A COMPREHENSIVE ANALYSIS OF PROJECT MANAGEMENT IN CONSTRUCTION SERVICES ENGINEERING: EMPHASIS ON HONG KONG.

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ABSTRACT

Despite the importance of determining how cities are built, the construction services engineering sector has been afflicted by problems like lack of coordination, safety concerns, cost overruns and delays. The study delves deeply into the project management techniques in Hong Kong which is a city characterised by a dense population, limited land resources and strict laws. The study's primary objective is to determine how digital advances like BIM affect the project's schedule, budget, quality and safety. Stratified sampling was used to guarantee that different professional groups were represented fairly in the quantitative study that was conducted. The results show that using BIM significantly boosts collaboration across disciplines, decreases design disagreements and makes decisions better in real-time. When compared to projects that relied on more conventional approaches, those that used BIM performed better in terms of cost management, risk mitigation, and communication with stakeholders. By providing a complete quantitative analysis, the study addresses a gap in the existing body of research on Hong Kong project management techniques. It is recommended by the research that the greater use of digital technologies, the development of training, and the improvement of collaboration frameworks be prioritised in order to achieve sustainable, efficient and high-quality building outcomes. The study emphasises the importance of using digital innovation to get around the problems that Hong Kong's construction industry is facing at the moment. People who work in the industry can help projects do better, be safer and make the city more sustainable and resilient by promoting a culture of ongoing learning and working together.

Keywords: Project Management; Construction Services Engineering; Building Information Modelling (BIM); Sustainability.

INTRODUCTION

Many economies rely on the construction industry to drive their development. Essential to the growth of other economic subsectors and businesses, it unites a number of related fields under one wing, such as the automotive and manufacturing industries. Since it requires more manual labour than other industries, it generates a lot of jobs and helps the economy grow. Major budget readings of most countries across the globe have acknowledged its ultimate function in contributing to GDP (Assaad et al., 2020). It is critical to manage the inputs, activities, and

processes efficiently and effectively because of the industry's potential contribution to economic development. This is possible through effective monitoring and evaluation plans that keep track of and judge the project's progress at every level. Because of this, project management is currently as much of a strategic role as a technical process when it comes to deciding whether a project will be successful.

Project management is essential in the construction services engineering industry which is complicated and resource-intensive to guarantee success at every stage of a project's lifecycle. Over the years, Hong Kong businesses have been known for their speedy and excellent building of residential blocks and office towers. Hong Kong has become at the forefront of the region's building industry due to its innovative use of specialised techniques like design-and-build procedures and reclamation. The engineering community in Hong Kong is highly engaged in providing its services to neighbouring countries, especially mainland China (Liu et al., 2021). Among the most common forms of engineering services that are now being exported are engineering consulting, project management and building services work. Large-scale housing, transport, and infrastructure projects are integrating BIM, AI and other cutting-edge techniques to deal with the growing population and the construction industry's demand for workers. Policies and digital transformation roadmaps that promote smart, environmentally friendly and resilient construction practices have also attracted a lot of funding from both the public and private sectors.

BACKGROUND OF THE STUDY

In order to facilitate urbanisation, industrialisation and social progress, the construction services engineering industry provides crucial infrastructure making it one of the biggest global contributors to economic development. The importance of project management in this industry has grown as a result of the prevalence of large-scale initiatives in this field, which typically include several stakeholders, considerable investments and complicated technical requirements. Timeliness is of the essence in the design and building industries of Hong Kong. There is constant and intense competition among building consultancy firms for new projects; thus keeping consultant rates low is essential to staying competitive and attracting clients (Lo, 2025). Building growth in Hong Kong is plagued by an issue whose long-term consequences are uncertain. Miscommunication about the building's structural, architectural and service designs is a typical problem. Repairing this can be difficult (Wuni & Shen, 2022). At the beginning of the design phase, there is often a failure to integrate and coordinate the various construction systems. Hence, Hong Kong offers a unique environment to analyse these changes.

