

# Enhancing The Effectiveness of Professional Development Among Civil Engineers in Construction Management

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## Abstract

The construction industry is undergoing rapid transformation driven by technological innovation, sustainability imperatives, and the increasing complexity of project delivery. These dynamics require civil engineers in construction management to possess a robust blend of technical expertise, leadership skills, and adaptive capabilities. However, many professional development initiatives remain insufficient, with a predominant emphasis on theoretical instruction and limited opportunities for practical application. This imbalance has led to skill gaps in critical areas such as project management, advanced software utilisation, crisis response, and sustainable construction practices, ultimately affecting project efficiency, cost control, safety, and quality outcomes. This study examines current professional development practices in Malaysia's government and private sectors, identifies skill deficiencies impacting project performance, and proposes targeted strategies aligned with contemporary industry needs. A quantitative research design was adopted, using a structured survey administered to civil engineers in Selangor to capture insights on training experiences, perceived gaps, and adaptation challenges in light of evolving theoretical frameworks and technological integration. Findings reveal that technical skills training is most critical (67.3%), followed by health, safety, and environment (HSE) programmes (66.3%) and soft skills development (66.0%). These results underscore the sector's demand for competency in hands-on technical applications, safety compliance, and effective leadership. The study concludes that current professional development frameworks inadequately address the realities of modern construction, advocating for blended learning, practical workshops, safety drills, leadership enhancement, and exposure to emerging tools such as Building Information Modelling (BIM) and drone technologies. These measures are essential to bridge the theory-practice divide and prepare civil engineers to manage the complexities of contemporary projects.

**Keywords:** Professional Development, Construction Management, Civil Engineering Skills Gap, Sustainable Construction Practices

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## 1. Introduction

The construction industry plays a critical role in supporting societal and economic development but is increasingly challenged by rapid technological advancement, regulatory pressures, and sustainability demands (Busawon et al., 2012). In Malaysia, the construction sector contributes approximately 3.7% to the national GDP (Department of Statistics Malaysia, 2024), employing over 1.3 million workers. Selangor alone accounts for the highest concentration of registered civil engineers (1,007 according to BEM 2023) and records a steady increase in infrastructure projects over the past decade. However, recurring issues such as delays (35% of projects), cost overruns, and labor shortages continue to affect performance and highlight the need for stronger capacity building and professional development frameworks. Traditional professional development approaches often fall short in preparing civil engineers to address these evolving needs. The emergence of technologies such as Building Information Modelling (BIM), artificial intelligence (AI), and sustainable building practices requires a workforce that is both technically proficient and practically skilled (Gao & Zhu, 2013). However, current training methods tend to emphasise theory over application, resulting in a lack of practical skills applicable to real-world situations.

This study investigates the effectiveness of existing professional development initiatives among civil engineers in both

