

TITLE PAGE



An Empirical Investigation into Determinants of Generative Artificial Intelligence (GenAI) Adoption in the Construction Industry: From the Perspectives of Technical Professionals

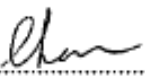
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ACKNOWLEDGEMENT

When I was starting to write my dissertation, my teachers gave me much support and advice, especially my supervisor, Dr Ho, who always responded to my questions timely and insightfully and my SPSS teacher, Dr Mo, who patiently guided me to use SPSS in my dissertation. Many angels, including my colleagues and friends, supported me a lot during the data collection process. They used their networks to send the survey questionnaires to suitable targets. My dissertation was not only accomplished by my own efforts but also those of the relevant parties. Finally, the results of this dissertation are not simply for final submission to satisfy the completion of the MBA programme but may also be used for demonstration of how to adopt Generative Artificial Intelligence in the real Hong Kong construction industry.

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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Date 17 Nov 2024

STATEMENT 1

This work is the result of my own investigations, except where otherwise stated.

Other sources are acknowledged by footnotes giving explicit references.

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ABSTRACT

The adoption of Generative Artificial Intelligence (GenAI) has been recorded more than doubled since 2017 and has contributed US\$4.4 trillion to the global economy every year (McKinsey & Company's Survey, 2023). The development of Gen AI has been fast and valued by the public since launching ChatGPT in recent years. Hong Kong, a developed economy, has also reserved a total of HK\$24 billion to drive the technology economy in the Hong Kong Budget 2024-25 (Yau, 2024). However, according to the Hong Kong Productivity Council and HKU Business School (2024), the industrial GenAI application of Hong Kong is falling behind Singapore, New York, Switzerland, Shanghai and Shenzhen and even other developing economies such as India and Indonesia. Meanwhile, in other studies, the application pace of GenAI, according to job positions, ages, genders, working experience and working locations, has shown inconsistent findings (Singla et al., 2024; McKinsey & Company, 2024; Oliver Wyman Forum, 2024). Due to the above phenomena, this research will specifically study how the technical professionals in Hong Kong to adopt GenAI in the Hong Kong construction industry to evaluate the differences with other findings and compare among other developed regions and understand the challenges to provide suggestions for improvement. The finding is important for the industry to develop a suitable adoption plan for the Hong Kong construction industry. After receiving 153 valid samples, the variables, including Perceived Usefulness, Subjective Norms, Top Management's willingness to take risks, Enhancing Customer Relationships and Competitive Pressure, were significantly related to the intention to use GenAI. The GenAI application culture, including trying to use GenAI and how much they understand GenAI was significantly related to the intention to use GenAI. Based on some situations, age groups, educational levels, managerial roles, and natures of the working company were also significantly related to the adoption of GenAI.

Keywords: Generative Artificial Intelligence (GenAI), Intention to Use, Adoption, Readiness,
Hong Kong Construction Industry, Technical Professionals

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1. Introduction

Definition of Generative Artificial Intelligence

Generative Artificial Intelligence (GenAI) has been widely used in different life aspects. Currently, the popular GenAI software, including ChatGPT-4, Bard of Google, and Copilot of Microsoft, have been adopted in different industries worldwide, for example, generating product designs through particular instruction in the Manufacturing industry and entertainment event design in the entertainment industry. The advantage is to shorten the development time and deduct manual work during the development stage. Globally, as defined by International Business Machines (IBM) Corporation (Cole & Mark, 2024), Generative Artificial Intelligence (GenAI) is a system for responds to the user's requests to generate some information, such as texts, images, videos, audio, or software codes.

1.1 Global Applications of GenAI

In 2022, the applications of ChatGPT-4 accelerated the adoption of GenAI in different industries. A McKinsey & Company Survey (2023) mentioned that the adoption of GenAI had more than doubled since 2017 and contributes US\$4.4 trillion to the global economy annually. GenAI had undoubtedly created both technical and financial impacts globally. According to the IBM AI Adoption Index (2022), AI, a branch of GenAI, adoption kept increasing at a stable pace in 2022, with more than 35 % of companies reporting using AI in their business compared to 2021. Accessibility, 44%, was the first factor driving AI adoption in the survey. More importantly, the average return on investment (ROI) of AI increased from 13% in 2022 to 31% in 2023 (IBM Institute for Business Value, 2024). In 2024, 65% of organisations reported that they regularly used GenAI, which was double the percentage compared with the survey done ten months before (Singla et al., 2024).

Hong Kong is closely connected to China where is the world's second-largest AI market behind the US (Haldane, 2024). The government also aims to develop its own ChatGTP-4 platform to

service the public, one of the GenAI tools, to keep up with the technological revolution (Yau, 2024). In the construction industry, Andriani (2023) mentioned that the usage of GenAI in terms of money increased to US\$185 million in 2023, compared to only US\$142 million in 2022.

1.2 Current Hong Kong Construction Industry's Chronic Issues

The construction project is a large-scale work in which the implementation is time-consuming and full of uncertainties. If the management is not well planned, it may lead to delays in projects. It is also a global phenomenon that occurs not only in Hong Kong (Owolabi James et al., 2014). Claims may appear if the construction project team fail to complete projects before the project completion day against the contract term. At the same time, not sufficient labour is a chronic issue in Hong Kong. According to the Construction Industry Council (2023), in 2027, there will be a 16 to 25 % labour shortage. Therefore, in 2023, construction companies were approved to import a maximum of 1200 workers to solve this issue (Chan & Kong, 2023). The Hong Kong Government and the Hong Kong Construction Industry Council have started to import labour to solve this matter afterwards. More importantly, population ageing will also affect productivity if the existing workforce gets older without substantial new blood supply to the construction industry. According to the Hong Kong Monthly Digest of Statistics 2023, the median age will be increased from 47.3 years old in 2021 to 55.5 years in 2046. Referring to the statistical highlights from the Legislative Council Secretariat (2018), 42% or 200,122 registered workers were at or above the age of 50. Based on this assumption, the average age may increase to 56 or above in 2024 given the low birth rate in recent years. Therefore, in 2018, the government started to promote more automation technologies and innovative construction methods to reduce the impact of population ageing.

1.3 Government Support of Implementing Innovative Technologies in Hong Kong

Due to the above chronic issues, Paul Chan, Financial Secretary (2024), mentioned that innovation is the key element to tackle those concerns in future. Advanced technologies can

reduce human errors, accelerate the process, reduce production costs and enhance construction site safety. Therefore, the Construction Innovation & Technology Fund (CITF), which was established by the Development Bureau (DEVB) of the Government of Hong Kong Special Administrative Region (HKSAR) in 2018 to promote the transformations of the local construction industry through advanced technologies, has been used to support the practical and innovative initiatives in the construction industry. The approval budget was HK\$1 billion in 2018. In 2012, the government injected an additional HK\$1.2 billion in the CITF. Up to 30 September 2024, 42332 projects, valued at HK\$ 1.3 billion dollars, have been approved through this Fund (Construction Industry Council, 2024). It can be concluded that the HKSAR government has provided continuous financial support to encourage the adoption of advanced technologies in construction projects.

Hong Kong's main Universities, training institutions and technology-related councils have developed advanced technology-related events, including GenAI for society (Table 2). The purpose is to equip related technical professionals with sufficient technical know-how to adopt GenAI in their workplace.

Table 2: Examples of AI-related Programmes in Hong Kong

Institution	Programme Name	Features
City University of Hong Kong, School of Continuing Professional Education	Generative Artificial Intelligence (GEN AI) Business Application	To understand the concept of GenAI and tools
Hong Kong Institute of Construction	Master Class on AI for Construction	Improve the business process through advanced computation and AI
Hong Kong Management Association	Certificate in Applying Generative AI in Occupational Safety and Health	To enhance site safety through GenAI
Hong Kong Productivity Council	Generative AI for Business Optimisation	Improve business workflows, create personalised GTP-powered Chatbots and interactive presentations
Hong Kong Institute of Information Technology	Introduction to AI and Generative AI Applications	To use AI to generate textual content, art images, text-to-video, and PowerPoint slides
HKU Space of Professional and Continuing Education	Artificial Intelligence (AI) in Built Environment in Hong Kong	To apply AI in various aspects of the built environment, such as, planning and design and smart buildings

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1.4 GenAI Programmes for Construction Projects

Industry 4.0, the fourth industrial revolution, brought several GenAI programmes (Table 3) to respond to the needs of the construction industry (Baduge et al. 2022). Up to 2022, the design and planning functions, such as BIM, was ranked the most use application in the construction industry. Construction optimisation (35%), such as Real-time monitoring (27 %), was ranked after design and planning (Andrill, 2023). Other research studies also found that Gen AI-related technologies, such as asset management in a construction project (Rampini & Cecconi, 2022), incorporating ChatGPT Model in surveying and mapping (Rane, Choudhary and Rane, 2024), cost budgeting monitoring (Parsafard, Pouyan, et al., 2024) and building structure design (Liao et al., 2024), were also implemented in the construction projects. The advantages of such technologies were to help predict problems, optimise operations, and recommend the proper solutions for a project within its learning (Pan & Zhang, 2021).

Table 3: Examples of GenAI Applications for the Construction Industry

Items	Functions
Personal Protective Equipment Detection	The model can identify the safety gear and body positions with high accuracy to prevent potential risks to the worker's behaviour. (Sunil, 2024)
Monitoring Labour Efficiency	AI-powered systems, including several cameras, can detect object movement and pose estimation, which can monitor the worker's activity in order to guess their working productivity. (Sunil, 2024)
Land Survey and Mapping	After taking several pictures of the land, the model can transform the images into 2D or 3D maps with geographic references, which can reduce the time of manual work but with higher accuracy. (Sunil, 2024).
HVAC and MEP Systems	The Model can generate efficient layouts for HVAC and MEP systems to improve space usage, energy efficiency and easy maintenance (Priyank, 2024).
Smart Inventory Management	The Gen AI model can help predict material requirements, monitor the inventory's real-time status and suggest better logistic arrangements (Priyank, 2024).

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1.5 Worldwide GenAI Application Challenges

The study from (Taiwo, Ridwan, et al, 2024) mentioned that the application of Gen AI in the construction industry, which mentioned several challenges, including 1) resistance to using new technologies, 2) lack of skills and Gen AI expertise, 3) high investment costs, 4) lack of infrastructure, and 5) ambiguous governance.

Ghimire, Kim, and Acharya (2024) have studied the advantages and difficulties of adopting GenAI in the construction industry. It required a proactive approach to security issues, safety management and governance related to employee readiness and understanding of GenAI.

To implement GenAI successfully, how to move from the honeymoon period to the execution period (McKinsey & Company, 2024) needed to be considered, including organisation support and leadership involvement (IBM, 2024), people readiness (World Economic Forum, 2024), legal issues (Shen, 2023) and awareness of technologies (Autodesk, 2024). The common challenge for an organisation to adopt GenAI is starting from a lack of experience to GenAI's misapplication and rapid pace of change (Singla et. al, 2024). The seamless integration of human work and GenAI could increase productivity (Barcaui & Monat, 2023). The current research on GenAI mainly investigated the technological advantages (Chaudhary, Vishal, et al., 2022), benefits and limitations (Lee et al., 2023), challenges and opportunities (Zhuang, Yue-ting, et al., 2017), and financial contributions (Singla et al., 2024). Singla (2024) mentioned that management should be ready to manage changes coming to the wave of GenAI, which can help enhance business effectiveness.

