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The Strategies to AEC Implement BIM-GIS-Drone-Mobile Apps-AI Towards Future Demands, Case Study: Setiu, Terengganu

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ABSTRACT

In the Architecture, Engineering, and Construction (AEC) industry, the integration of Building Information Modelling (BIM), Geographic Information System (GIS), and Drone Mobile Apps has revolutionized how professionals plan, design, construct, and manage buildings and infrastructure. This integration offers a comprehensive approach that leverages the strengths of each technology to enhance efficiency, accuracy, and collaboration throughout the project lifecycle. BIM is a process that involves creating digital representations of physical and functional properties of buildings or infrastructure. GIS is a system that collects, analyses, and presents spatial data related to natural and built environmental assets such as wetland resources are being overused because of severe occurrences and conditions such the rapidly rising population, the rapidly improving economic climate, and the expanding metropolitan region. Drone Mobile Apps have become an integral part of modern construction projects due to their ability to capture high-resolution imagery efficiently using drones. Artificial Intelligence (AI) plays a crucial role in processing vast amounts of data generated by BIM models, GIS databases, drones, and mobile apps due to social trends. However, the systematic implementation of current advanced technologies in AEC projects in the wetland area experience challenges. This study aims to identify critical strategies to be implemented in the current digital transformation. The significance of this study is to support current trends of technology in RMK-12, 4.0 Digital Transformation. Initially, 20 strategies are drawn from the existing literature review and 10 critical strategies are identified focusing on the strategies for BIM and GIS Integration with AI interoperability. An in-depth interview with 33 experts as qualitative study and quantitative study using a questionnaire survey with 100 respondents from construction field. The results may improve project efficiency and accuracy while ensuring better decision-making processes throughout the project lifecycle of the AEC industry in the wetland area.

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1. Introduction

1.1 The Setiu Wetland Nowadays

In the Architecture, Engineering, and Construction (AEC) industry, the integration of Building Information Modelling (BIM), Geographic Information System (GIS), and Drone Mobile Apps has revolutionized how professionals plan, design, construct, manage buildings and infrastructure also for coordination and monitoring. Setiu wetland ecosystems are among the most diversified ecological perspectives and crucial settings for human habitation. As a big population centre, the city's natural environment is unquestionably problematic [44].

Wetland areas are shrinking, and wetland resources are being overused because of severe occurrences and conditions such the rapidly rising population, the rapidly improving economic climate, and the expanding metropolitan region [43]. Urban wetlands are the "kidneys" of cities, and preserving and building wetlands is an essential part of urban ecological development. As a result, both the qualities of the wetland landscape and the amount of urban river wetland are drastically reduced [1]. In actuality, wetlands have been lost significant amounts in many cities, but wetlands are one of the products of urbanization that are vanishing the quickest [23]. Therefore, it is crucial to preserve and research urban wetland parks [13].

1.2 Integration BIM and GIS using Drone

Worldwide adoption of BIM and GIS integration has grown quickly in recent years. According to Mancini *et al.,* [45] several projects in the US, Singapore, the UK, Denmark, Finland, and Norway now call for the usage of BIM and GIS. Furthermore, the Australian government has a three-year plan to integrate BIM and GIS into its public AEC projects and to encourage BIM use nationally, according to Bernstein *et al.,* [11]. To promote its use in the tourism industry, BIM was also mentioned as an important project in China's National Economic and Social Development Plans [11].

Integration of BIM with GIS has been shown to offer a few significant advantages in the field. In a recent survey conducted by Bernstein *et al.,* [11], participants from the US, the UK, France, and Germany said that their projects had adopted BIM had a 25% larger return on investment. In addition, a recent case study by Jin *et al.,* [36] demonstrated that the use of BIM in a building project might fix issues that cost 15.92% of the project's entire budget. However, the use of BIM and GIS in the tourism sector requires strategic planning to accommodate the systematic deployment of BIM and GIS Integration and realize its potential benefits. This topic has not been the subject of any studies. Even though BIM and GIS Integration includes organizational strategies and industry implementation [16-19,22,40,44].

Drone integration with Geographic Information Systems (GIS) and Building Information Modelling (BIM) offers a great deal of promise for improved project results and building procedures. Construction teams can obtain a more thorough picture of the constructed environment and the surrounding geographic context by integrating the capabilities of BIM, GIS, and drones. The advantages of this integration are:

i. <u>Data Collection and Analysis:</u> Drones equipped with LiDAR technology can capture detailed information about both the building under construction and its surroundings. This data can include precise measurements of terrain, structures, vegetation, and other features that are crucial for accurate modelling in both BIM and GIS platforms.
ii. <u>Spatial Visualization:</u> Integrating BIM models with GIS data allows for a more holistic view of a construction project. By overlaying BIM information onto GIS maps, stakeholders can

visualize how the building interacts with its environment. This spatial visualization can help identify potential issues related to site conditions, accessibility, or environmental impact.

iii. Project Planning and Management: The combined use of BIM, GIS, and drones enables better project planning and management. Construction teams can utilize drone-collected data to create detailed 3D models that incorporate both the building design from BIM software and the geographic context from GIS mapping. This integrated model provides valuable insights for decision-making throughout the project lifecycle.

iv. Environmental Impact Assessment: By integrating drone-captured GIS data with BIM models, construction teams can conduct more thorough environmental impact assessments. Drones can survey areas surrounding the construction site to gather information on factors like vegetation cover, water bodies, or wildlife habitats. This data can inform design decisions to minimize environmental disruption.

v. Maintenance and Facility Management: Post-construction, the integration of BIM-GIS data collected by drones continues to be valuable for facility management. The detailed models created during construction provide a foundation for ongoing maintenance activities by offering insights into building components, infrastructure systems, and their relationship to the surrounding environment.