Project managers in the city's construction business have both opportunities and challenges because of the high population density, limited land availability and strict regulatory oversight (Gunduz & Almuajebh, 2020). Given these traits, it is essential to know how construction services engineering manages projects, especially in Hong Kong. Project management is a field

that is changing quickly and knowing its pros and cons as well as current trends can assist engineers, lawmakers and contractors in making smarter choices.

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PURPOSE OF THE RESEARCH

The aim of this study is to perform a comprehensive examination of project management in the domain of construction services engineering with a specific focus on the Hong Kong region. The primary objective of this research is to identify the most effective project management methodologies for addressing the economic and quality challenges present in the construction industry, characterised by intense competition and rigorous laws. Another purpose of the research is to discover several distinctive features of the Hong Kong construction sector. It has a large dependence on the large-scale infrastructure, an overdense population and strict laws about construction. It also looks at the pros and cons of the ways that are currently being used and finds areas where innovation and sustainability could be improved. Hence, the results of the study can help the policymakers, project managers and industry experts to develop projects that have a smoother workflow and encourage best practices which influence the construction services in Hong Kong.

LITERATURE REVIEW

Sustainability has recently emerged as a major issue for building project managers according to the literature. Sustainability evaluation, sustainable project management and sustainable building drivers were discovered in a systematic analysis which highlights the significance of lifespan perspectives and ongoing assessment (Mavi et al., 2021). The digital revolution has transformed construction project management in conjunction with the sustainability discourse. It is established that digital twins, modular integrated construction and BIM can boost effectiveness, precision of cost estimates and collaboration on construction projects (Du, 2021).

The literature highlights how complexity management and new technology are becoming more influential in Hong Kong's construction services engineering. Monitoring projects, predicting costs, and detecting risks have all been discussed in recent research using robotic cyber physical systems, artificial intelligence and machine learning. To realise their potential, these technologies must be integrated into current project management frameworks (Halder et al., 2024). Discussions and surveys with professionals in Hong Kong showed that adopting BIM for quantity surveying and other construction-related duties is harder than it seems. Researchers used BIM when looking at quantity surveyors in 2022. They did identify some possible benefits, including better control over prices and more efficient management, but they also uncovered some clear problems such as not enough training and tools that failed to perform the same way all the time (Keung et al., 2022). However, the flagship BIM and Modular Integrated Construction (MiC) projects also demonstrate the practical implementation of modern project management technologies. By using BIM, InnoCell which is the first hybrid MiC building in Hong Kong was able to address interdisciplinary coordination concerns two stories before construction ever began which resulted in a six-month scheduling boost and outstanding safety records (Tang, 2021). BIM and other platforms help people work together in real time by making it easier for them to communicate information, settle issues and communicate more clearly. Everyone working on a project should supply real-time information and updates. This helps individuals find and fix problems. They also help people choose better, make fewer mistakes and finish jobs on time (Owusu et al., 2024).

RESEARCH QUESTIONS

What is the impact of BIM on construction services engineering in Hong Kong?

RESEARCH METHODOLOGY

Research Design

Using a quantitative research strategy, this study investigated elements related to construction services engineering project management. SPSS version 25 was used for data analysis. To summarise demographic and project-related factors, descriptive statistics were used. To establish the strength and direction of relationships, inferential statistics such as odds ratios with 95% confidence intervals were employed. When $p < 0.05$, statistical significance was determined. To further validate the results and find statistically significant differences between the groups, the researcher used ANOVA and factor analysis.

Sampling

It was estimated that a sample size of 435 was necessary using RaoSoft's sample size determination. 600 questionnaires were disseminated proportionally across strata to reduce non-response. A total of 482 responses were received. The final valid sample size was 449 respondents, as a consequence of the 34 incomplete and discarded responses.

Data and Measurement

The principal technique for gathering information was the use of structured questionnaire surveys. (A) The survey asked for basic personal and occupational details from respondents and (B) it used a five-point Likert scale to determine how the respondents felt about various aspects of project management. An equal share of all project types and job functions was guaranteed by stratified sampling. Scholarly articles, company reports and internet databases provided the secondary data needed to finish the investigation.