1.6 Problem Statement

Hong Kong is recognised as one of the developed economies in the world. The technology investment cost and benefit of developed regions were higher than those of the developing regions (Nebel, 2018; Dewan & Kraemer, 2000; Pohjola, 2000). In recent years, nearly 4000 start-ups appeared in Hong Kong in 2021. The amount of venture capital funds was HK\$41.7

billion in 2021 (Hong Kong Innovation and Technology Development Blueprint, 2022). In the Hong Kong Budget 2024-25, the Hong Kong Government will reserve HK\$24 billion to drive the technology economy (Yau, 2024) in the future. However, Hong Kong Productivity Council and HKU Business School (2024) studied GenAI industrial applications between Hong Kong itself, Singapore, New York, Switzerland, Shanghai and Shenzhen; it was found that Hong Kong was not proportionally ranked as other developed countries despite all the investment. Insufficient processing power, data and technical talent were the hurdles they mentioned. In the Global AI Index (Tortois, 2024), in terms of investment, innovation and implementation, Hong Kong was ranked 16 out of 83 regions, falling behind some developed regions, including Japan, South Korea and developing regions, including India and Indonesia. In the small items, the operating environment and government strategy of Hong Kong were only ranked 40 and 59 out of 83 regions respectively. On the other hand, the pace of technology adoption in different industries appeared inconsistent (Singla et al., 2024). Also, different positions, job titles, ages, genders and working locations also appeared to have different levels of adoption readiness for GenAI (Mckinsey & Company, 2024; Oliver Wyman Forum, 2024). Due to the above inconsistency situations, it is not reasonable to overgeneralise the GenAI adoption situations based on previous researches. Therefore, it is valuable to conduct research on the GenAI adoption of technical professionals in the Hong Kong construction industry and evaluate the GenAI adoption differences with other regions. The specific results may be found in the research for tailor-made adoption strategies in Hong Kong.

Research Question 1: What are the main determinants that influence technical professionals to adopt GenAI in the Hong Kong construction industry?

Research Question 2: What are the implications of the results of adopting GenAI in the Hong Kong construction industry?

1.7 Research Targets

Technological Professionals (TP) refer to individuals with specialised knowledge and skill sets participating in construction projects in Hong Kong (HKSAR, 2024). To adopt GenAI into the construction project, effectively minimising the resistance from technical professionals, the findings of this research may provide them with some insights into GenAI implementation for organisation management, the ways of developing easy-to-use software for software developers, and organisation management and GenAI regulations planning for policymakers.

2. Literature Review

“Intention”, “Readiness”, and “Adoption” of GenAI were the focus of this research. Research studies from ScienceDirect, ProQuest, Google Scholar, etc., were used to support the literature review. The research location is in Hong Kong. Therefore, the keyword “Hong Kong” frequently appeared. This section discusses the findings of recent research studies on GenAI applications, and the value of my research studies compared with the inconsistent findings in the past studies.

2.1 Theoretical Frameworks

Several adoption-related models have appeared in recent studies, which assist in studying individuals' readiness to adopt new technologies. In this study, the Technology, Organisation, and Environment (TOE) is the fundamental theory to support the independent variables captured from the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB), with other variables supported by past research studies and interview from the focus groups that may influence the technology adoption progress. Therefore, the research model (Figure 1) has been built based on the frameworks of TOE, TAM and TPB.

2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), created by Fred Davis (1989), is one of the popular models for studying technology acceptance. Due to the popularity of personal computers, research studies on technology acceptance became critical to new technology implementation in the 1980s. TAM's objective is to measure the individual's behaviour in using technology and provide direction for the successful implementation of technology (Marikyan & Papagiannidis, 2023). TAM highlights two major determinants: Perceived Usefulness and Perceived Ease of Use. Perceived Usefulness was defined as how individuals perceive that given technologies could help enhance performance. Perceived Ease of Use was defined as how individuals perceive the less effort for using given technologies. Davis (1989) found that the feasibility of technology has a strong relationship to the Perceived Usefulness of the technology. Both determinants influenced the individual's attitude toward using technology, which were the affective perceptions towards the technology (Davis, 1993).

TAM was frequently used to study the adoption attitudes of new technologies in the past research studies, such as the adoption of digital technology in education (Scherer et al., 2019), the adoption of software measures for software engineers (Wallance & Sheetz, 2014), the adoption of Information and Communication Technology (ICT) in the US construction industry (Source & Issa, 2021), digital banking adoption (Alnemer, 2022) and the adoption of blockchain used smart contracts (Chaveesuk et al., 2020). They showed a significant relationship with the intention of using technology. However, Ajibade (2018) mentioned that only TAM, only two variables, were not enough to describe the entire technology adoption process, including the social influence and the company's regulations on adopting technologies. So, to supplement this limitation, other theoretical frameworks will also be used in this study.

2.3 Theory of Planned Behaviour (TPB)

The theory of Planned Behaviour (TPB), created by Ajzen (1985) in 1985, is a cognitive theory that explains how individuals engage in particular behaviours and what kinds of determinants could drive those behaviours (Ajzen, 1991). TPB highlights three determinants: 1) Subjective Norm, 2) Attitudes, and 3) Perceived Behavioural Control. Subjective Norm refers to how the individual's perception is influenced by other's attitudes, such as family, friends, and colleagues, towards behaviours. Personal Attitudes refer to how the individual's attitude interprets particular behaviours, whether it is positive or negative. It was similar to the concepts of Perceived usefulness and perceived Ease of Use from TAM (Wong et al., 2024). Perceived Behavioral Control refers to how individuals believe they can control their behaviours by internal factors, including self-ability, and external factors, including support from others. Ajzen (1985) emphasised that successful behavioural changes shall depend on the controllability of individuals supported by internal and external factors.

TPB has always been applied to study the adoption of new behaviours in recent years, including the acceptance of residents using desalinated water in China (Lili et al., 2021), behavioural intentions of using public transport in Japan (Ali et al., 2023) and AI-related technologies adoption (Ivanov et al., 2024; Sanusi et al., 2024).

2.4 Technology, Organisation and Environment (TOE)

The Technology-Organisation Environmental (TOE) framework was created by Tornatzky and Fleisher (1990). It emphasised that successful technological innovations should involve many activities, not just self-interest focus. This framework contains Technological Context (TC), Environmental Context (EC), and Organisational Context (OC), an organisational perspective theory used to study technology adoption. Technological context refers to technology's readiness for use in the company. Organisational Context refers to the resources and structures of the company, such as company size, company structures and related regulations. (Baker,

2012). TOE has currently applied to study the organisation-wide technology adoption, including online retailing utilisation in digital transformation (Nguyen et al., 2022), adoption of AI in the insurance industry (Gupta, Somya et al., 2022) and cloud-based technology adoption (Al Hadwer, 2021; Ali, et al., 2021). TOE was an easy-to-adopt framework in which researchers can easily measure each context by related adoption determinants (Baker, 2012). TOE was usually a skeleton for the research model when extending with other adoption models (Bryan & Zuva, 2021).

Integrated models diversified and strengthened research foundations and structures (Awa et al., 2015). In previous researches, TOE was already integrated with TAM and TPB to study the adoption of specific technologies (Table 4) according to the particular environment, target group, and technologies. Therefore, it is valuable to use the integrated models of TAM, TPB, and TOE to study the adoption of GenAI in the Hong Kong construction industry. The result is a key indicator for creating an implementation plan.

Table 4: Previous Studies of Technologies Adoptions integrating with either TAM, TPB or TOE

Technologies to be investigated	Included Models	Independent Variables	References
Building Information Modeling	TAM-TOE Model	Technological Context	(Qin, Xuan et al., 2020)
		Organisational Context	
		Environmental Context	
		Economic Context (Suggested by the researcher)	
		Perceived Ease of Use	
		Perceived Usefulness	
AI-Based Technologies in Construction Firms	TAM-TOB Model	Technological Context	(Na, et al., 2022)
		Organizational Context	
		Environmental Context	
		Personal Context (Suggested by the researcher)	
		Perceived Ease of Use	
		Perceived Usefulness	
E-commerce Adoption in SMEs	TAM-TPB and TOE	Technological Context: Perceived Usefulness Perceived Ease to Use Perceived Behavioural Control Perceived Service Quality (Suggested by the researcher)	(Awa, Ojiabo., & Emecheta, 2015)
		Organisation Context: Scope of Business Operations Firm's size	

		Organisation Mission Facilitating Conditions Individual Difference Factors Social Influence or Subjective Norms	
		Environment Context: Consumer Readiness Competitive Pressure Trading Partner Readiness Perceived Trust	
Precast Concrete Components in Building Construction	TAM-TOE Model	Technological Context: Perceived Risk Compatibility	(Katebi, Homami & Najmeddin, 2022)
		Environmental Context: Competitive Pressure Government Support	
		Organisational Context: Cost Organisational Readiness	
		Perceived Usefulness	
		Perceived Ease of Use	
Digital Marketing Adoption	TAM-TPB Model	TAM: Perceived Usefulness Perceived Ease of Use	(Abbas & Mehmood, 2021)
		TPB: Attitude towards Digital Marketing Subjective Norms Perceived Behaviour Control	
Environment Management Practices	TPB-TOE Model	Technological Context: Relative advantage Compatibility Complexity	(bin Ibrahim & binti Jaafar, 2016)
		Organisational Context: Organisational support Quality of human resources Company size	
		Environmental Context: Customer pressure Regulatory pressure Governmental support Environmental uncertainty	
		Behavioural attitudes: Environmental attitude	
		Subjective norms: General Awareness	
		Perceived Behavioural Control: Cost benefits attitude	

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2.5 Propositions Expanding TAM, TPB and TOE Frameworks

Investment in GenAI required a high software development and maintenance cost (Research dive, 2021). Therefore, to ensure effective use of the resources, studying the intention to use (Hsu, Lu & Hsu, 2007) is necessary for adopting technology.

TAM was an important model for studying individual attitudes to technology readiness, which highly determines the successful rate of new technology implementation (Rajak & Shaw, 2021).

TPB focused on the factors affecting their behaviours to new initiatives (Kuhl & Beckmann,

2012). After embedding TAM, TPB, and other determinants into the TOE model, the integrated model may help comprehensively investigate the adoption of GenAI in the Hong Kong construction industry through technological readiness, organisation readiness, and environmental support.

2.6 Technological Context

Technological context is the technological features, functions, and specifications of the potential technology being adopted. However, the adoptive ability or technology acceptance (Perceived Usefulness (PU) and Perceived Ease of Use (PEU) (Karahanna & Straub, 1999) of individuals was critical for the technology application (Webster & Gardner, 2019). The technology is useless if users resist using it. Furthermore, the individual capability to adopt new technologies is also important to behavioural changes. Therefore, Perceived Usefulness, Perceived Ease of Use and Perceived Behavioral Control are included in the technological context in the research.

2.6.1 Perceived Usefulness (PU)

Perceived Usefulness (PU) is the degree to which people assume that the technology is useful for them. Recent research studies have shown that PU is commonly used to measure the adoption of new technologies (Sugandini, et al., 2018), including using blockchain in the construction industry (Chaveesuk et al., 2020), e-learning adoption (AI-Gahtanbi, 2016), and web-based learning systems (Calisir et al., 2014), showing significant relationship to the intention to use. However, in the study of Zhang et al. (2022), Tahar, et al. (2022) found that PU did not influence the intention to use directly. Due to the above inconsistent findings, PU has been studied in this research to understand the influence of PU on the adoption of GenAI in this research.