In summary, employing drones to integrate BIM and GIS provides an effective toolkit for improving construction projects from design to completion. The combination of these technologies results in enhanced decision-making and project outcomes by providing a more thorough understanding of built environments in their respective geographic contexts.

Fig. 1. Construction monitoring in action using drones [10]

2. Literature Review

2.1 Sustainable Wetland Challenges

Malaysian wetland management faces many challenges, including limited resources and funding, poor interagency cooperation, insufficient public awareness and education, and legal and legislative gaps [4]. The study stressed the importance of managing wetlands holistically, considering their ecological, social, and economic aspects.

The article written by Ahmad *et al.,* [4] says that the sustainability of Malaysia's wetlands is threatened by many things, such as changes in land use, pollution, and climate change. Even though wetlands are very important to sustainable development because they provide ecosystem services, they need better coordination and more effective policy and regulatory systems to be protected and managed.

According to Abdul Hamid *et al.,* [1] that looked at how wetland management is done in Malaysia found that the focus of wetland management in Malaysia is on water quality control and monitoring, with less focus on wetland ecosystem conservation and restoration. The authors also pointed out

several problems with how wetland management is done, such as a lack of funds and assets, a lack of coordination between government agencies, a lack of public education and expertise, and a lack of clear laws and policies. The study showed how important it is to handle wetland ecosystems in a way that considers their ecological, social, and economic aspects [25].

2.2 AI as a Part of Sustainable Medium

Artificial Intelligence, or AI, is a fast-developing technology that has the potential to completely transform a few industries, including travel. To maximize advantages for local people and support conservation efforts. AI integration in sustainable construction has the potential to improve productivity and lessen environmental impact.

AI Applications in Sustainable can offer Natural Resource Conservation, Energy Efficiency, and Customer Service Automation [46-48].

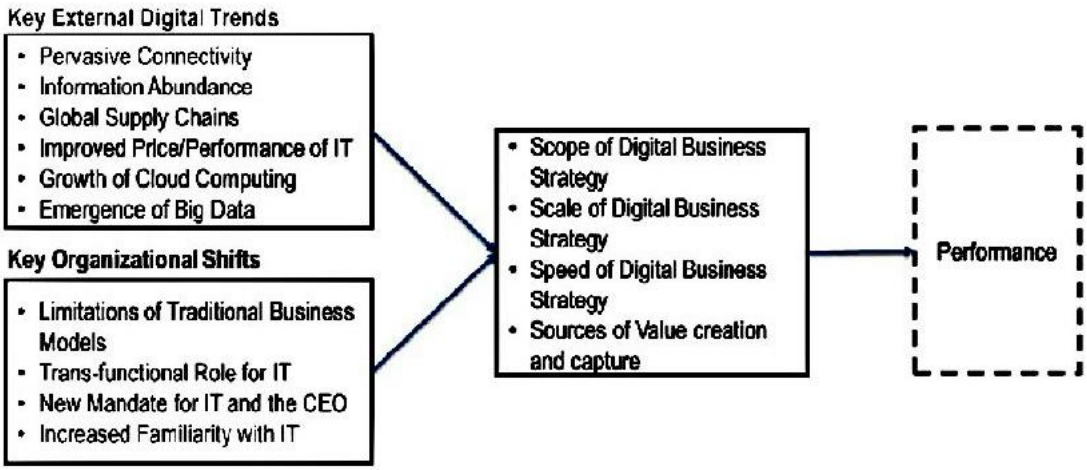

Fig. 2. Drivers of the four key themes of digital business strategy

2.3 BIM as Sustainable AI Medium

In recent years, the use of BIM has grown rapidly. According to Mancini *et al.,* [45] BIM adoption has become a standard guideline in some projects in Denmark, Finland, Norway, Sweden, the United Kingdom, the United States and Singapore. In addition, the Australian government policy set a three-year target of implementing BIM in public AEC projects and promoting BIM use throughout the country. BIM was also highlighted as a key initiative in China's National Economic and Social Development Plans to increase BIM adoption in the tourism industry [11]. However, to accommodate the systematic application of BIM, the use of BIM in the tourism area necessitates strategic planning. There has been no research into this topic. However, a few strategic plans have been allocated to improving BIM application in tourism practice projects focusing on wetlands.