government and private sectors. Thus, it aims to identify critical skill gaps and proposed targeted strategies to enhance practical competencies and bridge the gap between theory and practice. There are many construction organizations that lack adequate professional development within construction management, making it difficult for civil engineers to adapt to evolving industry demands and technological advancements. This insufficiency contributes to poor project outcomes, including delays, cost overruns, and quality issues, as civil engineers are not well-equipped with up-to-date skills required in modern construction environment (Rui et al, 2015). Moreover, construction engineering education tends to prioritise theoretical understanding over practical application. This imbalance leads to a workforce that may understand concepts but lack real-world experience in critical areas such as project scheduling, risk management, and quality assurance. As a result, engineers are often unprepared to manage complex on-site challenges (Gao & Zhu, 2013). Similar to global studies conducted in Australia and the United States that emphasize continuous upskilling, safety culture, and competency-based professional development (e.g., Gao & Zhu, 2013; Rui et al., 2015), the Malaysian construction industry faces comparable challenges in aligning training outcomes with modern project demands. However, unlike these developed contexts, Malaysia's initiatives remain fragmented, underscoring the need for localized and competency-driven approaches. Next, the construction industry is experiencing a demand in project complexity due to stricter regulatory standards, stakeholder expectations, and rapid technological integration. Emerging technologies such as prefabrication, BIM, and sustainable practices require professionals who are not only familiar with these tools but also capable of applying them effectively in real world projects (Chen et al., 2022). This research aims to enhance the effectiveness of professional development for assessing and improving project management performance to meet construction industry demands. These aims could be fulfilled by achieving the following three (3) objectives which are to identify the current practices of professional development among civil engineers in construction management within both government and private sectors, to analyze the specific skill gaps, present among construction management professionals and to propose strategic recommendations for enhancing professional development in construction management. This study focuses on the role of professional development in enhancing the performance of civil engineers within construction management sector, particularly in addressing project complexity, technological advancements, and sustainability challenges. It is geographically scoped to Selangor, Malaysia, due to its high concentration of registered engineers. The research utilizes questionnaire and pilot surveys with 278 respondents and case studies to gather insights from experienced professionals. However, the study is limited by its regional focus, which may not fully represent nationwide practices, and potential response bias in self-reported data. Additionally, limited access to certain professionals may restrict the scope of data collection. Next, for significance of study, this study provides insights into current practices in both government and private sectors, helping to assess their effectiveness and identify areas for improvement (factual & conceptual). By comparing practices, it promotes cross-sector learning (procedural) and supports better strategies for workforce development, career advancement, and construction industry demand. Next, in this study, it identifies the skill gaps affecting project performance and determines their impact on outcomes like efficiency and quality. It encourages stakeholders to strengthen critical skills through targeted development and promotes a culture of continuous improvement in the construction industry. This study proposes actionable strategies to address identified skill gaps, focusing on technical, management, and soft skills enhancement. It suggests adapted improvements in professional development structure and delivery, fostering learning cultures and supporting sustainable workforce growth.

## **2. Literature Review**

Professional development plays a pivotal role in ensuring that civil engineers remain equipped to meet the dynamic demands of modern construction management. Rapid advancements in construction technology, increasing regulatory requirements, and the growing emphasis on sustainability have intensified the need for continuous skills enhancement across technical, managerial, and interpersonal domains. As construction projects become more complex, engineers must possess not only strong theoretical knowledge but also the capacity to apply it effectively in real-world settings. However, literature suggests that professional development initiatives in the sector often vary significantly in scope, quality, and alignment with industry needs, leading to skill disparities that can affect project efficiency, safety, and quality outcomes. This section reviews existing studies on current professional development practices, identifies critical skill gaps, and highlights strategic recommendations to address these challenges.

### **1.1 The Current Practices of Professional Development Among Civil Engineers in Construction Management**

Professional development in construction management encompasses a broad spectrum of competencies, including technical expertise, project management, health, safety and environment (HSE), innovation and technology integration, sustainability, time management, crisis and disaster preparedness, regulatory compliance, and soft skills.

According to Husam et al. (2008) and Liu Zhao (2024), training initiatives particularly in the use of industry-standard software are often limited in depth and continuity. In the Malaysian context, government-led programmes typically emphasise formal workshops and regulatory compliance, whereas the private sector tends to prioritise performance-driven and internally motivated learning. According to Azmi and Che Ibrahim (2025), effective capacity building requires integration of technical, managerial, and soft skills to enhance civil engineers' readiness for complex projects. Similarly, Ijaola et al. (2020) and Obolewicz (2020) highlight that insufficient training in digital tools and regulatory compliance remains a major industry gap. This disconnect is particularly significant in areas where adaptability is essential, such as the use of digital construction tools and compliance with sustainable building practices. These challenges are consistent with previous research by Ferrada et al. (2013), Rui et al. (2015), and Gao and Zhu (2013), who found that limited exposure to hands-on training, rapid technological change, and weak knowledge transfer mechanisms contribute to persistent skill deficiencies among construction professionals. The reviewed literature suggests that professional development should become more practical, consistent, and continuous to better support the current demands of the construction industry. There are nine (9) practices that are related to professional development among civil engineers in construction management, such as proficient use of industry-standard software (e.g., AutoCAD, Revit, BIM, Primavera) being essential in ensuring project efficiency and precision. Next, critical thinking and decision-making skills demonstrated through case studies or real-world scenarios further strengthen professionals' ability to address complex challenges effectively. Besides, understanding and adherence to environmental standards and sustainability practices are also vital in modern construction management. Additionally, it is important to promote the adoption and effective use of advanced technologies and innovative practices in the construction industry. Focuses on promoting eco-friendly practices within construction projects that contribute to long-term environmental responsibility. The ability to manage time effectively, optimize workflows, and ensure projects are completed efficiently and within deadlines is crucial competency.