H1: Perceived Usefulness has a significant positive relationship with using GenAI in the Hong Kong Construction Industry.

2.6.2 Perceived Ease of Use (PEU)

Easy-to-use is a consideration for individuals when adopting new technologies. Several research studies found that PEU had a significant relationship to the intent to use in the technology adoption (Scherer, Siddiq, and Tondeur, 2019; Alnemer, 2022; Moslehpour. et al.,2018). However, Kahar, Wardi, and Patrisia (2019) found that PEU has no significant effect on repurchase intention at tokopedia.com, which is an online purchase platform. Due to the above inconsistent findings, PEU has been studied in this research to understand the influence of PEU on the adoption of GenAI in this research.

H2: Perceived Ease of Use has a significant positive relationship of adopting GenAI in the Hong Kong Construction Industry.

2.6.3 Perceived Behavioural Control (PBC)

Perceived Behavioural Control (PBC) is defined as the controllability of the individual to a particular behaviour. In past research studies, PBC was found to have a significant relationship in behavioural modifications, such as physical exercise promotion (Hagger, Martin et al., 2022; Elie-Dit-Cosaque et al., 2011). However, PBC was found not significant to the intention to use by education level founded by White, Al-Gahtani & Hubona (2007). Due to the above inconsistent findings, PBC has been studied in this research to understand the influence of PBC on the adoption of GenAI in this research.

H3: Perceived Behavioural Control (PBC) has a significant positive relationship with adopting GenAI in the Hong Kong Construction Industry.

2.7 Organisational Context

To implement technology successfully, organisational support, cultural atmosphere, and resources influenced the result of technology adoption (Lokuge et al., 2019). Management involvement was a core determinant of technology adoption (Crişan, & Stanca, 2021). Apart from compensation benefit, a supportive working environment also attracts GenAI talent (McKinsey & Company, 2024). Less support from decision-makers might discourage the intention to use in an organisation (Bolpagni & Bartoletti, 2021).

2.7.1 Organisational Readiness (OR)

Organisational preparation, including staff readiness, process readiness, and structure readiness, played a critical role in technology adoption (Snyder-Halpern, 2001; Williams, 2011). Organisation Readiness was also found a significant relationship to use by Halpern, et al., 2021; Su, Zhang & Wu (2023). However, Ngah, et al. (2022) found that organisation readiness was no significant to the adoption to use. Due to the above inconsistent findings, OR has been studied in this research to understand the influence of OR on the adoption of GenAI in this research.

H4: Organisation Readiness (OR) has a significant positive relationship with adopting GenAI in the Hong Kong Construction Industry.

2.7.2 Subjective Norms (SN)

Subjective Norms refers to how individuals think about the opinions of people who are important to them regarding their newly adopted behaviour (Ajzen, 1991). Some research studies found that Subjective Norms (SN), opinions from others, were rather highly ranked than other norms and influenced other determinants (Finlay, 2000; Schepers & Wetzels, 2007). However, Danurdoro and Wulandari (2016) found that SN was insignificant in influencing the adoption of internal banking for students. Chen & Li (2010) also found SN was no significant

to the consumer adoption of E-service. Due to the above inconsistent findings, SN has been studied in this research to understand the influence of SN on the adoption of GenAI in this research.

H5: Subjective Norms have a significant positive relationship with adopting GenAI in the Hong Kong Construction Industry.

2.7.3 Top Management Support (TMS)

Al Hadwer et al. (2021) research showed that top management support for adopting new technology in a company is high and significant. In 2024, 51% of top management hired Gen AI-related positions, which didn't exist in 2023 (IBM Institute for Business Value, 2024). The involvement level of top management influenced the success or failure of the initiatives (Young & Jordan, 2008; Dasgupta & Wendler, 2019). However, the support of top management was not significant in the research done by Gutierrez, Boukrami, E & Lumsden (2015). Due to the above inconsistent findings, TMS has been studied in this research to understand the influence of TMS on the adoption of GenAI in this research.

H6: Top management support has a significant positive relationship with adopting GenAI in the Hong Kong Construction Industry.

2.8 Environmental Context

The environmental trend forces the company to adopt potential technologies, which were already well accepted by the market, including customer readiness and Competitive Pressure. ChatGPT-4, one of the GenAI tools, might help create customer care and answer customer questions immediately, which helps reduce negative emotions during the waiting time (Aydin & Karaarslan, 2023). In past research, environmental readiness was shown to have a sufficient relationship to technology adoption (Ramafalo, 2019; Dai et al., 2018).

2.8.1 Consumer Readiness (CR)

Customers' readiness refers to the perceived attitudes of an organisation using the technology. Past research studies found that no matter consumer readiness (Nugroho et al., 2017), customer relationship (Xuqian et al., 2024) and their perception (Demirci & Ersoy, 2008) influenced the intention to adopt new technologies. The usefulness of GenAI, reducing repetitive work procedures and responding to questions quickly, helped improve the satisfaction rate of employees in the workplace (Brynjolfsson, Li and Raymond, 2023). However, Kandil, et al (2018) found that trading parents' readiness had no significant relationship to the adoption of EPR. Due to the above inconsistent findings, CR has been studied in this research to understand the influence of CR on the adoption of GenAI in this research.

H7: Consumer Readiness (CR) has a significant positive relationship with adopting GenAI in the Hong Kong Construction Industry.

2.8.2 Competitive Pressure (CP)

Competitive Pressure (CP) means that competitive circumstances influence an organisation to adopt new technologies (Lertwongsatien & Wongpinunwatana, 2003). More Executives believed that they needed to adopt GenAI quicker than their competitors, from 38% in 2023 to 77% in 2024 (IBM Instituitues for Business Value, 2024). The market competition intensifies the pace of an organisation driving innovative technologies (Benito, Pilar, et al., 2015). Also, the market effect with a strong competitive situation influences the speed of adopting new technologies (Majumdar & Venkataraman,1993; Gupta, Ruchi, et al., 2024). However, competitive pressure was insignificant to GenAI adoption in the Jordanian retailing industry (Wael AL-khatib, 2023). Due to the above inconsistent findings, CP has been studied in this research to understand the influence of CP on the adoption of GenAI.

H8: Competitive Pressure (CP) has a significant positive relationship with adopting GenAI in the Hong Kong Construction Industry.

2.9. Demographic factors

2.9.1 Gender

Previous research studies found that different genders had different concerns about adopting GenAI. A study from Venkatesh, Viswanath, et al. (2023) found that men focused on performance expectancy, and women focused more on effort expectancy. However, other researches found that women tended to delay their adoption of new technologies (Draxler, Fiona, et al. 2013). However, Li, Glass, and Records (2008) found there was no significant difference in gender in the adoption of new technologies. Due to the above inconsistent findings, gender has been studied in this research to understand the influence of gender differences on the adoption of GenAI.

H9: Gender differences have a significant relationship with adopting GenAI in the Hong Kong construction industry.

2.9.2 Age Groups

Previous research studies found that the age differences influence technology adoption. Morris and Venkatesh (2000) found that older individuals were more influenced by subjective norms and perceived behavioural control when adopting new technology. On the other hand, the attitudes of younger individuals were more noticeable than older individuals when adopting new technologies. Other updated researches also found that younger individuals tended to adopt new technologies easily (Draxler, Fiona, et al., 2023; Alnemer, 2022). However, Nayanajith & Damunupola (2019) found that age did not significantly influence the adoption of internal banking. Due to the above inconsistent findings, age has been studied in this research to understand the influence of age differences on the adoption of GenAI.

H10: Age differences have a significant relationship with adopting GenAI in the Hong Kong construction industry.

2.9.3 Working Positions

Individuals with different positions appeared to have different opinions about using technologies in safety training (Zhang et al., 2022). Kuciapski (2019) studied the adoption of technology acceptance in using mobile technology to transfer knowledge by job positions. Inconsistent results appeared for each variable in this study. Due to the above inconsistent findings, working position has been studied in this research to understand the influence of job positions on the adoption of GenAI.

H11: Job positions have a significant relationship with adopting GenAI in the Hong Kong construction industry.

2.9.4 Working Experience

Cafiero (2013) found that there was no significant relationship between the working experience and the use of Health Literacy Strategies. However, Faham and Asghari found using e-books was difficult for individuals with more work experience. Working experience had a significant relationship with perceived ease of use (Faham & Asghari, 2019). Due to the above inconsistent findings, working experience has been studied in this research to understand the influence of working experience on the adoption of GenAI.

H12: Working experience has a significant relationship with adopting GenAI in the Hong Kong construction industry.

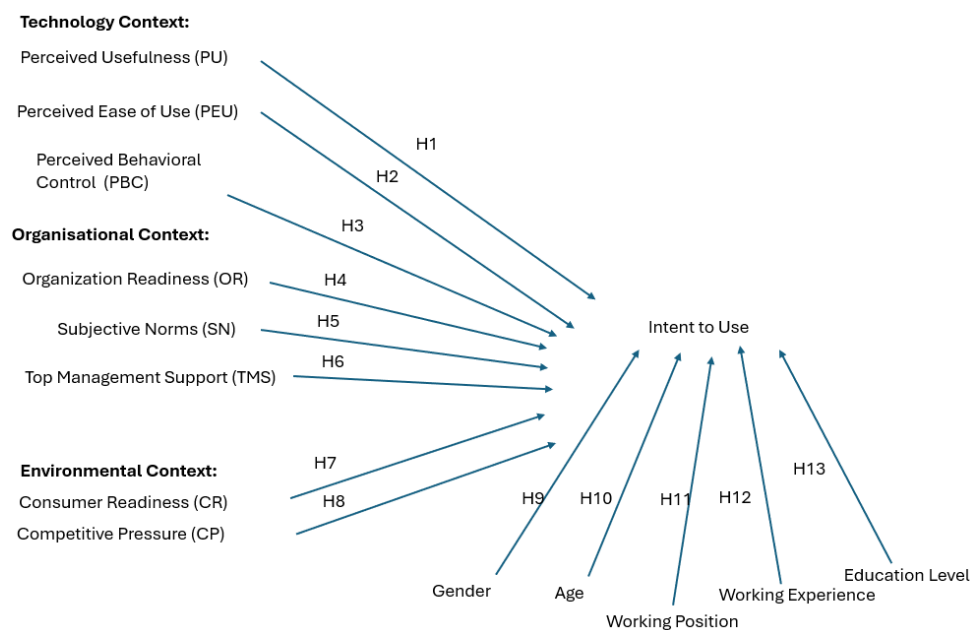
2.9.5 Education Levels

Individuals with tertiary or higher level of education were willing to adopt technologies in their workplace (Alnemer, 2022). Individuals with high levels tended to adopt ERP systems (Gumussoy, Calisir & Bayram, 2007). However, White, Al-Gahtani, and Hubona (2007) found that individuals with higher education levels have a negative significance with PBC on

intention to use. Due to the above inconsistent findings, education level has been studied to understand the influence of education level on the adoption of GenAI.

H13: Education level has a significant relationship with adopting GenAI in the Hong Kong construction industry.

Figure 1: Research Model: Independent Variables (PU, PEU, PBC, OR, SN, TMS, CR, and CP) against dependent variables (ITU)



Created by the Author

3 Research Methodology

The triangulation approach was used in this research. Literature, qualitative methodology and quantitative methodology were included, which is a level 1 in the evidence hierarchy (Table 5).