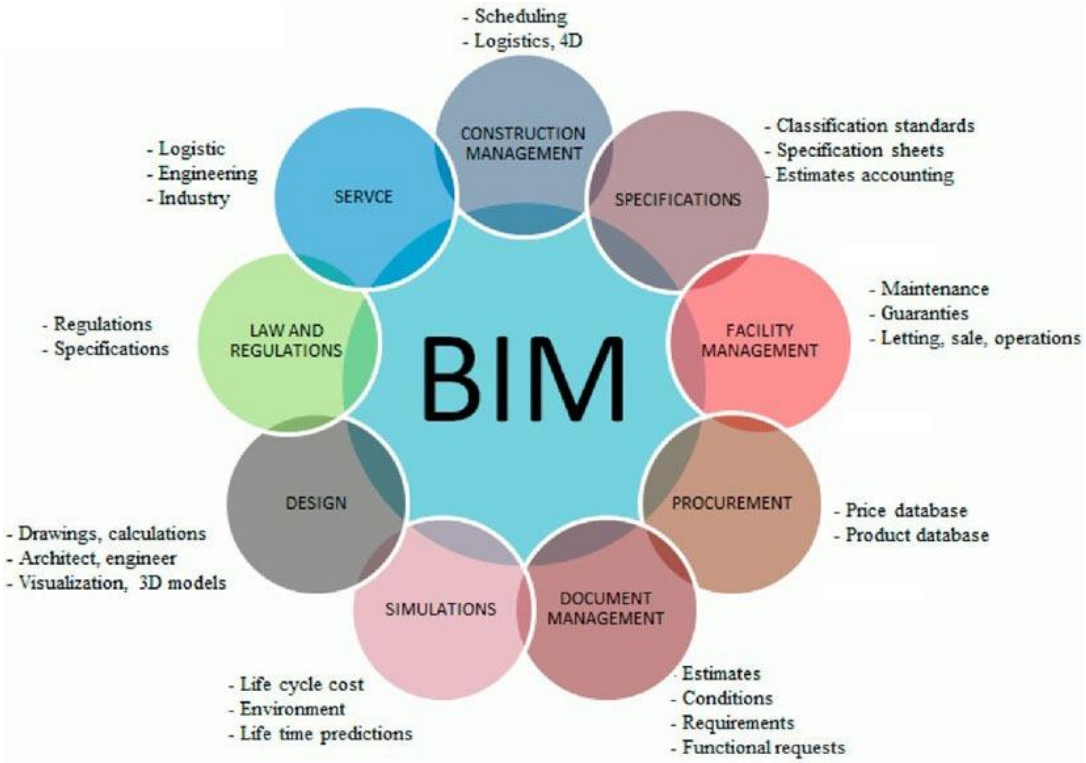

Fig. 3. Building information modelling (BIM) lifecycle view. Modified by Yan [41]

Building information modelling facilitates decision-making. According to Kim *et al.,* [38], it is the process of successfully creating, disseminating, exchanging, and managing information over the course of a building's lifecycle. Using a single data source to which the entire team has access is the basic tenet of BIM. This single model or database, or group of databases, can be linked to facilitate information interchange and access. The fundamental tenet of building information modelling, according to Miettinen *et al.,* [44], is the execution of projects in a virtual setting where all project-related data can be kept in a single (central) online system.

Making decisions is aided by information modelling [38], it is the process of successfully creating, disseminating, exchanging, and managing information over the course of a building's lifecycle. Utilizing a single data source to which all team members have access is the fundamental tenet of BIM. This single model or database, or set of databases, can be linked together to allow for easier information access and exchange. The primary idea of Building Information Modelling, according to Altohami *et al.,* [7] is project execution in a virtual environment where all project- related data can be housed in a single (central) online system.

BIM will develop into a reliable information source. By linking BIM and GIS platforms, which provide a high level of information from GIS to detailed information in BIM, it is now possible to close the gap between data at the global scale and data in detail. Additionally, BIM will promote high efficiency over the long term by maximizing product deliverable through knowledge capture, engaging communication, and continuing work analysis.

2.4 GIS as AI Sustainable Medium

A potent instrument for managing sustainable tourism, GIS (Geographic Information System) integrates artificial intelligence (AI) to improve decision-making and raises the general efficacy and efficiency of tourism operations. AI can support the sustainable growth of tourism by utilizing GIS technology to provide insightful research and facilitate well-informed decision-making grounded in

precise geospatial data analysis. The capability of GIS to combine and evaluate diverse data sets from multiple sources is one of the main benefits of employing it as an AI medium for sustainable tourism. This contains data on socioeconomic variables, infrastructure, cultural legacy, environmental elements, and visitor behaviour. Patterns, trends, and correlations that are essential for sustainable tourism planning and management can be found by GIS through the processing and analysis of these datasets utilizing AI algorithms [8].

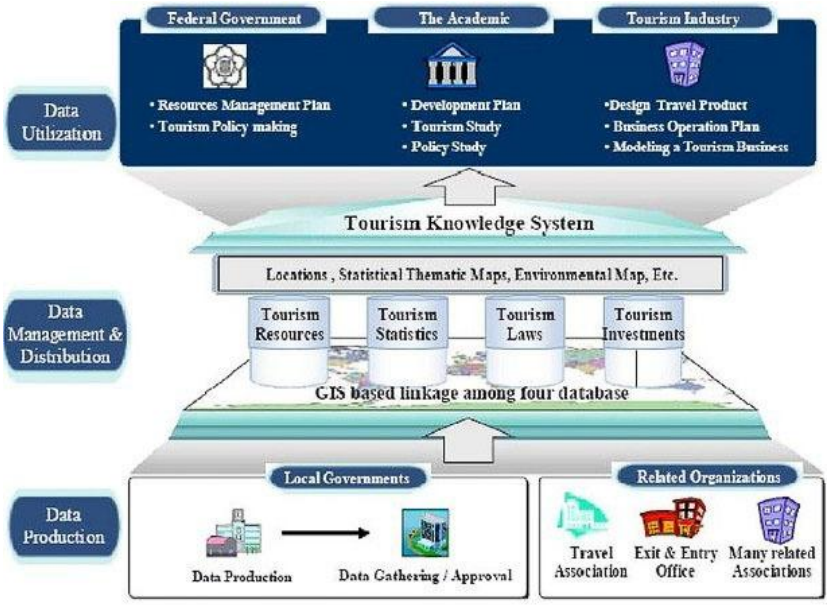

Fig. 4. Conceptual role of tourism knowledge system [36]

According to El-Mekawy *et al.,* [27] and Eriksson *et al.,* [28] a GIS is "a system for capturing, storing, verifying, integrating, manipulating, and displaying spatially referenced data." As a result, while BIM coordinates rely on modelling objects that are irrelevant to a specific location on the globe, GIS coordinates are dependent on geographic coordinate systems and global map projections [31]. GIS was utilized by He [24], to assess the value of traffic and the proximity of rail lines to intermodal facilities. To provide public services more effectively, Wiltshire Council makes use of mobile GIS tools. Ireland's national utility can deliver clean water to 1.8 million people thanks to the deployment of a mobile ArcGIS software that more effectively finds leaks, coordinates repair teams, manages data, and maintains the water network.