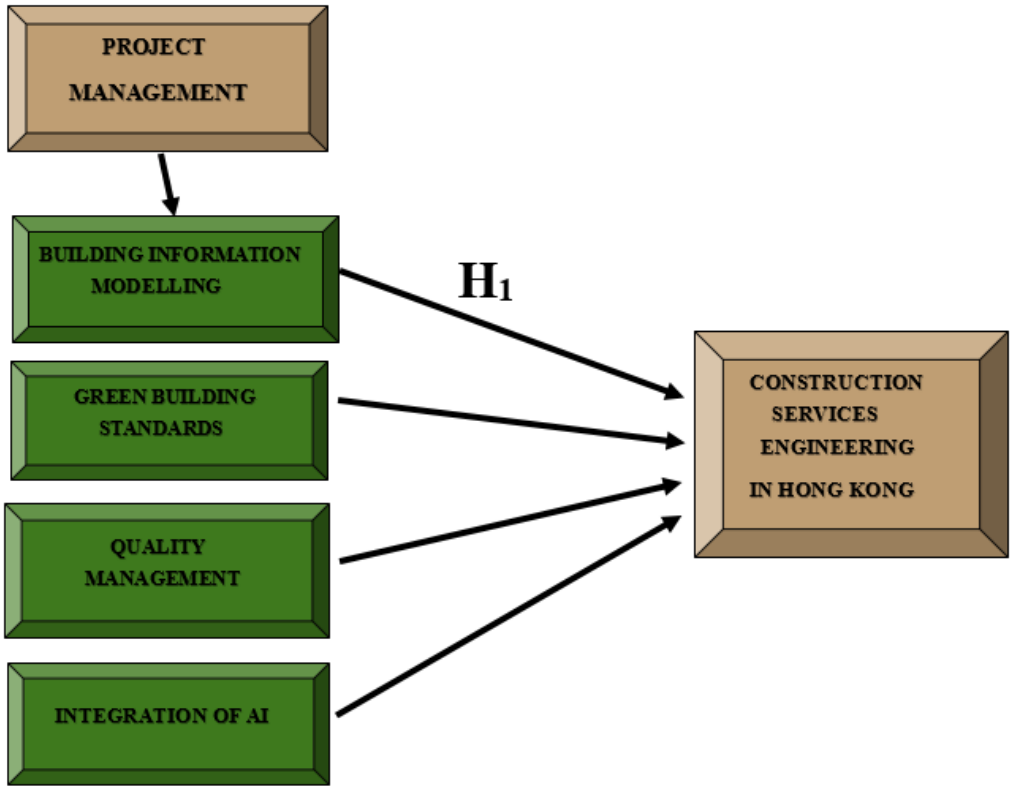
Statistical Software

Microsoft Excel and SPSS 25 were used to do the statistical analysis.

Statistical Tools

Demographic and project-related parameters were described across strata using descriptive analysis. Among the inferential statistical methods used were odds ratios with 95% confidence intervals (CIs), analysis of variance (ANOVA) to compare strata and factor analysis to verify measurement reliability and validate the constructs.

CONCEPTUAL FRAMEWORK



RESULT

Factor Analysis: It is common practice to use Factor Analysis to check if a measurement set's latent component structure is accurate. There is a possibility that latent factors impact the

results of measurable variables. An evaluation of model correctness using financial models (FA). It delineates causal relationships among observable events, latent causes, and measurement inaccuracies. The Kaiser-Meyer-Olkin (KMO) test assesses data suitability for factor analysis. The model and its variables are evaluated for appropriate sampling. Statistics quantify the shared variance among multiple variables. Factor analysis is most effective with reduced percentages. KMO yields a range of 0 to 1. Sampling is deemed sufficient if the KMO value ranges from 0.8 to 1. If the KMO value is below 0.6, the sampling is insufficient and corrective measures are required. Certain authors select 0.5. Kaiser-Meyer-Olkin A value close to 0 indicates relatively weak overall correlations in comparison to partial correlations. Significant correlations complicate component analysis. Kaiser's criteria for acceptance: Kaiser's acceptance limits range from 0.050 to 0.059. 0.60–0.69 subpar Middle grade: 0.70–0.79. Quality point value: 0.80 to 0.89. Values between 0.90 and 1.00 will be exceptional.