Table 5: Hierarchy of Evidence

Level	Descriptions & Features	Limitations
1	Generalisable studies Literature Review Qualitative Studies Quantitative Studies	Word Limitation due to not allowing Comprehensive Reporting
2	Conceptual studies Theoretical Studies	Only limited to the conceptual studies, fewer case studies
3	Descriptive studies Practical experience studies	Less of theoretical support for the studies
4	Single case study Focus on one person's experience	Fail to apply to the general situation

Source: Daly, et al. 2007

3.1 Importance of Literature Review

Literature Review is critical when doing empirical research (Snyder, 2019). It provides an entire picture, research findings, and impacts of the existing studies. The concrete and precise literature reviews can clearly provide a strong theoretical foundation and research gap. Literature reviews can address the research question soundly, using different past research studies. More importantly, it can help remove the subjective bias (Cooper, et. At., 2018). The suitable sources shall come from academic journals, academic books, and government publications (Denney & Tewksbury, 2013).

3.2 Qualitative Methodology

The qualitative methodology helps create more in-depth experience insights into the research and questionnaire design. Open-ended interviews and focus groups are always-used channels for conducting conversations with industrial experts and end users (Mohajan, 2018). It helps understand the human behaviours, experiences, perceptions and motivation of the participants regarding the research topic.

3.3 Focus Groups

Focus groups have been used. The most common purpose of the focus group is to explore a topic deeply that can't be found by the quantitative methodology. Therefore, a focus group can compensate for the weakness of quantitative methodology. Nyumba & Tobias et al. (2018) investigated 170 articles between 1996 and 2017, in which the number of participants of the focus group was in the range of 3 to 20 participants, with a median of 10 participants. The duration was 90 minutes.

To align with the above findings, 10 participants have been suggested for an end-user group. However, due to the tight schedule of participants, a 60-minute session was addressed for this focus group. On the other hand, 2 technological expert interviews related to GenAI were arranged for this research.

Table 6: Suggested Questions for an end-user group

	Related Areas	Questions	References
Technology Context	Perceived Usefulness (PU)	How can GenAI benefit your work?	(Nugroho, et al., 2017)
	Perceived Ease of Use (PEU)	Tell me your experience when using GenAI in your work	(Nugroho, et al., 2017)
	Perceived Behavioural Control (PBC)	Tell me how much you grasp the functions of GenAI in your work.	(Nugroho, et al., 2017)
Organisational Context	Organisation Readiness (OR)	Tell me how your organisation supports the adoption of GenAI in your work.	Nugroho, Mahendra Adhi, et al. (2017)
	Subjective Norms (SN)	Tell me what your peers' comments are about the adoption of GenAI.	Nugroho, Mahendra Adhi, et al. (2017)
	Top Management Support (TMS)	Did our top management give GenAI the top priority?	(Dai, Chan & Yee, 2018)
Environmental Context	Customer Readiness (CR)	Did your main client expect us to use GenAI to manage the project?	(Dai, Chan & Yee, 2018)
	Competitive Pressure (CP)	Did your competitors adopt GenAI technology that the customer has already appreciated?	(Dai, Chan & Yee, 2018)

Created by the Author

3.4 Quantitative Methodology

Goundar (2012) mentioned that quantitative methodology can provide statistical impacts to the research result. The results are usually used to imply the target population. Choy (2014) indicated that the advantage is the high reliability of the results by comprehensive analytic processes can consolidate different findings by the collected data.

3.4.1 Sampling Techniques – Snowball Sampling

Sampling techniques can be divided into probability sampling and non-probability sampling. Probability sampling is a random sampling in which every individual in the target population has an equal opportunity to be included in the research. Non-probability sampling is a non-random sampling in which respondents are not selected randomly but limits the target criteria (Taherdoost, 2016). Snowball sampling, which is one of the non-probability sampling was

selected in this research to fit real-life accessibility. This method was the most effective when the target population was not easy to reach; the researcher could find a group of suitable respondents first, and after gathering their data, they could recommend individuals with similar backgrounds to study (Naderifar et al., 2017).

3.4.2 Target Population

The target population includes technical professionals with specialised knowledge and skillsets related to planning, designing and managing construction projects in Hong Kong. Therefore, to decide the sufficient sample size for the research, table 7 showing the number of employees in the past 10 years in the construction industry has been listed below for further calculation:

Table 7: Construction Industry Employee Distribution from 2013-2023 (Number' 000)

Years	Number of employees
2013	270.8
2014	270.7
2015	288
2016	295.7
2017	309.1
2018	319.1
2019	304.6
2020	269.3
2021	284.6
2022	287.5
2023	303

Source: Census and Statistics Department, HKSAR, 2024

Figure 2: Chart for Table 7

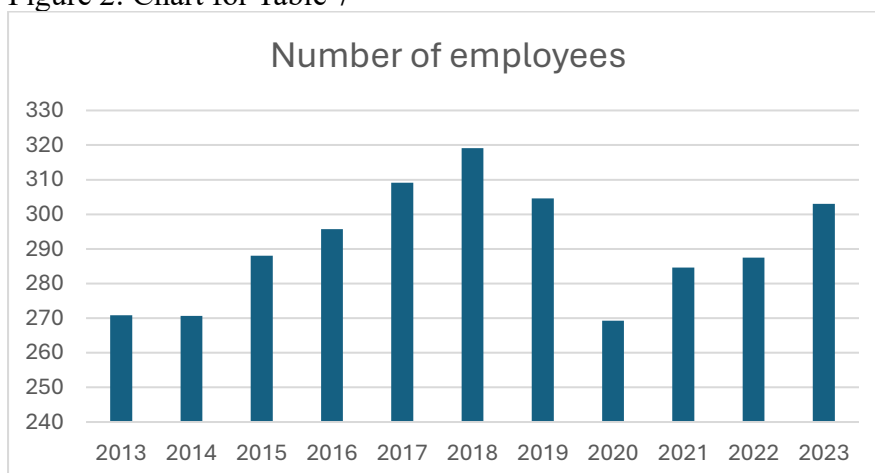


Table 8: Descriptive Statistics for Table 7

Items	Results
Means	293.16
Median	291.85
Standard Deviation	16.23
Minimum (2020)	269.3
Maximum (2018)	319.1

Consolidated by the Author

3.4.3 Sample Size Calculations

Several sample size calculations are suggested for the quantitative methodology, including Cochran's Samples Size Formula, Sample Size for Prevalence Studies and Sample size for Regression Analysis. Their applications may be suitable for different research designs. The sample size for regression analysis will be adopted in this research study.

Green (1991) proposed $N \geq 50 + 8M$ to calculate the sample size for the coefficient of dependent variables. M represents the number of dependent variables for the research. For example, if 8 dependent variables appear in this research, the sample size will be $50 + 8(8) = 114$. Meanwhile, Sudman (1976) mentioned that the minimum sample size shall be at least 100. Due to the data collection situation and limitations, Green's suggestion of 114 samples has been adapted in this research.

3.4.4 Questionnaire Design

This questionnaire contained three parts: 1) Understanding Professional Information, 2) Perception of Adopting GenAI into your work, and 3) Demographic Data. Part 1 was about understanding the professional information of the respondents, such as professional areas, working experience related to the construction industry, the nature of their working company, the size of their working company, the number of their subordinates, etc., The purpose is to understand how that information may affect the adoption behaviours of GenAI. Part 2 was about the perception of respondents about the 8 independent variables and 1 dependent variable. Each variable contains 3-4 questions. The questions related to the same variables were grouped

together, which could help facilitate the respondent's cognitive processing with consistent logic (Krosnick, 2018). To consider the comprehension ability of the respondents, the length of each question was between 16-20 words (Lietz, 2010). Part 3 was about the demographic data of the respondents. Those data may show the differences of specific groups (Ray, 2020). The demographic data may help show which groups are more or less ready to adopt GenAI in the construction industry.

The scale direction is also one of factors affecting the result. Yan, Keusch, and He (2018) found that the scale direction, including "High to Low" or "Low to High", influenced response results. They found that most respondents chose from the options when they appeared first, 46%, more than when they appeared later, 43.5 %. Being supported by this finding, the scale direction of this research was "high to low". Selecting different points of scale is another consideration for this research. From the previous research on this matter, Taherdoost (2019) suggested that either a 7-point scale or a 6-point scale would be suitable for the research. Since a 7-point scale may appear to centralise tendency, a 6-point is suitable. So, a 6-point "High to Low" scale has been used in this research.

3.4.5 Data Analytic Tools

Descriptive statistical analysis plays a core role in research by helping researchers understand and describe the collected data. It provides the result of the research in the later part of the data analysis (Johnson, 2014). Mean, mode, median, variance, and standard deviation are used to describe the data collected from this research.

Inferential statistics is also used in this research to analyse the data comprehensively. Its function was to conclude according to the analysis of the given data set (Sutanapong & Louangrath, 2015). The confidence level, P-value, and Z-score, which are critical factors affecting the data interpretation, are defined below. Reliability analysis, correlation analysis,

factor analysis, and regression analysis are used to obtain this result. They are essential for making recommendations based on the findings.

3.4.6 Confidence Interval: 95%,

A Confidence Interval (CI) is a standard part of the qualitative results of the research. It can be used to measure the precision of the sample result as an estimate of the target population value. 90%, 95%, and 99% CI were adopted in the past research studies. A 95% CI was well enough to be used in the research study, which contains the true population value (Altman, 2005).

3.4.7 P-Value: 0.05

The P-value is 0.05, and the CI is 95%. The importance of the P-value is used to reject the null hypothesis (Figueiredo et al. et al., 2013). If the P-value is less than 0.05, the null hypothesis can be rejected, which means the hypothesis can be accepted.

3.4.8 Z-score (Standard Score): 1.96

The function of the Z score is to measure how the standard deviations of the data input are away from the mean of the overall data (Andrade, 2021). The Z-score will be 1.96 if the CI is 95%, which means allowing 1.96 deviations from the overall mean.

3.5 Reliability Analysis

Cronbach's alpha value, which was at least 0.7 (Hussey, et al., 2023), is used to measure the reliability of respondent data. The purpose is to ensure the consistency of the returned data for each variable. The range of Cronbach's Alpha is 0 to 1. Generally speaking, the higher Cronbach's alpha appears the higher reliability of the result will be. In this research, Cronbach's alpha value between 0.6 and 0.7 has been accepted to measure the consistency of responses of each independent variable under the sub-categories (Uraschi, Hordnic & Zait, 2015).

3.6 Correlation Analysis

Correlation analysis measures the association between two variables. Pearson's correlation is commonly used to measure the strength of linear association between two variables (Sedgwick,2012). Table 9 indicates different levels of correlation, as shown in the table below. It helps predict each factor according to the correlation indicators.

Table 9: Different levels of correlation

Range	Interpretation
0.00-0.10	Negligible Correlation
0.10-0.39	Weak Correlation
0.40-0.69	Moderate Correlation
0.70-0.89	Strong Correlation
0.90-1.00	Very Strong Correlation

Source: Schober, Boer & Schwarte, 2018

3.7 Principal Component Analysis (PCA)

PCA is a statistical technique that integrates highly related factors into a component and assesses its importance. It helped to process the regression analysis afterwards (Shresthan, 2021). In this research, Kaiser-Meyer-Olkin (KMO) measurements from 0 to 1 have been used to measure the adequacy of the sampling. Between 0.8 and 1, it means that the sampling is adequate (Table 10). To determine which factors shall be retained, with the support from Williams, Onsman, A & Brown (2010), eigenvalues greater than 1, Karer's criteria has been accepted. According to the finding from Amin, Saas & Lajis (2022), the loading score of each variable higher than 0.5 has been accepted.