In the areas of civil engineering, where it offers geographic answers, GIS has several uses. A few examples are transportation, water resources, facilities management, urban planning, building, and e-business. Additionally, GIS can be utilized to properly display the topographical features of a construction site [32,33].

For a variety of reasons, there have been ongoing efforts over the years to merge BIM with GIS, which can provide a project with a full image and information drawn from building information models and pertinent geographic data [31].

Geographical Information Systems (GIS) can be viewed as a toolbox of approaches and technology with broad relevance for achieving sustainable tourist development. Spatial (environmental) data can be used to investigate disputes, assess impacts, and make decisions. Impact assessment and simulation are becoming increasingly essential in tourism development, and GIS may help with inspecting environmental conditions, assessing the feasibility of places for proposed developments, finding competing interests, and modelling linkages. Systematic evaluation of environmental effects

is frequently hampered by a lack of information, but also by technologies for data integration, processing, visualization, and analysis.

Overall, planning, managing, and marketing destinations can benefit greatly from the use of GIS as an AI sustainable tourism medium. Intelligent decision-making and the creation of sustainable tourist practices that strike a balance between social progress, environmental preservation, and economic growth are made possible by the integration of AI algorithms with geospatial data analysis provided by GIS.

2.5 BIM and GIS Integration with AI Sustainable Construction

The development of sustainable tourism can be greatly aided by the integration of two potent technologies, Building Information Modelling (BIM) and Geographic Information Systems (GIS), with Artificial Intelligence (AI). " In contrast to GIS, which is a system for gathering, storing, processing, and managing spatial data, BIM is a digital depiction of a building's or infrastructure's functional and physical attributes. Conversely, artificial intelligence (AI) is the replication of human intellect in machines, which includes functions like learning, thinking, and problem-solving [10].

It is possible to integrate BIM with GIS [31]. Ten strategies have been utilized to achieve complete BIM/GIS integration with AI interoperability. As a result, enhancements such as Geo BIM extensions and urban information modelling extensions for facility management were developed. Amirebrahimi *et al.,* [8] recommend using a data model to integrate BIM with GIS. Fazal [29] offer an IFC (Industry Foundation Classes)-based tool.

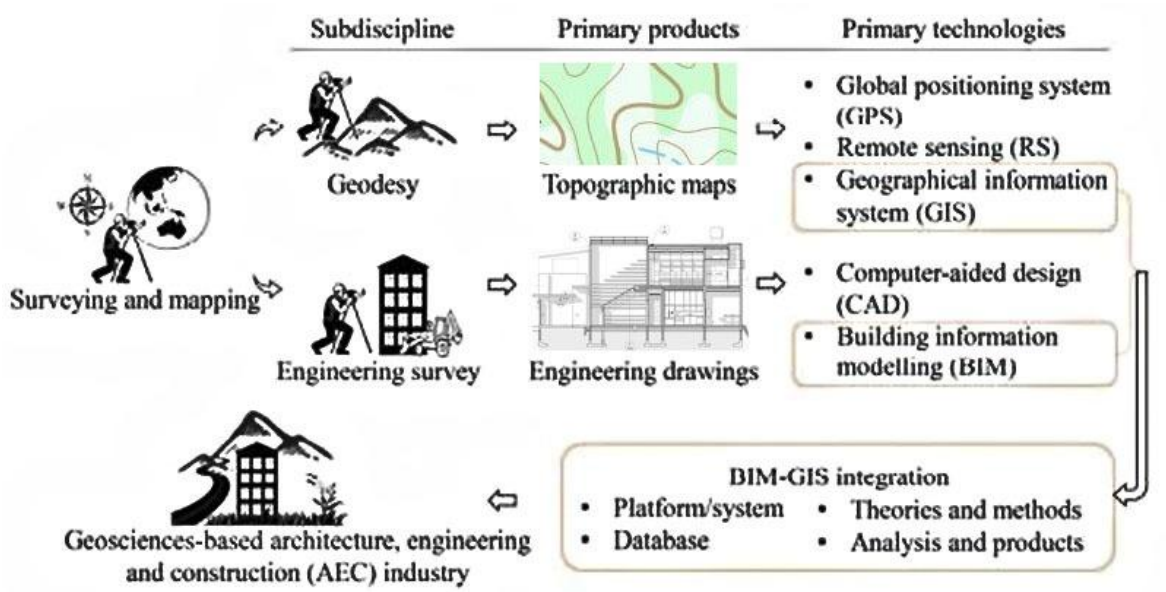

Fig. 5. History of BIM-GIS integration from the perspective of surveying and mapping [25]

Yanuarsyah *et al.,* [25] presented the Unified Building Model (UBM) method, which allows users to merge the features and capabilities of BIM and GIS into a single unified mode [31]. Several strategies have been utilized to achieve complete BIM/GIS integration. Various authors, for example, have presented various methodologies and built new tools based on existing standards.

As a result, enhancements such as Geo BIM extensions [31] and urban information modelling extensions for facility management [41] were developed. Amirebrahimi *et al.,* [8] recommend using a data model to integrate BIM with GIS offer a tool based on IFC (Industry Foundation Classes). UBM enables bidirectional data exchange between IFC for BIM and City GML for GIS. This reduces data loss

due to conversion for the exchange. This study's integration intends to deliver up-to-date information for more accurate collaborative decision making.

In summary, the manner that BIM, GIS, and AI are integrated into sustainable tourism has the potential to completely change how travel destinations are planned, created, and managed [22]. Using these technologies, policymakers may design tourism developments that are socially and environmentally conscious, improving visitor experiences and destination sustainability [38].