Additionally, promoting the adoption and effective use of advanced technologies and innovative practices in the construction industry is essential. It is also important to encourage eco-friendly practices within construction projects to support long-term environmental sustainability. Furthermore, skills and knowledge to effectively manage and mitigate the impact of crises and disasters, ensuring project continuity, safety, and resilience, are necessary for sustainable operations. It is equally important that engineers and construction projects comply with all relevant laws, regulations, and industry standards. Lastly, effective communication, team leadership and conflict resolution ability, critical thinking and decision-making skills are fundamental attributes that support successful project delivery and collaborative working environments.

## 1.2 Specific Skill Gaps Among Construction Management Professionals

The construction industry is still facing a lack of important skills that affect how complex projects are carried out. Despite ongoing professional development efforts, significant skill gaps persist within the construction management sector, affecting the execution of complex projects. Studies by Ferrada et al. (2013), Obolewicz (2020), and Arnold and Javernick-Will (2013) reveal that many civil engineers face challenges in areas such as digital tool utilisation, regulatory compliance, sustainability integration, and risk management. While a strong academic foundation is common among practitioners, the ability to apply theoretical knowledge in real-world project environments remains inconsistent. Difficulties include operating project management software, collaborating effectively within multidisciplinary teams, and addressing on-site problem-solving demands. Deficiencies are particularly evident in applying current safety standards, implementing green building practices, and managing projects that involve emerging technologies or multiple stakeholders. The lack of hands-on training in these contexts often results in delays, increased costs, and compromised safety. Furthermore, research highlights that the missing competencies extend beyond technical expertise to encompass essential soft skills such as communication, leadership, and decision-making. To solve this, the studies suggest that more practical and structured training is needed, especially for both beginners and experienced engineers, so they're better prepared for today's construction challenges. There are many issues and challenges that are related to professional development among civil engineers in construction management, such as inadequate knowledge of current construction methods, materials, and technologies. Next, inability to use project management software (e.g., MS Project, Primavera) effectively remains a significant concern and insufficient knowledge of local health, safety, and environmental regulations. Besides, there is difficulty in adopting or implementing new construction technologies (e.g., BIM, drones) which continue to delay construction progress. Additionally, insufficient understanding of sustainable building practices and materials that will affect the environmental performance and long-term operational efficiency. Next, an inability to prioritize tasks effectively, leading to missed deadlines, can reduce client satisfaction. Besides, poor crisis management plans or inability to adapt

to unexpected project changes, which can lead to delays and threatened safety. Moreover, limited understanding of local and international building regulations can affect compliance, increase liability, and compromise quality standards. Lastly, poor communication with stakeholders, clients, and team members remains a challenge in ensuring project coordination or progress, leading to misunderstanding, delays, and inefficient teamwork.

### 1.3 Strategic Recommendations for Enhancing Professional Development in Construction Management

The literature highlights a range of strategies to strengthen professional development frameworks in construction management, ensuring they address both current skill gaps and the evolving demands of the industry. Halim et al. (2023) and Yu (2024) emphasise the value of blended learning approaches that integrate online modules with face-to-face training, supported by mentoring programmes and skills qualification frameworks. These methods enable engineers to build both technical competencies and managerial capabilities while fostering continuous learning.

Pokorski (2019) further underscores the importance of creating training environments that replicate real project conditions, enabling professionals to apply theoretical knowledge in realistic, problem-solving contexts. Such experiential learning is particularly valuable for enhancing confidence in the use of digital construction tools, managing project risks, and implementing sustainable building practices. Aligning training content with regulatory changes and technological advancements also ensures that engineers remain competitive and adaptable in a rapidly evolving industry.