Table 10: Measurement of KMO

Indicator	Interpretation
0.8 to 1	Adequate
0.7-0.79	Middle
0.6-0.69	Mediocre
>0.6	Not Adequate

Source: Shresthan, 2021

3.8 Linear Regression Analysis

Linear regression is a statistical procedure to calculate the causal relationship between independent and dependent variables (Kumari & Yadav, 2018). It helps find the best-fitting straight line between the measured variables, whether statistically significant or not. Analysis of variance (ANOVA) is used to test for the significance of the model (Marill, 2004). The P-value should be less than 0.05. Multiple Comparison Test by Tukey (HSD) was the most common and popular technique in regression analysis (Nanda, Anita, et al., 2021). However, multicollinearity may occur when several variables are statistically significant not only with the dependent variables but also with independent variables (Shrestha, 2020). The result may be influenced if the Variance Inflation Factor (VIF) is too high (Table 10). If VIF exceeds 10, multicollinearity may appear (Kumari, 2008).

Table 11: Measurement of VIF

Indicator	Interpretation
1	There is no correlation between each independent variable.
>1 to <5	There is a moderate correlation between each independent variable.
>5 to 10	There is multicollinearity among each variable

Source: Shrestha, 2020

3.9 Independent T-test and One-way ANOVA

An Independent T-test and One-way ANOVA have been used in the data analysis process to find the correlation between demographic data and different variables. An Independent T-test has been used to analyse only the independent variable with two sub-categories, such as gender (Male and Female) with the dependent variable, a simple regression analysis. However, if the independent variable includes more than two sub-categories and two independent variables, such as different age groups, need to be measured, One-way ANOVA has been used to measure their cross-correlation within the dependent variable.

4 Results

4.1 Qualitative Findings

To grasp comprehensive feedback about the gap in adopting GenAI in the construction industry. 3 sessions of interview were arranged to collect different perspectives: 1) 10-potential-user interviews, 2) large-scale company - MTR representative interview and 3) Solution provider – AWS representative interview.

4.1.1 10-Potential-User Interview

Due to limited networks and tight schedules, the positions of those interviewees were mainly engineering staff from ATAL Engineering Group, ranging from Engineer to Senior Project Manager. To summarise, the findings of this interview, Perceive Usefulness and Perceive Ease of Use, were their focuses, for example, how GenAI could assist them in preparing the tender presentation, including cost estimation, PowerPoint design, and content restructuring. Meanwhile, reducing their time, increasing accuracy and meeting the supervisor's requirements also attracted them to adopt GenAI in their work. However, Customer Readiness and Competitive Pressure were the push factors that force them to use GenAI.

4.1.2. Large-scale Company - MTR Representative Interview

The interviewee was Ir Prof. Lawrence Poon, Head of Emerging Technology, Global Innovation from The MTR Corporation. He is responsible for promoting new technology initiatives in MTR. Playing a senior management role, he mentioned that adopting GenAI in the construction industry is market-driven, and we are led by the market trend, which may be Customer Readiness (CR) and Competitive Pressure (CP), two of the IDs in this research. If we cannot follow it, we will soon be excluded from the market. Of course, the management should consider some initiatives that may assist our frontline staff in adopting them smoothly, The “No Pain” experience is very important for beginners when adopting new technologies in the workplace. On the other hand, adopting new technologies should create a positive

experience, indicating how it can be helpful in the job. For example, one of the duties of a secretary is to prepare minutes after the meeting. They will consider using TEAMS in Microsoft if they learn that GenAI functions can automatically record meeting notes (Velush, 2024), reducing their workloads. They should experience the advantage of the new technology, not the complex user manual, aligning with one of the IDs, Perceived Ease to Use (PEU). On the other hand, peer encouragement is an important motivator for elder colleagues. Younger colleagues can help them adopt new technologies in their workplace, matching with one of the IDs, Subjective Norms (SN). Finally, the involvement of top management is a compass to achieve success in implementing new technologies. If key performance indicators (KPIs) are necessary, they should be soft KPIs that encourage usage but not punish failed users.

4.1.3. Technology Solution Provider – AWS Hong Kong interview

The second interviewee was Mr. Jay Fong, a Business Development Manager from AWS. He highlighted that driving the applications of GenAI should be business driven. The company shall study the current GenAI application situation in the construction industry, e.g., customer readiness, competitor practice and investment cost. Otherwise, its implementation cost and return on investment cannot be obtained by the top management. Therefore, CR and CP should be the main drivers in promoting GenAI in the company. After determining the market trend, top management support (TMS) is another important factor in driving GenAI application in the company. For example, showing their encouragement rather than result-focus at the beginning stage. The last but critical stage is to promote the advantages of using GenAI to colleagues. As a solution provider, Jay mentioned that AWS DeepRacer (AWS, 2024), a relaxing and fun game competition, is an intervention point to promote the easy-to-use and easy-to-learn concepts of the GenAI applications. Its purpose is to reduce the psychological resistance of colleagues at the beginning stage.

4.2 Quantitative Findings

4.2.1 Population and Sample Distribution

The IBM SPSS version 22 statistical package was used for data analysis of this research. A total of 153 valid questionnaires were collected using the snowball sampling method. Table 12 shows the characteristics of the collected sample. The population of the sample consisted of 127 males and 26 females, which was almost similar to the current gender ratio in the industry, with 12% of females in the construction workforce (Statista, 2024). For the age group distribution, the age groups of “35 to 44” received 36 responses, the highest group in this research. The second highest was “45 to 54”, 9.8%. The lowest group was 65 or above, 3.9 %. For the education level, most samples were at the undergraduate level, 46.4%. The second highest was the post-graduate level, at 44.%. The lowest one was secondary school level, at 7.7 %. For the working experience, 51 % of the respondents obtained 16 years of working experience or above, 16.3 % from 5 years or below, 17% from 6 to 10 years, and 15.7% from 11 to 15 years. Besides that, 73.9 % of the respondents played in a managerial role.

For the nature of the working company, most respondents were contractors, 56.2%, 20.3% from suppliers, 13.7% from consultants, 5.9 % from developers and 3.9% from government departments. After that, 86.9 % of the respondents came from a company with 51 or more employees, 7.8 % from a company with 11 to 50, and 5.2% from a company with less or equal to 10.

To understand the current technology applications which may influence the later GenAI adoption, 56.2% of respondents mentioned that over 50% of their work adopts technologies. Another 43.8% of respondents mentioned that their work only includes 50% or below technology applications. Also, 20.3% of respondents mentioned that they never tried to use GenAI at work. 10.5% of the respondents mentioned that they always tried to use GenAI at work. The other respondents, 69.2%, also tried to use GenAI. For the score of understanding

GenAI, 83.6% of the respondents, including Slightly Agree, Agree, and strongly Agree, mentioned that they agreed that they understood GenAI. 16.4% of respondents, including Slightly Disagree, Disagree, and Strongly Disagree, mentioned that they disagreed with their understanding of GenAI.

Table 12: Sample's Characteristics (n=153)

Respondents		Frequency	Percentage
Gender	Male	127	83
	Female	26	17
Age Group	25 or Below	14	9.2
	26-34	32	20.9
	35-44	36	23.5
	45-54	33	21.6
	55-64	32	20.9
	65 or above	6	3.9
Highest Education Level	Secondary School Level	14	9.2
	Undergraduate Level	71	46.4
	Post-Graduate Level	68	44.4
Professional Area	Consultant	19	12.4
	Engineer	93	60.8
	Surveyor	8	5.2
	Supporting Staff	21	13.7
	Technical Staff	12	7.8
Working Experience	5 Years or Below	25	16.3
	6 Years to 10 Years	26	17
	11 Years to 15 Years	24	15.7
	16 Years or Above	78	51
Managerial Role	Yes	113	73.9
	No	40	26.1
Total Number of Employees of the Working Company	Less than or equal to 10	8	5.2
	11 to 50	12	7.8
	51 or above	133	86.9

Nature of your working company	Consultant	21	13.7
	Contractor	86	56.2
	Developer	9	5.9
	Government	6	3.9
	Supplier	31	20.3
Percentage of Adopting Technologies in Work	25% or below	37	24.2
	26% - 50%	30	19.6
	51% - 75%	35	22.9
	75%-100%	51	33.3
Trying to adopt GenAI	Never	31	20.3
	Seldom	35	22.9
	Sometimes	50	32.7
	Usually	21	13.7
	Always	16	10.5
Understanding the functions of Gen AI	Strongly Agree	15	9.8
	Agree	68	44.4
	Slightly Agree	45	29.4
	Slightly Disagree	8	5.2
	Disagree	11	7.2
	Strongly Disagree	6	3.9

4.3 Reliability Analysis

Reliability analysis is used to test the consistency and stability of the collected data (Hussey, et al., 2023). The reliability analysis was conducted three times in this research, twice for the pilot tests and once for the formal data collection. Two pilot tests were conducted for this survey, and the sample size was higher than Browne's (1995) suggestion of 30. The first test failed because the Cronbach's Alpha of three variables, CR, CP, and ITU, was lower than 0.7 (Table 12). After the first pilot test, the questions for these variables were reviewed. Some questions tended to be negative. Respondents might take longer to process it and make a mistake easily (Weems et al. 2023). Using positive wording may increase the reliability of the survey.

Therefore, some questions were adjusted in the second pilot test. After collecting 30 samples, all variables passed the reliability test (Table 13). Therefore, the revised questionnaire was used in the formal survey. The reliability test for the formal data collection was also passed.

Table 13: Reliability Analysis

Factors	Pilot Test 1: Cronbach's Alpha	Pilot Test 2: Cronbach's Alpha	Formal Survey: Cronbach's Alpha
Perceived Usefulness (PU)	0.833	0.743	0.835
Perceived Ease of Use (PEU)	0.858	0.817	0.825
Perceived Behavioural Control (PBC)	0.744	0.813	0.867
Organisation Readiness (OR)	0.716	0.722	0.703
Subjective Norms (SN)	0.803	0.825	0.830
Top Management Support (TMS)	0.854	0.938	0.883
Customer Readiness (CR)	0.532	0.938	0.890
Competitive Pressure (CP)	0.131	0.889	0.900
Intention to Use (ITU)	0.482	0.92	0.884
Overall	0.890	0.962	0.956

4.4 Demographics against Intention to Use (ITU)

a. Gender

As the P-value was >0.05 , Gender was not significantly related to Intention to Use (ITU). For the descriptive statistical analysis, the mean of female, 5.11 against ITU was slightly higher than male, 4.96.

b. Age Groups

As the P-value was >0.05 , the age was not significantly related to the Intention to Use (ITU). From the descriptive statistical analysis, the range of the mean was between 4.84 to 5.18. The mean of the age group between 26 and 34, 5.18 against ITU was the highest. The mean of the age group between 55 and 64, 4.84 was the lowest. However, for female, the age was

significantly related to ITU, as the P-value was <0.05 . Also, in the group of “Slightly Agree” of understanding of GEN AI, the age group was significantly related to GenAI.

c. Working Positions

As the P-value was >0.05 , the working positions were not significantly related to the Intention to Use (ITU). From the descriptive statistical analysis, the mean range was between 4.82 and 5.21. The mean of the consultant, 5.21 against ITU was the highest. The mean of the supporting staff, 4.82, was the lowest.

d. Managerial Grade

As the P-value was >0.05 , the managerial grade was not significantly related to the Intention to Use (ITU). However, in the age group between 35 and 44, the managerial role was significantly related to ITU, as the P-value was <0.05 . For the descriptive statistical analysis, the non-manual staff, 5, against ITU was the highest. The mean of the managerial staff, 4.99, was the lowest.