2.6 BIM/GIS/AI Integration using Drone for Sustainable Coordination and Monitoring

Architects, engineers, and construction (AEC) businesses can use building information modelling (BIM) to see inside structures in three dimensions. Before construction begins, planners can view a structure's design on a screen, and as the building changes, the model can be updated. A KPMG study indicates that 86% of the most creative executives in the engineering and construction sector have implemented BIM.

In addition to BIM, a geographic information system, or GIS, maps and graphically represent the land and characteristics surrounding a place. A building's intended interaction with the networked world can be seen through GIS, which illustrates the relationships between a project and the surrounding terrain. AEC planners may boost output and cut expenses from unforeseen site obstacles or last-minute design modifications with that visibility. Drones are being added to processes by tech-forward businesses to increase efficiency. Planners may view highly realistic 3D models of construction progress immediately using drone imagery connected with GIS and BIM, the cameras that offer sharp, comprehensive visuals from every angle.

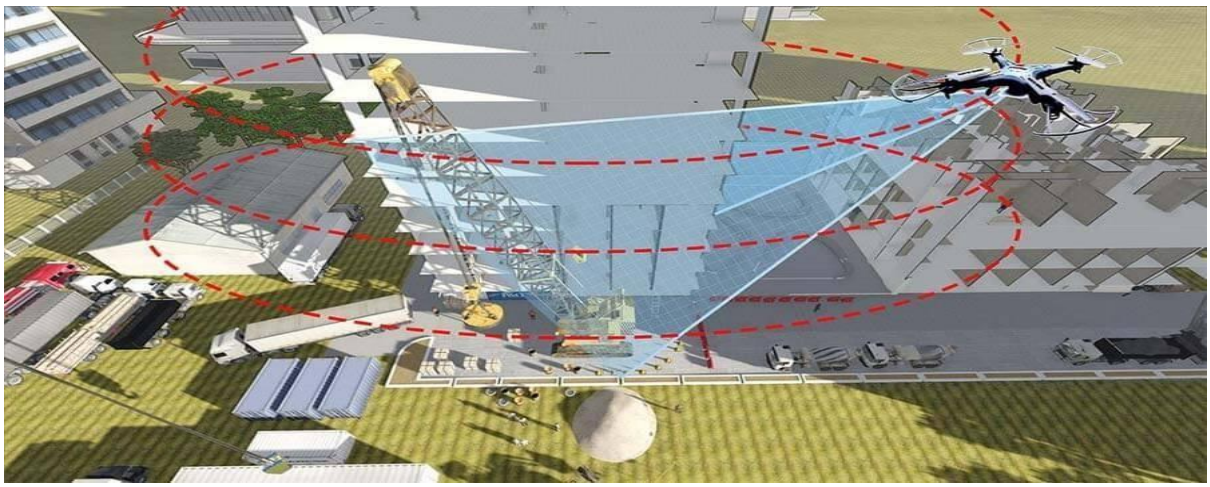

Fig. 6. Integrating BIM with GIS using drones [38]

In addition to BIM, a geographic information system, or GIS, maps and graphically represents the land and characteristics surrounding a place. A building's intended interaction with the networked world can be seen through GIS, which illustrates the relationships between a project and the surrounding terrain. AEC planners may boost output and cut expenses from unforeseen site obstacles or last-minute design modifications with that visibility. Drones are being added to processes by tech-forward businesses to increase efficiency. Planners may view highly realistic 3D models of construction progress immediately using drone imagery connected with GIS and BIM, the cameras that offer sharp, comprehensive visuals from every angle. Data sharing between GIS and BIM was difficult in the past due to their silos. The two are now achieving unprecedented levels of

interoperability, providing corporate executives and designers with a seamless view of a building as it is being built, as well as a shared platform for stakeholder cooperation and communication.

By integrating drone footage, managers may virtually visit building sites and experience what it would be like to rewind and fast-forward work progress or view a project from every perspective.

In a case study of a large building project in China, drones were used to capture high-resolution images of the site and generate 3D models that were integrated with BIM data. The digital twin solution helped to solve technological and coordination problems, develop innovative digital management concepts, and achieve full lifecycle BIM application for the civil aviation industry.

In another case study of a construction monitoring project in the US, drones were used to collect aerial imagery of the site and create Ortho mosaics that were georeferenced and overlaid with BIM data. The Ortho mosaics were used for better site communication and collaboration, as well as for comparing point clouds and models to detect deviations and errors.

In a third case study of a construction project in Dubai, drones were used to collect real-time data of the site and update the digital twin model. The digital twin model was then used for various purposes such as design validation, clash detection, schedule analysis, risk assessment, and stakeholder engagement.

These case studies demonstrate how accurate, timely, and comprehensive data that drones provide may boost the value of BIM and digital twins in construction management by facilitating better decision- making, coordination, and performance. Additionally, compared to more conventional methods of data collecting and processing, drones can save expenses, dangers, and delays. Consequently, the use of drones to create and maintain digital twins of construction projects is quite effective.