Other recommendations include offering hands-on workshops and simulations to improve technical proficiency, integrating real-world case studies to strengthen decision-making skills, and embedding safety drills alongside environmental sustainability training to reinforce compliance and responsible practices. Exposure to emerging technologies such as Building Information Modelling (BIM), drones, and robotics can further enhance innovation capacity, while dedicated sessions on legal compliance help reduce liability risks. Equally important is the incorporation of communication, leadership, teamwork, and negotiation skills into training curricula, ensuring that engineers are equipped not only to manage technical challenges but also to lead collaborative, multidisciplinary teams effectively.

## 3. Methodology

This study adopts a quantitative research design, which is well-suited for systematically examining the relationship between professional development and the competencies of civil engineers, as well as identifying specific skill gaps within the construction industry. A quantitative approach enables the collection of structured, measurable data that directly addresses the research objectives and facilitates objective analysis. The research focuses on Selangor, Malaysia, selected due to its status as the state with the highest number of registered civil engineers. According to the *2023 Annual Report* of the Board of Engineers Malaysia (BEM), Selangor has 1,007 registered civil engineers, making it an ideal case for capturing diverse perspectives from both the government and private sectors. The questionnaire was first validated through a pilot test involving ten senior engineers and two academic experts to ensure content clarity and reliability. The questionnaire criteria were developed based on a review of existing studies (Busawon et al., 2012; Rui et al., 2015) and refined through expert consultation with five senior academicians and industry practitioners. A pilot test with 15 civil engineers was conducted to ensure clarity and reliability, yielding a Cronbach's alpha value of 0.89. The questionnaire comprised four sections (A – demographics, B – current practices, C – skill gaps, D – recommendations). It was distributed via Google Forms using professional email channels and verified registries to ensure eligibility of respondents. Out of 310 invitations, 278 valid responses were received, representing a response rate of 89.7%.

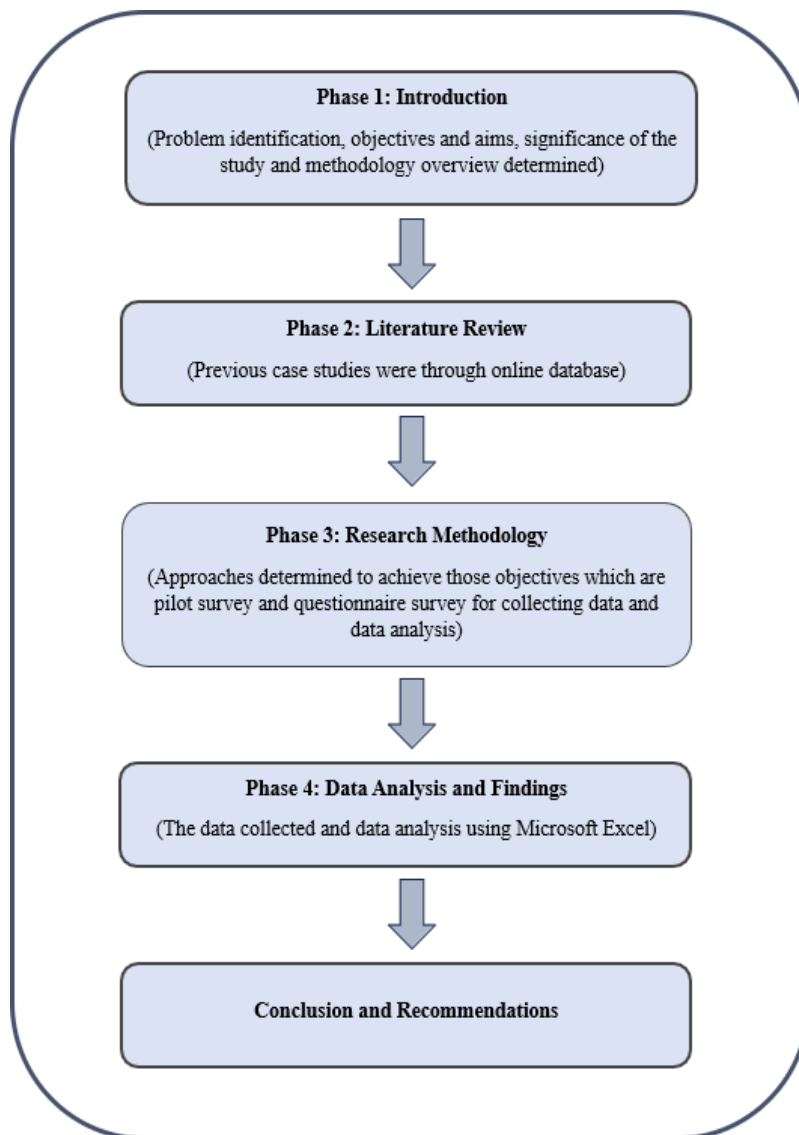
The sample size was determined using the Krejcie and Morgan formula at a 95% confidence level ( $\chi^2 = 3.841$ ,  $p = 0.05$ , margin of error  $d = 0.05$ ), calculated as follows:

The calculation is shown below:

$$s = (3.841 \times 1007 \times 0.5 \times 0.5) / [(0.05^2 \times (1007 - 1)) + (3.841 \times 0.5 \times 0.5)]$$

$$s \approx 278$$

Thus, the required sample size is approximately 278 respondents. Participants were selected through purposive sampling, targeting civil engineers with direct experience in construction management. Purposive sampling was adopted to target civil engineers directly involved in construction management, ensuring participants possessed relevant project experience, particularly in infrastructure, commercial, or residential developments. While this approach enabled focused insights, it also represents a limitation in terms of generalizability. Data collection was conducted via a structured questionnaire distributed through Google Forms, providing participants with flexibility to respond at their convenience. The data were compiled and analyzed using Microsoft Excel, focusing on descriptive statistics such as frequencies, percentages, and mean scores to identify prevailing trends and perceptions. Ethical considerations were strictly observed participation was voluntary, informed consent was obtained, and all responses were kept confidential to protect participants' rights and privacy. Figure 1 illustrates the overall flow of the research methodology.



**Figure 1.** Flowchart Diagram of the Research Methodology

#### 4. Results and Findings

#### 1.4 Demographic Profile of Respondents

Table 1 summarises the demographic characteristics of the respondents. In terms of academic qualifications, the majority hold a Master’s degree (56.1%), followed by Bachelor’s degree holders (22.7%) and PhD graduates (16.9%). A smaller proportion possess a Diploma (2.5%) or other qualifications (1.8%). The distribution between sectors is balanced, with 50.0% employed in the government sector and 50.0% in the private sector. Regarding professional experience, most respondents (58.6%) have 16–20 years of experience, while 19.1% have more than 20 years, 18.3% have 11–15 years, and only 4.3% have less than 10 years in the field. In terms of project type, the largest share (60.1%) is engaged in infrastructure projects, followed by social amenities (14.4%), commercial or office developments (13.5%), and residential projects (11.0%). Project management experience is also extensive, with over half of the respondents (51.6%) having managed 21–30 projects, and 36.0% having handled more than 30 projects. A smaller proportion have managed 11–20 projects (11.1%), while only 1.4% have been involved in fewer than 10 projects. Overall, the demographic profile indicates that the respondent pool comprises highly experienced and well-qualified civil engineers, with a strong representation in infrastructure development.