e. Nature of the Working Company

As the P-value was >0.05 , the nature of the working company was not significantly related to the Intention to Use (ITU). However, it revealed that the intention to use of suppliers was significantly related to the government, as the P-value was <0.05 . For the descriptive statistical analysis, the mean range was between 4.22 and 5.12. The supplier, 5.12 against ITU, was the highest. The mean of the government, 4.22, was the lowest. Also, in the group of 16 years of working experience, the nature of the working company was significantly related to the intention to use, as the P-value was <0.05 .

f. Working Experience

As the P-value was >0.05 , the working experience was not significantly related to the Intention to Use (ITU). For the descriptive statistical analysis, the mean range was between 4.89 and

5.17. The mean of years of working experience 5 years or below, 5.17 against ITU was the highest. The mean of years of working experience of 16 years or above, 4.89, was the lowest.

g. Education Levels

As the P-value was >0.05 , the education level was not significantly related to the Intention to Use (ITU). However, in the group of “Agree” of understanding of GenAI, the education level was significantly related to GenAI, as the P-value was <0.05 . For the descriptive statistical analysis, the mean range was between 4.9 and 5.02. The mean of post-graduate level, 5.02 against ITU was the highest. The mean of secondary school level, 4.9 was the lowest.

h. Percentage of Adopting Technologies on Work

As the P-value was >0.05 , the Percentage of Adopting Technologies on Work was not significantly related to the Intention to Use (ITU). However, in the 75% to 100% group, the age group was significantly related to ITU, as the P-value was < 0.05 . For the descriptive statistical analysis, the mean range was between 4.86 to 5.11. The mean of the percentage between 51% and 75%, 5.11 against ITU was the highest. The mean of the percentage between 51% and 75%, 4.86, was the lowest.

Understanding the functions of GenAI

As the P-value was < 0.01 , the understanding of the functions of GenAI was significantly related to the Intention to Use (ITU). It reveals that “Strongly Agree” was significantly related to “Slightly Agree”, “Agree”, “Disagree”, “Slightly Disagree”, and “Strongly Disagree” with a P-value <0.05 . For the descriptive statistical analysis, the mean range was between 4.36 and 5.67. The mean of “Strongly agree”, 5.67, against ITU was the highest. The mean of “Slightly disagree”, 4.36, was the lowest.

i. Trying to Adopt GenAI

As the P-value was <0.05 , the Trying to Adopt GenAI was significantly related to the Intention to Use (ITU). It reveals that “Always” was significantly related to “Sometimes” and “Never”, P-value <0.05 . For the descriptive statistical analysis, the mean range was between 4.68 and 5.48. The mean of "Always", 5.48 against ITU, was the highest. The mean of “Never”, 4.68 was the lowest.

Table 14: Demographics with Significant Findings

Demographics	Significant Factors
Age Groups	In female, the age group was significantly related to ITU.
	In the group “Slightly Agree” of understanding of GenAI, the age group was significantly related to GenAI.
	In the group of 51% to 75%, the age group was significantly related to ITU.
Education Levels	In the group “Agree” of understanding of GenAI, the highest education level was significantly related to GenAI.
Managerial Role	In the age group of 35-44, the managerial role was significantly related to ITU.
Nature of your working company	The supplier was significantly related to the Government.
	In the groups of 16 years or above of working experience, the nature of the working company was significantly related to ITU.
Trying to adopt GenAI	Trying to adopt GenAI was significantly related to ITU.
Understanding the functions of GenAI	Understanding the functions of GenAI was significantly related to ITU.

4.5 Correlation Analysis

Pearson correlation analysis was used to analyse the relationship between each factor and the Intention to Use (ITU) (Sedgwick,2012). Table 15 shows the result of the correlation analysis:

1) PU was significantly associated with ITU, with a Pearson correlation coefficient equal to 0.496 (Moderate Correlation) (p-value <0.001). 2) PEU was significantly associated with ITU, with a Pearson correlation coefficient equal to 0.508 (Moderate Correlation) (p-value <0.001). 3) PBC was significantly associated with ITU, with a Pearson correlation coefficient equal to 0.490 (Moderate Correlation) (p-value <0.001). 5) OR is significantly associated with ITU, with

a Pearson correlation coefficient equal to 0.472 (Moderate Correlation) (p-value<0.001). SN was significantly associated with ITU, with a Pearson correlation coefficient equal to 0.576 (Moderate Correlation) (p-value<0.001). 7) TMS was significantly associated with intention to use (ITU), with a Pearson correlation coefficient equal to 0.566 (Moderate Correlation) (p-value<0.001). 8) CR was significantly associated with ITU, with a Pearson correlation coefficient equal to 0.640 (Moderate Correlation) (p-value<0.001). 9) CP was significantly associated with ITU, with a Pearson correlation coefficient equal to 0.688 (Moderate Correlation) (p-value<0.001).

All factors were significantly associated with ITU. However, it could not interpret that they have causal relationships. Further influential analyses are necessary to study the result deeply.

Table 15: Correlation Analysis

	Avg_PU	Avg_PEU	Avg_PBC	Avg_OR	Avg_SN	Avg_TMS	Avg_CR	Avg_CP
Avg_ITU	.496**	.508**	.490**	.472**	.576**	.566**	.640**	.688**

4.6 Principal Component Analysis (PCA)

Principal Component Analysis is used to study the importance of the variables and group them for further analyses. The Kaiser-Meyer-Olkin (KMO)'s test was 0.894, > 0.6 (Shresthan, 2021). So, the sample is adequate for data analysis in factor analysis.

Table 16 shows the variance explained by each component and the cumulative variance explained by all components. The eigenvalues checked the retention of the first four components, which are > 1, meaning they should be kept in the model (Williams, Onsmann, A & Brown, 2010). Therefore, the first four components can explain the 24 items with 69.181% of the cumulative variance. The first component was the most important factor, explaining the variance of the 24 components with 11.470%.

Table 16: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.470	47.794	47.794	11.470	47.794	47.794	4.823	20.096	20.096
2	2.525	10.522	58.316	2.525	10.522	58.316	4.657	19.404	39.500
3	1.384	5.767	64.083	1.384	5.767	64.083	4.204	17.518	57.019
4	1.223	5.098	69.181	1.223	5.098	69.181	2.919	12.162	69.181
5	.880	3.666	72.847						
6	.850	3.543	76.390						
7	.703	2.931	79.321						
8	.608	2.533	81.854						
9	.489	2.039	83.893						
10	.465	1.936	85.830						
11	.430	1.793	87.623						
12	.406	1.693	89.316						
13	.373	1.555	90.871						
14	.325	1.353	92.225						
15	.276	1.152	93.376						
16	.266	1.110	94.487						
17	.231	.961	95.448						
18	.217	.903	96.351						
19	.207	.864	97.215						
20	.199	.831	98.046						
21	.143	.597	98.643						
22	.125	.523	99.165						
23	.113	.470	99.636						
24	.087	.364	100.000						
Extraction Method: Principal Component Analysis.									

Table 17: Rotation Component Matrix

	Component			
	1	2	3	4
PU1_Enhancing my productivity				.788
PU2_Gen AI's high practicability				.766
PU3_Reducing time and cost losses				.735
PEU1_Not Much Mental Pressure		.629		
PEU2_Easy to Use		.601		
PEU3_Easy to Operate		.632		
PBC1_Having an Autonomy		.715		
PBC2_Having sufficient confidence		.766		
PBC3_Having enough resources		.743		
OR1_Enough Company Specialists		.790		
OR2_Cost Affordable				
OR3_Company direction		.596		
SN1_Colleagues opinions	.583			
SN2_Supervisor opinions	.814			

SN3_Opinions I valued	.714			
TMS1_Top management encouragement	.840			
TMS2_Top management active participation	.758			
TMS3_Top management willingness to take risk	.647			
CR1_Gen AIing Client credit	.528		.516	
CR2_Customer relationship	.554		.645	
CR3_Customer requirement			.696	
CP1_Enhancing competitiveness			.812	
CP2_Award more Projects			.841	
CP3_Competitor pressure			.751	
Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 7 iterations.				

Table 17 shows the distribution of the factors inside each component in which the factor loading is > 0.5 (Amin, Saad & Lajis, 2022). Linear Regression Analysis can analyse those components to understand their causal relationship with Intention to Use (ITU). Therefore, Table 18 shows the reliability to understand its consistency and stability.

Table 18: Reliability Analysis of those 4 components converted by Principal Component Analysis

Component	Rename	Cronbach's Alpha
Component 1	Organisational Factors	0.917
Component 2	Functional Factors	0.909
Component 3	Environmental Factors	0.927
Component 4	Usefulness Factors	0.835

Also, to use the findings from Principal Component Analysis, Table 19 shows the grouping of each variable by factor analysis based on their inter-relationship and the importance of the intention to use GenAI. Compared to the research model, Perceived Usefulness was suggested to separate the individual component, showing its importance to the intention to use GenAI. The changes in the external environments of GenAI might drive internal colleagues to use GenAI.

Table 19: Comparison of the Original Research Model and Principal Component Analysis

	Original Research Model	Model converted by Principal Component Analysis
Component 1	PU1, PU2, PU3, PEU1, PEU2, PEU3, PBC1, PBC2, PBC3	SN1, SN2, SN3, TMS1, TMS2, TMS3
Component 2	OR1, OR2, OR3, SN1, SN2, SN3, TMS1, TMS2, TMS3	PEU1, PEU2, PEU3, PBC1, PBC2, PBC3, OR1, OR2
Component 3	CR1, CR2, CR3, CP1, CP2, CP3	CR2, CR3, CP1, CP2
Component 4		PU1, PU2, PU3

4.7 Regression Analysis

Regression Analysis is used to find the most significant independent variables against the dependent variables, which may create a precise implementation direction of GenAI in the construction industry. The analysis included three parts: 1) 8 factors (Average score for each variable) against Intention to Use (ITU), 2) 24 Sub-items of each variable against Intention to Use (ITU) and 3) Factors Score of 4 Factors (Table 18) against Intention to Use (ITU).

4.7.1 Eight IDs against Intention to Use

After cutting the insignificant variables, R^2 was 0.550, which meant that CP, PU, and SN explain 55.5% of the variance of ITU. The effect size interpretation is strong if the R^2 was > 0.25 (Turney, 1998). The P-values of PU, CP, and SN were less than 0.05, meaning the model was significant. The VIFs of PU, CP, and SN were less than 10, meaning no multicollinearity appeared in this model. Through the standardised coefficients, CP was the stronger factor, 0.485 compared with SN, 0.217 and PU, 0.185. Through the B value of Unstandardised Coefficient:

$$ITU = 0.841 + 0.196PU + 0.197SN + 0.456CP$$

4.7.2 Twenty-four Sub-items of each factor against Intention to Use

After cutting the insignificant variables, R^2 was 0.588, which meant that CP1, PU2, TMS3, and CR2 explained 58.8% of the variance of ITU. The effect size interpretation was strong if the R^2 was > 0.25 (Turney, 1998). The P-values of PU2, TMS3, CR2, and CP1 were less than 0.05, meaning the model was significant. The VIFs of PU2, TMS3, CR2, and CP1 were less than 10, meaning no Multicollinearity appeared in this model. Through the standardised coefficients,

CP was the strongest factor, 0.354, compared with CR2, 0.272, PU2, 0.212 and TMS3, 0.14.