2.7 BIM/GIS/AI Integration using Drone and Mobile Apps for Sustainable Coordination and Monitoring

Drone Mobile Apps have become increasingly popular in the AEC industry due to their ability to capture high-resolution images and videos from unique perspectives. Drones can be used for various applications such as site surveying, progress monitoring, inspections, and marketing. By integrating drone mobile apps into their workflows, AEC professionals can gain valuable insights into their projects that were previously difficult or impossible to obtain. The integration of these technologies has led to numerous benefits for the AEC industry:

i. Improved accuracy: By using digital models and spatial data instead of traditional paper plans or surveys, professionals can reduce errors and improve overall accuracy.
ii. Enhanced collaboration: BIM models and GIS data can be shared among team members in real-time, enabling better communication and coordination between stakeholders.
iii. Increased efficiency: Digital tools such as BIM software or drone apps can automate repetitive tasks or provide real-time data that was previously time-consuming to obtain manually.
iv. Better decision-making: The use of digital tools allows professionals to make more informed decisions based on accurate data rather than relying on intuition or guesswork.
v. Improved safety: Drones can be used for inspections in dangerous locations or hard-to-reach areas without putting personnel at risk.
vi. Enhanced sustainability: Digital tools enable more efficient use of resources by reducing waste or optimizing energy usage in buildings or infrastructure projects.

3. Methodology

In-depth interviews and literature review were two qualitative research approaches used in the current study. The Setiu Wetland's observation has provided important insights into the benefits and drawbacks of facility planning. Undoubtedly, the construction of physical infrastructure and facilities in coastal wetlands involves time-consuming and expensive procedures, thus it is essential to guarantee their excellence and compliance with international standards. Factor studies are frequently used in many academic disciplines. For example, key success factors (CSFs) research is prevalent in strategic management and project management.

3.1 Identification of the Strategies through Literature Review

A detailed review of BIM/GIS implementation with current digital technology (AI) studies aids in the identification of methods. To begin, the initial literature research referenced factor studies such as [22,34,35] to provide an overview of BIM/GIS implementation. The investigation that followed concentrated on qualitative study about BIM/GIS/AI practice, such as that of [5,20,41,42]. These two sorts of investigations were used to create strategies. However, the strategies to be practical and contribute to improving BIM/GIS implementation with AI technology in projects, they are based on qualitative studies that directly research BIM/GIS/AI practice rather than empirical factor studies, and they include at least one source of qualitative BIM/GIS/AI practice studies. Table 1 shows the ten strategies identified during the evaluation for BIM/GIS/AI interoperability deployment in projects.

Table 1
The previous study of the strategies for BIM and GIS Integration with AI interoperability

Code	Strategies	Sources
S1	Clearly defined plans and objectives	[20,21,30,43,54]
S2	Financial support	[20,37]
S3	Capabilities and skills	[21]
S4	Collaborative working and Flexibility to execute.	[6,8,12,23,40,43,52]
S5	Managing changes and risks in projects	[21,36,43]
S6	Organizational and delivery measures	[8,26,43]
S7	Government policy and incentives	[2,21]
S8	Justification of cost changes	[3,9,53]
S9	Continuous updating	[35,39]
S10	Increase productivity	[49-51,55-57]

3.1.1 Qualitative data collection: Interview

Based on qualitative information gathered from primary sources, the study used an explorative qualitative research methodology [12]. In-depth interviews were recently used to gather primary data. The interviews, which started with open-ended questions to explore themes, were conducted with ten experts in the fields of tourism, BIM, and GIS implementation with AI interoperability, including a BIM expert, program and project manager, AEC, town planners, Setiu wetland experts, ICT expert and GIS expert. For face-to-face interviews, video calls, and online interviews (Zoom), recordings of the interviews have been made using a recording device. The researcher manually converted the audio interview into a text write-up and used NVivo software to analyse it. The interview transcripts were grouped according to straightforward themes and subjected to pattern coding analysis.

3.1.2 Data analysis: NVivo

NVivo software was used to conduct thematic analysis throughout the research project. We employ an inductive strategy to identify and learn from the research expertise's ideas, opinions, knowledge, experiences, and values because there is not currently a body of literature on the use of BIM, GIS and AI for sustainable wetland tourism. So, utilizing NVivo software, we were able to separate out major themes with ease.

Table 2
The overview of the participants demographic information

Code	Role Type	No of Expert	Years of Experience
Architect	Design	4	5-20
BIM Expert	Design & coordinate	3	5-10
Contractor	Off-site works	5	5-20
Engineer	Civil & Mechanical & Electrical	6	5-20
Program Manager	Overall management	1	5-12
Project Manager	Facility management	3	5-12
Town Planner	Planning	6	5-20
Wetland Expert	Off-site Coordination	1	5-10
ICT Expert	AI interoperability & communication	3	3-10
GIS Expert	Land-use planning & managing geospatial data.	1	5-10
Total		33	

3.2 Quantitative Study: Questionnaire

Quantitative study using a questionnaire survey and a review of the literature are the main research approaches utilized to accomplish the desired goals. It has been attempted to determine the variables of study (relevance, application and KPI) and the indicators as shown in Figure 7 by an extensive literature analysis in the field of drones in construction.

A questionnaire instrument has been designed for quantitative study and deployed online. The questionnaire contained seven sections with questions related to the respondent’s profile, awareness, relevance, application, and KPI. Three-point Likert scales (of agreement and value) are used to measure the indicators of the variables identified. Target population for this study are clients, contractors and consultants in Malaysia construction industry. Descriptive statistics are used for data analysis. Relative Importance Index (RII) is used to rank the indicators to understand the relative importance as perceived by the stakeholders. ANOVA analysis is used to check the statistical significance of the perceived differences between clients, contractors and consultants. Cronbach Alpha is used for internal consistency and data reliability for analysis.