The results of Bartlett's test of Sphericity are as follows:

approx. chi-square = 3252.968

df = 190

sig =.000

Table 1. Testing for KMO (Kaiser-Meyer-Olkin) and Bartlett's Sampling Adequacy Measured by 0.891.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.891
Bartlett's Test of Sphericity	**Approx. Chi-Square**	3252.968
	df	190
	Sig.	.000

This mostly permits claims for sampling reasons. Researchers employed Bartlett's Test of Sphericity to evaluate the significance of the correlation matrices. A Kaiser-Meyer-Olkin score of 0.891 signifies that the sample is sufficient. The p-value derived from Bartlett's Sphericity test is 0.00. The positive outcome of Bartlett's Sphericity test indicates that the correlation matrix is not an identity matrix.

INDEPENDENT VARIABLE

Project Management: The broad role of project management includes measuring and evaluating project performance. Thus, in order to attain success factors, it is necessary to assess and quantify project activities, resources, and procedures in the construction business

efficiently. In the construction industry, project management is characterised as the process of organising and directing a project to ensure that it meets its goals in terms of time, money, quality and performance. For a variety of reasons, project management is crucial. The first benefit is that it maintains projects on track in terms of finances, time and efficiency. Throughout a project's lifetime, managers can keep things running smoothly by systematically planning, executing, and monitoring to identify and eliminate any risks (Nicholas & Steyn, 2020). The management of construction projects is known as construction project management. The fundamental difference between mission-based projects and others is the nature of construction project management. The project's organisation comes to its conclusion once the project's build is finished. Architecture, engineering, public works, city planning and many more fields can all interact with construction project management at various points in a project's lifecycle. Due to the dynamic and rapid nature of the construction industry, construction project management combines the knowledge and experience of a conventional project manager. For this reason, construction project managers need a wide range of abilities to deal with varied teams, different stakeholders, copious volumes of paperwork and tight deadlines (Rodriguez, 2025).

FACTOR

Building Information Model (BIM): Data related to the geometry and semantics of a building, including information about the materials used and their qualities are all part of a BIM. As a result of the interconnected nature of this data, great automation of planning procedures is possible. Construction blueprints, simulation models, and collision checks are some of the examples. Additionally, architects and outside experts can minimise inconsistencies and redundancies. With BIM, both traditional and additively created building components can have their planning quality and efficiency greatly enhanced (Qi et al., 2023). BIM is more than just software. It is a collection of data sources and tools that may work together to serve several fields and, via their interoperability, generate a three-dimensional space for construction. In order to facilitate better building project planning, design, construction, operation, and maintenance, software suppliers create these solutions. Designed to meet the needs of various stakeholders including planners, designers, engineers, contractors, managers and owners, BIM is a by-product of the next Big Data era that offers a more accurate and visually appealing 3D model of a building than the more conventional two-dimensional (2D) drawings of the same type. BIM could be a new frontier for making earthquake design and evaluation of non-structural aspects more reliable. When used with performance-based seismic design, BIM could change the way buildings are designed and make it easier to build structures that work effectively. Project timelines, budgets, material inventories, quantities, spatial linkages, geographic information, and building element attributes and quantities are all described in a BIM (Kabirifar et al., 2020). Complete construction life cycle demonstrations are possible with this model. Therefore, it is easy to derive material quantities and common attributes.