Through the B value of Unstandardised Coefficient:

$$ITU = 0.86 + 0.193PU2 + 0.097TMS3 + 0.232CR2 + 0.413CP1$$

4.7.3 Four Factors from PCA against Intention to Use

R^2 was 0.576, meaning that organisational, functional, environmental, and usefulness factors could explain 57.6% of the variance of ITU. The effect size interpretation was strong if the R^2 was > 0.25 (Turney, 1998).

The P-values of organisational, functional, environment, and usefulness factors were less than 0.05, meaning the model was significant. The VIFs were less than 10, meaning no Multicollinearity appeared in this model. Through the standardised coefficients, environmental factors, 0.554, was the strongest compared to organisational factors, 0.362, usefulness factors, 0.317 and functional factors, 0.22. Through the B value of Unstandardised Coefficient:

$$ITU = 4.987 + 0.254 \text{ Organisational factor} + 0.154 \text{ Functional factors} + 0.382 \text{ Environmental factor} + 0.222 \text{ Usefulness factor}$$

Table 20: Summary of the Regression Analysis

Hypothesis	Independent Variables	Result
Part 1: Significant Hypotheses		
H1	Perceived Usefulness (PU)	Significant
	PU2_Gen AI's high practicability	Significant
H5	Subjective Norms	Significant
H6	TMS3_ Top management willingness to take risk	Significant
H7	Customer Readiness_Enhancing Customer Relationship	Significant
H8	Competitive Pressure (CP)	Significant
	CP1_Enhancing Competitiveness	Significant
H2	Perceived Ease of Use (PEU)	Not Significant
H3	Perceived Behavioral Control (PBC)	Not Significant
H4	Organisation Readiness (OR)	Not Significant
H6	Top Management Support (TMS)	Not Significant
H7	Customer Readiness	Not Significant

5 Discussion

Table 14 shows the causal relationship status of the demographics against ITU. Table 20 shows the result of the regression analysis of each factor against the Intention to ITU. The results of all hypotheses findings will be discussed:

5.1. Hypotheses – With Significant Findings

H1-Perceived Usefulness (PU)

The study found that PU was a significant relationship with using GenAI, which aligned with previous findings (Scherer, Siddiq, and Tonder, 2019; Alnemer, 2022; Moslehpour et al., 2018). The high practicability of GenAI was also significantly related to GenAI, which aligned with the qualitative findings from the 10-potential user focus group. During their conservation, they were concerned about how GenAI would assist them in their busy work environment.

H5-Subjective Norms (SN)

The study found that SN was significantly related to the intention to use GenAI, which aligned with previous findings (Finlay, 2000; Schepers & Wetzels, 2007), suggesting the company and department should take a positive position regarding GenAI adoption. Word of Mouth highly influences the efficiency of GenAI applications in a company. It also aligned with the strategy of Dr Prof Lawrence Poon, in which a buddy programme is important for encouraging colleagues to adopt new technologies. Therefore, positive experience sharing may help accelerate the pace of GenAI applications in a company.

H8-Competitive Pressure (CP) (H8)

The study found that CP was significantly related to the intention to use GEN AI, which aligned with previous findings ((Majumdar & Venkataraman, 1993; Gupta, Ruchi, et al., 2024). Enhancing competitiveness, one of the CR's items, also was significantly related to using GenAI, which Jay Fong and Dr. Prof. Lawrence Poon highlighted. Technology adoption

should be market driven. What are the market needs in GenAI adoption? How can a company benefits through GenAI adoption? At the beginning stage, to reduce the investment losses, a company may apply for the CITF offered by the Construction Industry Council (Construction Industry Council, 2024).

5.2. Hypotheses – With Partially Significant Findings

H6-Top Management Support (TMS)

The study found that Top management's willingness to take risks, one of the TMS's items, was significantly related to the intention to use GenAI, which aligned with previous findings (Young & Jordan, 2008; Dasgupta & Wendler, 2019). To show commitment to the company, the risk-bearing attitude of top management plays an important role. Therefore, the top management should arrange more talks to deliver their message for providing colleagues with confidence to implement GenAI .

H7-Consumer Readiness (CR)

The study found that enhancing customer relationships, a sub-item of Customer Readiness (CR), was significantly related to the intention to use GenAI, which aligned with previous findings (Xuqian et al., 2024). If GenAI applications can attract customers' attention, colleagues are willing to adopt them. Meanwhile, the GenAI applications of Suppliers were significantly related to the intention to use compared with the government in this research. Suppliers should be the beginners of using GenAI in the construction industry. To enhance this significant relationship, industrial networking, especially the experience sharing of suppliers, can be arranged to promote the positive use of GenAI applications. They shall not reject if they can gain more business opportunities at every chance.

5.3 Hypotheses – With not Significant Findings

H2-Perceived Ease of Use (PEU)

The study found that PEU was not significantly related to intention to use, which aligned with previous findings (Kahar, Wardi, and Patrisia, 2019). However, another research Alnemer (2022) found that the PEU was significantly related to the intention to use. The difference may be caused by the target participants. The target group of Alnemer was their customer. The target of this research study was the professionals working in the construction industry. It may appear the different between the service provider and the service user. The second difference is the industry nature. A digital banking is a new banking system growing with the technology's advantages. However, the construction industry is a traditional industry having its own construction method. However, to promote a technology development, Kahar, Wardi and Patrisa (2019) mentioned that ease of use is necessary when implementing new technologies to the user, which makes significant differences. Therefore, the company should promote GenAI ease of use to colleagues, through product seminars and training, for accelerating the pace of using GenAI.

H3-Perceived Behavioural Control (PBC)

The study found that PBC was not significantly related to the intention to use GenAI , which aligned with previous findings (White, Al-Gahtani & Hubona, 2007). However, other previous research studies (Elie-Dit-Cosaque et al., 2011) found that PBC was significantly related to the intention to use. The differences may be caused by the research target. The target of Elie-Dit-Cosaque's study was the IT end users. But the target of this research is technical professionals working in the construction industry. The pace of using technologies is not the same. Therefore, the result may not be consistent. However, Elie-Dit-Cosaque's research mentioned that anxiety, which was not studied in this research, will also influence the colleague's behaviour on GenAI

adoption. Therefore, before implementing GenAI, anxiety level towards using technology, GenAI in the construction industry may be a key indicator in future study.

From the points of view of Ir Prof. Lawrance Poon, Head of Emerging Technology, Global Innovation from The MTR Corporation, starting from small is his strategy to facilitate the use of GenAI in MTR, for example, using GenAI to take meeting notes (Velush, 2024). This may help colleagues use GenAI smoothly from the basic to the advanced level and increase their controllability to GenAI. Therefore, a company should arrange some GenAI-related practical workshops to enhance colleagues' applicability of GenAI.

H4-Organisation Readiness (OR)

The study found that OR was not significantly related to the intention to use GenAI, which aligned with previous findings (Ngah et al, 2022). However, the research studies from Halpern, et al. (2021) found a significant relationship to the intention to use. The difference may be caused by the research target. The target of Halpern focused on the managers. The target of this research was supporting staff, surveyors, engineers and consultants, which may create inconsistency with Halpern's research study. Also, Halpern et al. (2021) mentioned that the culture, collaboration with stakeholders and company directions would lead to technological changes in a company. Therefore, before implementing GenAI in a company, a company should allow more time to discuss with colleagues and plan a company direction precisely.

Jay Fong, AWS Business Manager, also mentioned that company directions are important for adopting GenAI in a company. The company will be fragmented if the GenAI applications are only based on the preferences of colleagues, not a collective company-wide movement. Therefore, company policies and incentive schemes may be useful to attract colleagues to learn and adopt GEN AI through company support.

H9-Gender

The study found that gender was not significantly related to the intention to use GenAI, which aligned with previous findings (Li, Glass, and Records, 2008). In the descriptive statistical result, the mean of females of intention to use GenAI is slightly higher than males. Furthermore, no females rejected using GenAI in accordance with the company's direction. Only 3.3% of the male respondents disagreed with using GenAI with the company's direction. However, other research studies found gender differences in the intention to use studied by Draxler Fiona et al. (2023). The difference may be caused by the nature of the participants. The research from Draxler Fiona et al (2023) was not limited by the industry, respondents who were over 18 years old were welcome. However, the target of this research was limited to respondents working in the construction industry. Both genders working in the construction industry are expected to use technologies in their work. More importantly, this is not a surprising result in Hong Kong. According to the Hong Kong education system, males and females have the same opportunity to learn technological knowledge through STEAM (Science, Technology, Arts and Mathematics) education starting from primary school in which students can strengthen their skillsets and mindsets on the above areas (STEAM Education,2024). Both genders should not feel resistant to adopting technologies at work.

H10-Age Groups

The study found that age was not significantly related to the intention to use GenAI, which aligned with previous findings (Nayanajith & Damunupol, 2019). Other research studies by Draxler. Fiona et al. (2023) found that age was significantly related to ITU. The nature of the participants may cause the difference. The research from Draxler Fiona et al. (2023) was not limited by the industry; respondents who were over 18 years old were welcome.

However, the target of this research was limited to respondents working in the construction industry. However, after studying age integrated with other factors, the age in the female was significantly related to ITU. In the “Slightly Agree” of understanding GenAI, the age was

significantly related to ITU. In the group of “51% to 75%” using technology in the work, the age was significantly related to ITU. Due to the above findings, age may be a frustrating factor that affects the current use of technology. It is suggested that age should also be included in the consideration of the GenAI adoption in a company.

H11-Working Positions

The study found that professional areas were not significantly related to the intention to use GenAI, which aligned with previous findings (Kuciapski, 2019). However, the research by Faham & Asghari (2019) found that the working position was significantly related to ITU. The difference may be caused by the dependent factors: the intention to use e-textbooks for farmers. Although they are also related to technology adoption, their complexity is different. Using a e-textbook may relate to the education background of farmers. However, GenAI can benefit all colleagues with different experiences; a significant difference may not occur in this research. Also, it is an expected result of this survey. Colleagues focus on how GenAI functions to help in their work. Table 3 mentions the GenAI functions in different engineering functions. Therefore, a company should consider how the functions suit colleagues with different positions rather than consider the GenAI acceptance for different positions.

H12-Working Experience

The study found that working experience was not significantly related to the intention to use GenAI, which aligned with previous findings (Cafiero, 2013). Faham and Asghari (2019) found significant differences in intention to use according to working experience. With more working experience, it is more difficult to use. It may relate to how frequently the training course is provided to them. However, GenAI was widely promoted in Hong Kong. Irrespective of your work experience, opportunities for learning GenAI are found everywhere. Several institutions

provide GenAI-related courses for the industry (Table 2) for different target participants, such as contract management, safety management, and project management.

H13-Education Levels

The study found that education levels were not significantly related to the intention to use GenAI, which aligned with previous findings (Whiet, Al-Gahtani, and Hubona, 2007). Alnemer (2022) found a significant difference in the intention to use. The difference may be caused by the study location. Alnemer's study was done in Saudi Arabia, where the education opportunities may be different to those in Hong Kong. In Hong Kong, every colleague has at least 12 years of free primary and secondary education. Also, nearly 72.8% of employed persons obtained post-secondary qualifications in Q2 2024 (Census and Statistics Department, 2024). The difference in the education level may not create a significant difference. However, in the group "Agree" of understanding of GenAI, the highest education level was significantly related to GenAI. The education level may be a frustrating factor affecting the intention to use. Therefore, a company can arrange GenAI-rated courses about job functions that are not limited to education. Several institutions provide GenAI-related courses for the industry (Table 2) for different educational backgrounds, such as certificate courses and diploma courses.