Code	Relevance of drones [R]
R1	Drone is an emerging robot in the field of construction
R2	Automation and robotics have an impact on construction industry
R3	Drones have potential uses in the construction industry
R4	It is simple for me to use the existing drone technology
R5	Drone are compatible to the construction industry
R6	Drones are still in inception stage in implementing when it comes to construction
R7	Drones must be experimented before using it in the construction projects
R8	Drones are difficult to handle and require a skilled personnel to handle it

Code	Application [A]
A1	Surveying
A2	Inspection
A3	3-D Modelling
A4	3-D Printing
A5	Drone Construction
A6	Progress Reporting
A7	Safety Monitoring
A8	Facility Management
A9	Logistic and Tracking
A10	Emergency Response and Accessibility
A11	Advertising and Marketing

Codes	Key Performance Indicators [K]
K1	Cost
K2	Time
K3	Quality
K4	Health and Safety
K5	Stakeholder Satisfaction

Fig. 7. Perception of interviewed expertise towards implementation BIM/GIS/AI for strategic planning in wetland

4. Results and Discussion

4.1 Interview

By gathering and entering the audio and written transcripts of the interviews into the NVivo program, the research was then assessed. The analysis's findings showed that different levels of stakeholders had varying opinions about the use of BIM and GIS integration to sustain wetland as a tourist destination. The findings show that the decisions about the adoption of expertise would be based on their familiarity with BIM and their accessibility to BIM/GIS and AI application capability. The use of BIM/GIS with AI integration for complicated wetland projects is depicted in Figure 8 along with various managers' assessments of their level of skill. Positive response reactions show that these experts believed adoption of BIM and GIS Integration with AI interoperability for wetland project case studies was feasible. Mixed response reactions show experts who are unsure of the benefits of BIM and GIS with AI Integration adoption, and negative response reactions show experts who are not yet ready to adopt BIM/GIS integration with AI technology interoperability.

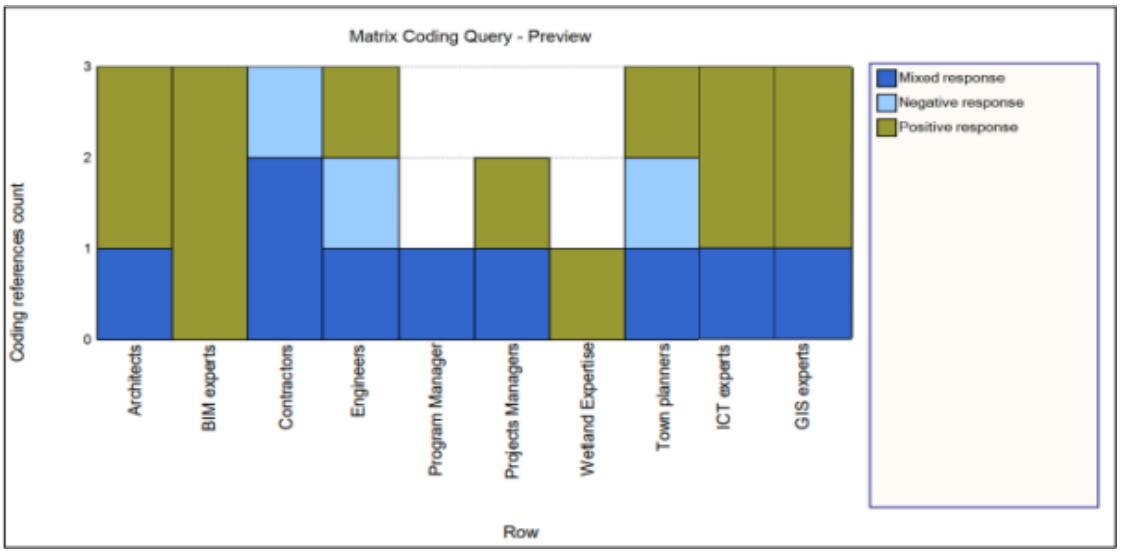

Fig. 8. Perception of interviewed expertise towards implementation BIM/GIS/AI for strategic planning in wetland

According to Figure 5, most architects have sufficient knowledge of BIM and GIS integration and AI technology injections, which results in a stronger favourable reaction or influence. While engineers and municipal planners lack sufficient expertise about BIM and GIS Integration with AI medium, some of them have conflicting opinions. Despite being fully aware of the advantages of BIM and GIS Integration with AI touch for such projects, the manager representative organizations are utterly impartial and unsure about it. The Setiu wetland experts and BIM and GIS modelers are fully informed and prepared to embrace BIM/GIS with AI technology benefits, however certain engineers, municipal planners, and contractors appear to depend on the customers for this decision. To execute BIM/GIS with AI platform for the used in wetland projects, other expertise such as BIM/GIS/AI managers, project managers, and contractors' attitudes are impartial.

In order, to improve BIM/GIS/AI application in wetland Malaysian tourist practices and increase BIM/GIS/AI use in the tourism business, this study looked at the guidelines for planning, guidelines awareness, and adoption. The findings emphasize the importance of implementing BIM/GIS for wetland strategy planning as well as latent influences on these strategies. The consequences of the criticality analysis and strategy planning are thus covered in the debate. The Setiu wetland in Terengganu is used as a case study in the current study. The technical features of BIM [17], for building construction and GIS as the site's topography solely are the key areas of focus in earlier publications [31]. To provide detailed data and solutions for smart optimization, the BIM/GIS platform must be integrated with new Virtual Reality (VR) technologies like Artificial Intelligence (AI), Machine Learning (ML), the Internet of Things (IoT), and three- dimensional technologies [7].