DEPENDENT VARIABLE

Construction Services Engineering in Hong Kong: Systems that ensure the security, functionality, efficiency, and comfort of buildings and infrastructure are the focus of Construction Services Engineering which includes their design, installation, operation and maintenance. In construction projects, it combines engineering, project management, and technology to provide services like water, power, ventilation, fire protection, lifts and digital infrastructure. This comprises networks for public health, communication, and safety, as well as mechanical services like plumbing, fire protection, and lifts and electrical systems like power distribution, lighting, emergency backup, and smart controls. In Hong Kong, where there are a lot of tall buildings, big infrastructure projects, and strict rules, the main purpose of construction services engineering is to make sure that everything runs smoothly, is safe and comfortable (Yu et al., 2021). A significant number of enterprises in Hong Kong's construction industry serve as both developers and contractors, and the industry is marked by a high level of subcontracting, a large number of international contractors and only a few large local contractors. On average, there are 11.5 employees per construction company in Hong Kong, making it a relatively small industry (Lo, 2025). Most of the time, the bigger companies are the main contractors and the smaller ones are subcontractors. Several big construction companies are also expanding their businesses in the area and they have the tools and funds to handle complicated projects that need a lot of machinery and money. Therefore, construction services engineering is essential to the durability, innovation and sustainable development of Hong Kong's construction industry in addition to providing a technical basis for building performance.

Relationship between BIM and Construction Services Engineering in Hong Kong: BIM is crucial for current construction services engineering. People in the industry believe it is a revolutionary tool. It helps with the planning part of project management by making it easier for functions to work together and be more efficient. Digitisation has had a huge effect on construction services engineering, leading to better efficiency, safety and project quality (Zuo et al., 2025). Data analysis that speeds up project completion is also possible with the help of a number of different applications (Chiu & Lai, 2020). When it comes to building projects, their innovative use of BIM technology has established new standards for economy, accuracy and sustainability (Keung et al., 2022). In recent years, Hong Kong has taken a significant step by mandating BIM in all public projects which exceed the budget of HK$30 million. This clearly depicts the nation's approach towards modernisation of infrastructure and development of high standards for executing projects (Du, 2021).

Based on the preceding discussion, the researcher developed the following hypothesis to examine the impact of BIM on construction services engineering in Hong Kong:

"H_{01}: There is no significant relationship between BIM and construction services engineering in Hong Kong."

"H_1: There is a significant relationship between BIM and construction services engineering in Hong Kong."

Table 2. H1 ANOVA Test.

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	49588.625	186	4235.418	811.212	.000
Within Groups	492.771	262	2.457		
Total	50051.396	448			

This investigation produces substantial results. The F value is 811.212, with a p-value of .000, indicating statistical significance below the .05 alpha level. This signifies that the ***"H_1: There is a significant relationship between BIM and construction services engineering in Hong Kong"*** is accepted, and the null hypothesis is rejected.

DISCUSSION

The study's findings highlight the need for good project management in resolving numerous issues affecting Hong Kong's construction services engineering. Findings highlighted the critical importance of BIM in enhancing project results. Costs were better controlled, fewer safety issues occurred and scheduling went more smoothly on projects that used BIM. Additionally, BIM simplified collaboration between many experts which lessened conflicts between the design and construction teams. Although digital transformation is an appealing goal, the study shows that there are several challenges along the way. Many people who took the survey brought up the fact that it can be costly to use BIM and other advanced technologies, what with the cost of the technology itself and the cost of staff training. The vast majority of people who took the survey agree that BIM and other modern project management techniques create a controlled environment that encourages creativity and cuts down on misunderstandings between the design and construction teams. This supportive structure promotes teamwork, guarantees adherence to stringent rule and produces improved sustainability and safety metrics. The significant expense of technology, the necessity for training and the opposition to organisational change are some of the difficulties brought up in the course of the conversation as being related to these practices. Data in real-time and visual simulations help professionals and project managers make better decisions and deal with issues before they become major problems. With consistent use, project teams can use these digital technologies, leading to better collaboration and increased efficiency all through the construction lifecycle.