To interpret the above discussion for an entire GenAI adoption plan in the construction industry, the findings from the demographics and the 8 factors give a clear direction on the implementation plan. Firstly, gender differences, professional areas, working experience, company size and the percentage of adopting technologies in work will not be the concern in the implementation plan. Secondly, the frustrating factors are age, education level, managerial role, and nature of the working company. Generally, they are not significantly related to ITU. However, in some particular situations, they are significantly related to ITU. Therefore, a company should consider how to address their influence on GenAI adoption. More importantly, trying to use GenAI and Understanding GenAI were significantly related to ITU. The

implementation plan should highly focus on these two factors, which should include the elements of PU, SN, TMS, CR and CP.

Meanwhile, the nature of the industry may also affect the implementation of GenAI. Compared with other industries, such as banking or finance, the construction industry is relatively traditional and already has a fixed and workable formula. The readiness for changes may lag behind other industries. The question is, “Why do I need to change?” If the reason cannot persuade colleagues, the change will be slow. Therefore, regarding the result, the advantages of using GenAI shall be strongly promoted to colleagues.

6 Recommendations

By 2026, over 100 million employees will work with robot colleagues to contribute to their work (Gartner, 2024). To implement GenAI in the Hong Kong construction industry, with the results of the survey, the recommendations should suit the suggestions of the technical professionals in the construction industry. Therefore, recommendations will be made according to the significant factors with TOE framework with short-term and long-term measurements.

6.1 Technological Context

6.1.1 Perceived Usefulness - Adopting the Low Code / No code application in GenAI

To address the usefulness of GenAI, which should be simple and effective, no-code apps like Microsoft's Platform were created for non-IT professionals to design tailor-made apps for business needs (Microsoft, 2024). At the beginning stage, Information technology (IT) department can take a lead in this recommendation. A company may consider adopting the fundamental GenAI applications, which benefit repetitive and task-consuming tasks and align with Pro's suggestion. Dr Lawrence Poon, for example, to create a PowerPoint for the project presentation automatically, Design.ai (Kothari, 2024) may help design an attractive and professional PowerPoint. The advantage is reducing the development cost and customising

your business-related software and gaining colleague's buy-in to GenAI. For the short-term measurement, the Safety Department, which is responsible for site safety and critical issues for the government in Hong Kong currently, can be the first department to adopt GenAI personal safety software (Table 3). The effectiveness can be evaluated regularly after 3 months / 6 months. Management, safety professionals and workers should explain the usefulness to the safety department. The key indicator should be to achieve zero accidents after using GenAI. For the long-term measurement, departments should adopt at least 1 GenAI application, for example, recording the meeting notes by GenAI function (Velush, 2024),

6.2 Organisation Context

6.2.1 Subjective Norms - Developing a buddy programme for the GenAI application

To address the differences coming from subjective norms, a buddy programme combined with different age groups, education levels, and positions may create a synergy in adopting GenAI. The Human Resources (HR) department takes the lead in this recommendation. Referring to the result, the age group of 26 to 34, obtaining the highest mean, may be assigned a leader role to lead the buddy group and support other generations of colleagues. The HR department should search for GenAI talent from the talent pool and train up to maintain the technical support for colleagues. Each group should consist of one management member, one trained GenAI professional, and other users to strengthen the GenAI application. At least, they should make use of GenAI in their current project. For the short-term measurement, those groups should promote the updated GenAI functions to colleagues monthly and invite potential colleagues to join the group. For the long-term measurement, the HR department may develop some procedures for facilities departments to embed GenAI elements in the work. All departments should create at least one GenAI to reduce repetitive work, saving at least 2 man-days.

6.2.2 Subjective Norms - Forming a GenAI association for the construction industry

Industry support is very important for a company to promote GenAI. The Corporate department may help forming a GenAI association with other companies. The collective power may motivate colleagues to accelerate the pace of GenAI applications. For the short-term measurement, a regular monthly meeting can be arranged for all companies to exchange their opinions, difficulties and successful cases in the GenAI applications. For long-term development, a GenAI exhibition can be arranged to promote the advantages of GenAI to all shareholders in the construction industry.

6.2.3 Risk Created by using GenAI -Developing the internal policies for cybersecurity issues

To address the cybersecurity issues brought by GenAI, which are already cared by the Office of the Privacy Commissioner for Personal Data (PCPD) (Kong, 2024), technology-related policies shall be prepared to minimise the potential risk collected with the third-party system. How can colleagues balance security and opportunity? The IT and legal departments should take the lead in this area. A balance between safety and efficiency should be achieved. What information can be defined as sensitive information that should not be uploaded to the cloud? For the short-term measurement, immediate cybersecurity training should be provided to colleagues to enhance their mindsets. For the long-term measurement, they shall develop a clear guideline (HKSAR, 2024) to introduce what kind of data they shall avoid uploading on the cloud, the role and responsibility of each position, and emergency procedures when touching on cybersecurity issues.

6.2.4 Top Management's Participation

Top Management may introduce a GenAI Adoption Statement to all colleagues internally. It is very important to increase the colleague's confidence in the adoption. No one will take risks if the success rate is uncertain. Therefore, Top management, namely, Chief Executive Officer

(CEO) should give a clear direction, such as investment cost, and perform a risk-bearing attitude on GenAI adoption, such as the affordable losses. For the short-term measurement, the top measurement should arrange a talk to deliver their vision and mission on the GenAI application, for example, Lunch and Learn sessions, which are a relaxing moment to share with colleagues. For the long-term measurement, the top management may consider using a 4.7 % percentage, an average amount for the GenAI budget in 2024 (BCG, 2024) of the annual profit for the GenAI investment project.

6.2.5 GenAI Culture Creation - Company-Wide Promotion Campaign

From the results, the demographics, including gender, age groups, and education levels, were partially significantly related to the intention to use. If they differentiated the adoption strategies, it may not be a good strategy. It is suggested that all colleagues should be encouraged to use GenAI. Using GenAI is a whole company direction. Everyone should adopt GenAI at work. Surely, the company should provide sufficient support, including training and opportunities for colleagues to use GenAI at work. The purpose is to reduce their psychological hesitation in using GenAI. For the short-term measurement, to arrange GEN AI week twice each year may help promote the advantages of GenAI to colleagues intensively. For the long-term measurement, a company may consider creating a GenAI department for responsible for the whole GenAI promotion for a company.

6.3 Environmental Context

6.3.1 Customer Relationship - Grasping the Market Trend

To address the difference from customer readiness, in the previous survey with about 25,00 executives, 38% mentioned that customer experience and retention is the purpose of their GenAI investment (Gartner, 2024). To understand the market trend on GenAI adoption to retain customers, a company should consider helping colleagues to understand the competitor's

situation and market trend. A company may send colleagues to join the external seminars, workshops or training sessions organised by the government, CIC or VTC. Colleagues may grasp the most updated technologies to Gen AI in the customer's trust. The training department and marketing department may work together to provide some GenAI market trend training to colleagues. The evaluation should be provided to colleagues after launching the training 3 months. The percentage of GenAI understanding should be higher than this survey. The "Always" of try to adopt GenAI should be higher than 10.5%. The "strongly agree" to understand the functions of GenAI should be higher than 9.8%.

6.3.2 Competitive Pressure - Using External Funding

To increase the GenAI understanding and provide opportunities to use it, the company may consider applying for external funding to support the learning of colleagues to enhance their competitive pressure. The Hong Kong government has offered funding to support the development of technology for corporations. To expand the application resources, a company may consider applying for the Innovation and Technology Fund (ITF) organised by the Hong Kong Government (ITC, 2024). Its purpose is to support companies using technological services and solutions to improve productivity or update or transform business processes. The company should apply for the ITF once each year in the GenAI project.

Table 21: Summary of the Recommendations

Significant Factors	Recommendation	Task	In-charge
Perceived Usefulness	Adopting the Low Code / No code application in GenAI	To adopt the GenAI safety programme to achieve zero accident To develop at least 1 GenAI application for a company	Safety Department
Subjective Norms	Developing a buddy programme for the GenAI application	To arrange one management, one GenAI professional and other users to create a GenAI application in the current project To develop a GenAI talent pool to sustain the development of GenAI	Each Business Department, HR Department
Subjective Norms	Forming a GenAI association for the construction industry	To arrange a regular monthly meeting to exchange the situations on Gen AI development To arrange an exhibition to promote GenAI application in the industry	Corporate Communication
Top Management –	Developing the internal policies for cybersecurity issues	To provide the cybersecurity sessions for colleagues	IT and Legal Department

Willing to take a risk		To develop a cybersecurity policy to avoid the potential risk	
Top Management	Top Management's Participation	To deliver "Lunch & Learn" session to share their sharing for colleagues. To make use of 3 % of the annual profit for GenAI applications	Management
Customer Readiness – Enhancing Customer Relationship	Company-Wide Promotion Campaign	To arrange GenAI week twice each year to promote the advantages and usefulness of GenAI To create a GenAI department to responsible for the GenAI promotion	Corporate Communication Department
Competitive Pressure	Grasping the market trend	To enhance the GEN AI market trend understanding, higher than 10.5%, try to adopt GenAI and 9.8%, understand the GenAI functions of the current survey	Marketing Department and Training Department
Competitive Pressure	Using external funding	To apply for the ITF, at least 1 GenAI project	Each Business Department

7 Limitations

This research was conducted by random sampling with Google Forms. Firstly, collecting responses was limited to online format. Although most of us are adept at using the internet, some people still do not use it frequently. This group of targets may not be included in the research studies. The studies may only be limited to the targets who always use technologies. The result may not represent the GenAI adoption phenomena in the construction industry in which some hurdles may not be found.

Due to the limited schedule, 153 questionnaires were collected, which may not be the technical professionals' voice. The respondents were mainly engineers. The voices of other professionals, such as consultants, surveyors, and technical staff, may be eliminated. The working company nature of the respondents was centralised on a contractor, 56.2%. The voices of consultants, developers, government and suppliers may not reflect the result. More importantly, the workforce of the construction industry was 303 thousand in 2023. Although the sampling size was statistically effective in the research base, practically, it might not reflect the actual construction industry's situation.

In the survey design, considering the response rate, the number of questions was limited to 40, which may neglect other GenAI adoption aspects, such as the involvement of government and

resource allocations. Also, the timing of the survey affected the result, which only allowed one month to receive the responses. It is difficult to reach the targets who can participate in this survey immediately during the busy working period.

8 Conclusion

Based on the research findings, Perceived Usefulness, Subjective Norms, Top Management Willingness to take risk, Enhancing Customer Relationship from Customer Readiness and Competitive Pressure were significantly related to Intention to Use. The findings were different from the previous finding about GenAI adoption in different industries and regions. Therefore, to successfully implement a new technology in a company, the adoption plan should be tailor-made to fit the culture of Hong Kong Construction Industry. The technology advancement may be a driver to motivate respondents to adopt GenAI in the workplace. The usefulness of GenAI and the buddy's support also create a significant relationship in GenAI adoption, which means that colleagues are ready to adopt GenAI. However, the ease of use and organisation readiness did not have a significant relationship on the GenAI adoption, which means that at the practical level, colleagues still did not obtain the advantages from the organisation's support and tasted the function's advantages of GenAI functions. The speed of the market change is faster than the reaction of the organisation. It may be the next research direction for GenAI adoption, to study how the organisation readiness may influence the success of GenAI implementation in advance.

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