**Table 1.** Summary of demographic background

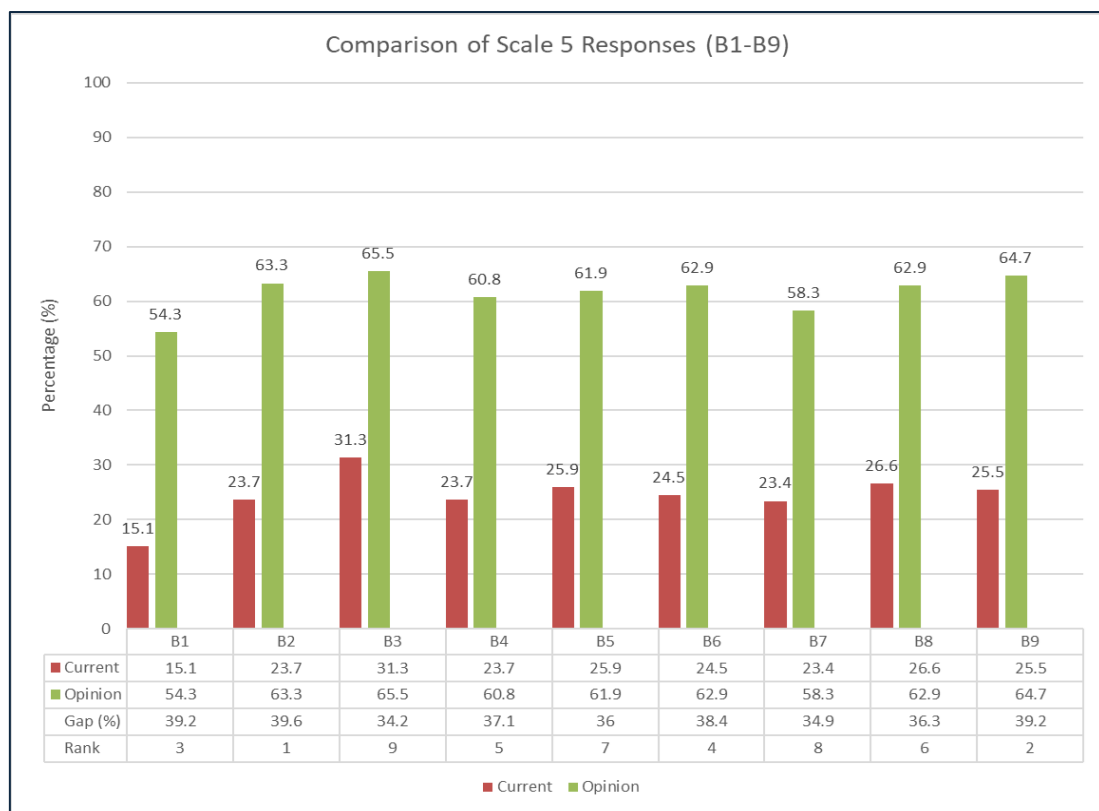
Category	Sub-category	Frequency (n)	Percentage (%)
<b>Academic Qualification</b>	PhD	47	16.9
	Master’s Degree	156	56.1
	Bachelor’s Degree	63	22.7
	Diploma	7	2.5
	Other	5	1.8
<b>Employment Sector</b>	Government	139	50.0
	Private	139	50.0
<b>Years of Experience</b>	< 10 years	12	4.3
	11–15 years	51	18.3
	16–20 years	163	58.6
	> 20 years	53	19.1
<b>Type of Projects</b>	Infrastructure	167	60.1
	Social Amenities	40	14.4
	Commercial/Office	38	13.5
	Residential	31	11.0
<b>Projects Managed</b>	< 10 projects	4	1.4
	11–20 projects	31	11.1
	21–30 projects	144	51.6
	> 30 projects	101	36.0

#### 1.5 The Current Practices of Professional Development Among Civil Engineers in Construction Management Within Both Government and Private Sectors

Based on Figure 2, a survey was conducted among civil engineers in Selangor, involving participants from both government and private sectors, to identify the current practices of professional development in construction management. The term current refers to the existing practice level of each criterion as rated by respondents based on their organizational experience, whereas opinion represents their perceived importance or expected priority. Each criterion was evaluated using a 5-point Likert scale (1 = Very Low to 5 = Very High). The analysis begins with the highest-ranked criteria to enhance readability. The assessment was based on nine key categories from Section B of the questionnaire.