CONCLUSION

According to the final outcome of the study, the success and effectiveness of Hong Kong's construction services engineering are impacted by properly managed projects. The study found

that when digital advanced tools like BIM are used together with other construction-related elements, the interdisciplinary teams get opportunities for better communication, better work schedule as well as tighter cost control. In todays highly competitive and strictly regulated construction industry, these tools are essential for project managers to enhance safety and quality standards, speed up coordination, and detect hazards early on. Project management has progressed from a purely technical function to one that encourages innovation, sustainability, and long-term resilience. Specifically, BIM excels at writing and obtaining intricate project elements, like spatial layouts, material requirements and sequencing. These tools enable better project management by offering a consistent and open platform for engagement. Moreover, the latest digital tools provide easy and quick feedback to project handling teams at every stage of the project which provides the continuity of the project. While conducting the study, it was found that more digital technologies can enhance project management in Hong Kong's construction sector. Hence, the key focus to overcome the challenges and present resistance will be training and continuous development. Additionally, project managers need to consider the sustainability criteria to achieve long-term success in Hong Kong's construction industry.

REFERENCES

1. Assaad, R., El-Adaway, I. H., & Abotaleb, I. S. (2020). Predicting project performance in the construction industry. Journal of construction engineering and management, 04020030.
2. Chiu, B. W., & Lai, J. (2020). Building information modelling for building services engineering: benefits,. Engineering, Construction and Architectural Management, 2221-2252.
3. Du, X. (2021). Research on Engineering Project Management Method Based on BIM Technology. Scientific Programming.
4. Gunduz, M., & Almuajebh, M. (2020). Critical success factors for sustainable construction project management. Sustainability, 1990.
5. Halder, S., Afsari, K., & Akanmu, A. (2024). A Robotic Cyber-Physical System for Automated Reality Capture and Visualization in Construction Progress Monitoring.
6. Kabirifar, K., Mojtahedi, M., Wang, C., & Tam, V. W. (2020). Construction and demolition waste management contributing factors coupled with reduce, reuse, and recycle strategies for effective waste management: A review. Journal of Cleaner Production, 121265.
7. Keung, C., Yiu, T., & Feng, Z. (2022). Building Information Modelling in quantity surveying practices: current state and future challenges in Hong Kong. Journal of Information Technology in Construction, 1060-1074.
8. Liu, Y., Jarvamardi, A., Zhang, Y., Liu, M., Hsiang, S. M., Yang, S., . . . Jiang, Z. (2021). Comparative study on perception of causes for construction task delay in China and the United States. Journal of Construction Engineering and Management, 04020176.

9. Lo, E. (2025, August 22). Real Estate and Construction Services Industry in Hong Kong. Retrieved from Research HKDTC: https://research.hktdc.com/en/article/MzExMzQzOTc4
10. Mavi, R. K., Gengatharen, D., Mavi, N. K., Hughes, R., Campbell, A., & Yates, R. (2021). Sustainability in Construction Projects: A Systematic Literature Review. Sustainability.
11. Nicholas, J. M., & Steyn, H. (2020). Project management for engineering. business and technology.
12. Owusu, E. K., Wong, K. H., & Chan, A. (2024). Applications of BIM in project cost management and associated barriers: The case of Hong Kong. In Routledge Handbook of Construction Project Procurement and Delivery (pp. 276-296). Routledge.
13. Qi, L., Luo, Z., Cao, Y., & Xue, J. (2023). Seismic damage mechanism and performance evaluation of suspended ceiling systems. Journal of Building Engineering, 105595.
14. Rodriguez, D. (2025, May 26). Project Management in Construction: Importance and Functions. Retrieved from Invensis Learning: https://www.invensislearning.com/blog/phases-of-construction-project-management-processes/
15. Tang, W. (2021). Digital transformation of HK's construction industry. Ejinsight.
16. Wuni, I., & Shen, G. (2022). Developing critical success factors for integrating circular economy into modular construction projects in Hong Kong. Sustainable Production and Consumption, 574-587.
17. Yu, A. T., Wong, I., Wu, Z., & Poon, C.-S. (2021). Strategies for effective waste reduction and management of building construction projects in highly urbanized cities—A case study of Hong Kong. Buildings, 214.
18. Zuo, W., Mei, T., Zhong, S., Jiang, X., & Yan, N. (2025). How to improve performance of Chinese BIM-supported civil engineering projects based on the qualitative comparative analysis method. Scientific Reports.