The audio was gathered and entered the NVivo program for analysis of interpretative research in the current study. The findings showed that varied levels of skill were perceived in relation to the use of BIM/GIS/AI and its adaptability in terms of site topography and building construction and digital communication technology to provide overall master planning at Setiu Wetland. The person in charge of the Setiu Wetland (competence) towards future growth and planning in the tourism sector is shown in Figure 5 together with diverse perceptions of various levels of BIM/GIS/AI expertise in building/land use/digital communication technology and development. The positive response reaction shows that the case study projects' adoption of BIM/GIS/AI for wetland planning as part of future strategic planning is possible. The mixed response shows those who are unsure about BIM/GIS/AI adoption, while the negative reaction shows those who are not ready to adopt BIM/GIS/AI. Although the advantages of BIM/GIS/AI include increased productivity, better decision-making, informational advantages, competitive advantages, and better risk management by reducing project mistakes during construction [14-16]. Cost savings, the elimination of redundant tasks, and ease of coordination and monitoring are other advantages.

In addition, by implementing BIM/GIS/AI in whole project life cycle in the Built Environment to solving problems or risks occur during the construction and development process and management [6]. However, a negative response shows that they are not yet prepared to embrace BIM/GIS/AI because they still lacked the necessary knowledge and expertise to apply BIM/GIS/AI throughout the project lifecycle. The mixed response indicates that some people are unsure about adopting BIM/GIS/AI because there are no clear guidelines or government regulations to follow. Less financial support for the adoption of BIM/GIS/AI Integration was another factor.

Table 3
The critical strategic planning of BIM/GIS/AI implementation in wetland

Code	Nodes
S1	Clearly defined plans and objectives on the given project time-line basis.
S2	Financial support to adopt BIM/GIS/AI software for each level of construction team or consultants to maximize the values of project delivery.
S3	Capabilities and skills will be developed by providing the BIM/GIS/AI training workshop for the construction team or consultants that will be organized by professional BIM /GIS/AI trainer.
S4	Collaborative working before project execution by doing VA/VE evaluation in BIM/GIS adoption.
S5	Managing changes and risks in projects by using BIM/GIS/AI integration solution.
S6	Organizational and delivery measures department should be set up for each consultant's department consists of AEC team/planning team/ICT team.
S7	Formulate government policy to implement BIM/GIS/AI at the very beginning stage and incentives should be given for wetland development project to increase values in tourism industry.
S8	AI-BIM integration can control the cost and complexity of building jobs in construction projects, as well as lower the rate of budget and schedule instability.
S9	Building professionals can benefit from important data provided by AI-assisted BIM machines through their updating features, as AI devices are dependent on experimental knowledge and learning from past and present projects.
S10	Investment in the building sector has accelerated the development of AI-assisted BIM, which has improved project pace and reduced inefficiencies in the construction process.

To enhance BIM implementation there are 10 (S1-S10) critical strategic planning of BIM/GIS/AI implementation in wetland projects were identified. Hence, we summarized the summary of the main points through the nodes by coding similarity as shown in Table 2 critical strategic as majority of interviews identified S2, S3, S7, S9 as the saturation intersection results. After reviewing the need to adopt BIM/GIS/AI for strategic planning in wetland projects suggested by the participants, solutions were offered for existing or new development in wetland projects.

Hence, by referring to code S2, financial support would be from the government assistance in terms of financial resources to adopt BIM/GIS/AI in the whole project life cycle for each level of construction team or consultants to maximize the values of project delivery. While referring the code S3, Capabilities and skills will be developed by providing the BIM/GIS/AI training workshop for the construction team or consultants that will be organized by professional BIM/GIS/AI trainer from the legal company such as Autodesk to develop set of skills by using BIM/GIS/AI tools. Lastly, by referring to code S7, formulating government policy to implement BIM/GIS/AI at the early stage of projects will educate awareness among stakeholders. S9, AI devices rely on experimental knowledge and learning from previous and current projects, which means AI-assisted BIM machines can provide useful data to building workers through their updating features. Thus, incentives should be given for wetland development projects to attract interest among public and private industry players, at once increase values in the tourism industry.

4.2 Data Analysis, Results and Discussion

The data collected is screened and codified for further analysis. Data Analysis Cronbach Alpha is used to evaluate the internal consistency of the instrument and reliability of the data collected for further analysis. The calculated Cronbach Alpha values are greater than 0.8 (except for KPI), which is very good, and the data collected is reliable for further analysis. Descriptive data analysis is conducted to understand the profile of the respondents and awareness levels. The Relative Import Index (RII) is computed for all the indicators and ranked overall and within stakeholder groups for observation.

ANOVA test has been conducted to check for statistical significance in difference in opinion of respondent group.

5. Conclusion

Monitor developments and with technologies like GIS, BIM, and drone imagery create a productive feedback loop, enabling executives to adjust the project vision based on the latest developments, and fold those updates back into daily site work. The same pattern can be repeated during the maintenance and operation stages of a project. In the United Kingdom and Asia, commercial and civil construction firms are already incorporating this kind of workflow throughout the life cycle of a project, thanks to the combined use of GIS and BIM. Integrating these technologies from project start to finish could give the construction and engineering industry the productivity gains needed to deliver higher-value work.

Ecotourism and economic growth have potential at the Setiu Wetland in Terengganu, Malaysia. Wetland landscape characteristics and urban river wetland are disappearing due to rapid urbanisation, social development, and economic growth. However, a lack of administration, coordination, and national policy has slowed down development. The study uses building information modelling (BIM) and geographic information systems (GIS) to find gaps in the physical planning development progression for sustainability strategic planning guidelines. Thus, this study identifies the Integration AI tools between BIM and GIS, aims to provide updated information for more accurate collaborative decision making in strategies and frames them in the tourism projects collaboration. This study reveals that BIM and GIS Integration have started to spend in-depth research in the efforts of sustainable tourism industry, which aids in the development of better tourism strategies master planning in Setiu, Terengganu. Through a review of literature and interviews with people with different levels of competence, this article will also conduct in-depth research and analysis in conjunction with the pertinent theories to advance the development of wetland tourism using BIM and GIS Integration AI technologies.

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