	15	25	25	20	15
J	3	4	3	5	3	3	4	4	4	3	3	4	4
		12	9	15	9	9	12	12	12	9	9	12	12
K	5	3	4	3	4	4	3	3	3	3	5	3	4
		15	20	15	20	20	15	15	15	15	25	15	20
L	5	2	2	3	2	2	2	2	3	5	5	2	2
		10	10	15	10	10	10	10	15	25	25	10	10
M	5	3	4	3	3	3	3	2	3	5	5	2	3
		15	20	15	15	15	15	10	15	25	25	10	15
Weighted score		**185**	**184**	**189**	**196**	**180**	**203**	**182**	**172**	**204**	**207**	**189**	**199**
Rank		**8**	**9**	**6**	**5**	**11**	**3**	**10**	**12**	**2**	**1**	**6**	**4**

To demonstrate the proposed methodology, a university classroom was selected as the case study environment, with the DT intended primarily for research-oriented operational energy monitoring, predictive analysis, and carbon emission reduction within an educational building context. The case study required real-time IoT-based environmental monitoring, including operational building data integration, visualisation, simulation capability, and interoperability with BIM. The carbon management focus of the study was limited to operational carbon emissions associated with energy consumption rather than embodied carbon assessment. Furthermore, the proposed DT framework was intended for pilot-scale academic implementation under limited financial resources and varying technical expertise levels among users. Following the weighted evaluation process, the DTPs were comparatively ranked to determine the most suitable platform for developing the proposed DT framework considering a case study related to building energy and carbon management applications. The results indicate that ProtoTwin (P10) achieved the highest overall weighted score, demonstrating strong performance across key criteria such as real-time simulation capability, interoperability, visualisation, user accessibility, and integration potential for operational building management. The findings indicate that selecting a suitable DTP for the built environment goes beyond technical functionality and should also consider implementation practicality, educational accessibility, licensing availability, and resource constraints.

The findings of this study also highlight the importance of developing application-oriented platform selection methodologies tailored to the operational requirements of the built environment. Existing studies related to DTP selection, such as Dodero et al. (2025), primarily focus on manufacturing-oriented Digital Twin applications. While these studies provide valuable guidance for structured platform evaluation processes, direct comparison with the findings of the present study remains limited due to the significant differences between manufacturing systems and building operational environments. Unlike manufacturing applications, building energy and carbon management require greater emphasis on factors such as occupancy-driven operations, energy monitoring, environmental performance, interoperability with BMS, and long-term operational sustainability.

5. CONCLUSIONS

This paper proposes a methodology to select a suitable DTP for construction applications. In the literature, existing platforms were identified based on their underlying technology and usage (Refer to Table 1): BIM-oriented platforms, IoT-driven platforms, simulation-focused platforms, and integrated digital twin environments. While the core technologies of BIM, IoT, and simulation are well established in the CI, the proposed methodology conceptualises BIM-oriented, IoT-driven, simulation-focused, and fully integrated platforms as functional architectural pillars that influence the operational capabilities and suitability of DTPs within the CI. Furthermore, the literature review helped to identify potential assessment criteria. Then, a weighted scoring mechanism was applied, enabling users to rank platforms according to their suitability for each project. The methodology was demonstrated through a case study aimed at improving building energy efficiency and reducing carbon emissions. Based on the weighting and scoring model established in this study, platforms focused on simulation emerged as the most suitable category. ProtoTwin and OpenTwin received the highest ratings among the evaluated platforms, with ProtoTwin selected as the final choice for its intuitive user interface, visualisation capabilities, support for real-time simulation, educational accessibility, and free licence options.

The main contribution of this paper is a repeatable method for selecting a suitable DTP. At the time of writing, very few studies were found that provided guidelines for selecting a DTP, and none were directly associated with buildings. Thus, this study fills a gap in knowledge and theory by providing a novel categorisation schema for DTPs and demonstrating a weighted scoring mechanism, SMART, to select the most suitable platform. Although only 12 DTPs were reviewed in this study, this methodology can be applied using refined assessment criteria to analyse all available DTPs. From a practical perspective, this research offers clear decision-making steps for researchers and practitioners seeking to identify which DTPs align with their technical requirements, sustainability objectives, and resource constraints.

Limitations include that platform ratings and associated weightings were determined by available information on platforms, reviews and comments published online by users, and the priorities outlined in the case study. Thus, the suitable DTP may differ for other projects based on project needs and objectives, budgets, technical requirements, or operational priorities.

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