The findings demonstrated significant gaps between the current practice levels and the perceived importance of these categories. For Technical Skills (B1), only 15.1% of respondents rated the current practice at the highest level (Scale 5), while 54.3% considered it very important for construction management roles. Similarly, for Project Management Skills (B2), the current implementation was rated at 23.7%, compared to 63.3% who regarded it as essential. The area of Health, Safety, and Environment (B3) showed the highest current practice percentage at 31.3%, yet 65.5% of

respondents believed it should be a top priority. In abilities such as Innovation and Technology Integration (B4) and Sustainability and Environmental Responsibility (B5), current practice ratings were 25.9% and 23.4% respectively, while their perceived importance was 62.3% and 60.8%. Similarly, Time Management and Productivity (B6) showed a current practice rate of 24.2%, although 62.9% of participants rated it as very important. The lower rate of current practice implementation was observed in Crisis and Disaster Management (B7), Regulatory and Legal Compliance (B8), and Soft Skills (B9), with ratings of 26.3%, 26.6%, and 26.8% respectively, while their importance ratings were 64.2%, 59.6%, and 64.7%. The analysis of these findings revealed significant gaps between current practice and perceived importance across all competencies, with the highest gaps recorded for Project Management Skills (39.6%) at Rank 1, Soft Skills (39.2%) at Rank 2, and Technical Skills (39.2%) at Rank 3. The reasons for these rankings can be justified as Project Management Skills are fundamental for coordinating multiple aspects of construction projects, yet the considerable gap highlights insufficient attention in current practices despite its recognized importance. Similarly, Soft Skills are essential for effective leadership, communication, and teamwork in a multidisciplinary environment, explaining its placement at Rank 2. Besides, Technical Skills, though critical for operational efficiency and quality, are often assumed to be acquired through experience rather than structured development, resulting in its significant yet slightly lower emphasis in practice. These results clearly indicate a significant disparity between existing professional development practices and the expectations of civil engineers working in both sectors. Thus, these findings suggest urgent actions for organizations in Selangor’s construction industry to enhance professional development programs, particularly in technical expertise, project management, safety practices, and soft skills, to align with the evolving demands of the construction management profession. These findings align with Ferrada et al. (2013) and Arnold and Javernick-Will (2013), who similarly identified project management proficiency as a key challenge in professional practice. However, unlike their contexts, the Malaysian setting reveals stronger emphasis on regulatory compliance but weaker integration of sustainability, likely due to differing institutional priorities and resource availability.



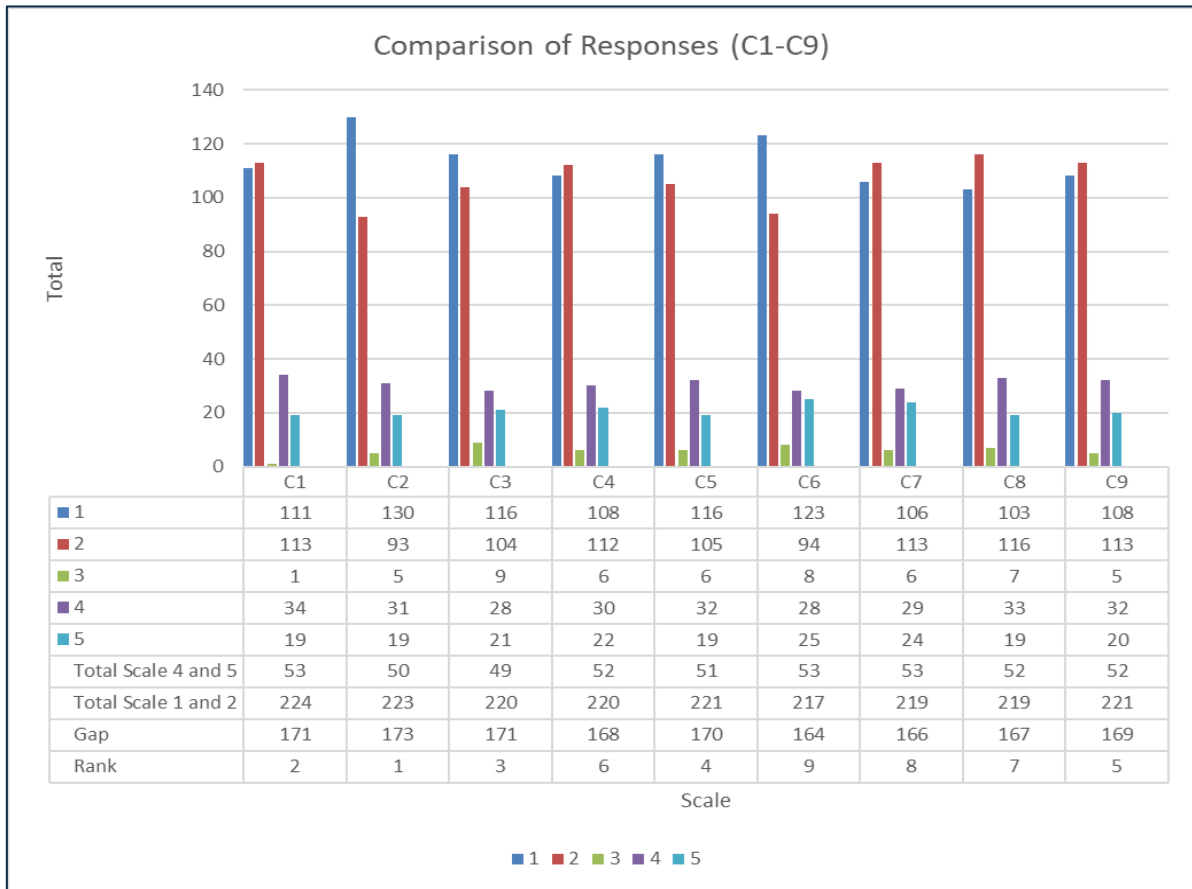
**Figure 2.** Current vs Opinion on practices in construction management

### 1.6 The Specific Skill Gaps Present Among Construction Management Professionals

Based on Figure 3, the analysis of responses in Section C of the questionnaire focuses on identifying specific skill gaps among construction management professionals, especially Civil Engineers. Due to the comparison graph of responses for categories C1 to C9, a clear pattern emerged regarding areas of strength and weakness within the

workforce. In comparison, the analysis first identified areas where construction professionals demonstrate enhanced understanding and skills. C6: Time Management and Productivity registered the lowest skill gap with a score of 164, placing it at ninth rank (Rank 9). This result indicates that most professionals are sufficiently skilled at prioritizing tasks, optimizing workflows, and ensuring projects are completed within deadlines. It suggests that time management practices are already well-established within the industry. Next, the following are C7: Crisis and Disaster Management with a gap score of 166 at eighth rank (Rank 8) and C8: Regulatory Compliance with a gap score of 167 at seventh rank (Rank 7). The lower rankings for these categories suggest that professionals generally possess a satisfactory level of knowledge and skills in managing emergent issues, adapting to unexpected changes, and understanding local and international building regulations. These competencies appear to be sufficiently embedded in current professional practices, likely due to the emphasis placed on regulatory compliance and risk management in the construction sector. Besides, the categories with the highest observed skill gap are C2: Project Management Skills, which ranked first (Rank 1) with a gap score of 173. This result indicates a significant deficiency in the ability of construction professionals to effectively use project management software such as MS Project and Primavera. The relatively high number of respondents selecting the lower scales (1 and 2) combined with a lower total of high agreement (Scales 4 and 5) suggests that this skill is an area where understanding and practical application are lacking. It highlights an essential requirement for targeted training and professional development in project scheduling, resource management, and software operation skills to improve overall project performance. The second-highest gap was recorded in C1: Technical Skills, with a gap score of 171, placing it in second rank (Rank 2). This reflects concerns about insufficient understanding among professionals regarding current construction methods, materials, and the latest technological advancements. These findings suggest that while some professionals possess adequate technical skills, a substantial portion of the workforce may struggle to keep up with evolving industry standards. This underscores the importance of continuous technical education, hands-on workshops, and exposure to innovative construction practices. The third rank (Rank 3), also with a gap score of 171, is C3: Health, Safety, and Environment (HSE). This finding factors to insufficient knowledge and awareness of local health, safety, and environmental regulations among construction professionals. Given the critical role that HSE plays in ensuring worker safety, environmental protection, and regulatory compliance on-site, this skill gap is particularly concerning. It emphasizes the necessity for ongoing HSE training, workshops, and integration of safety practices into daily operations.

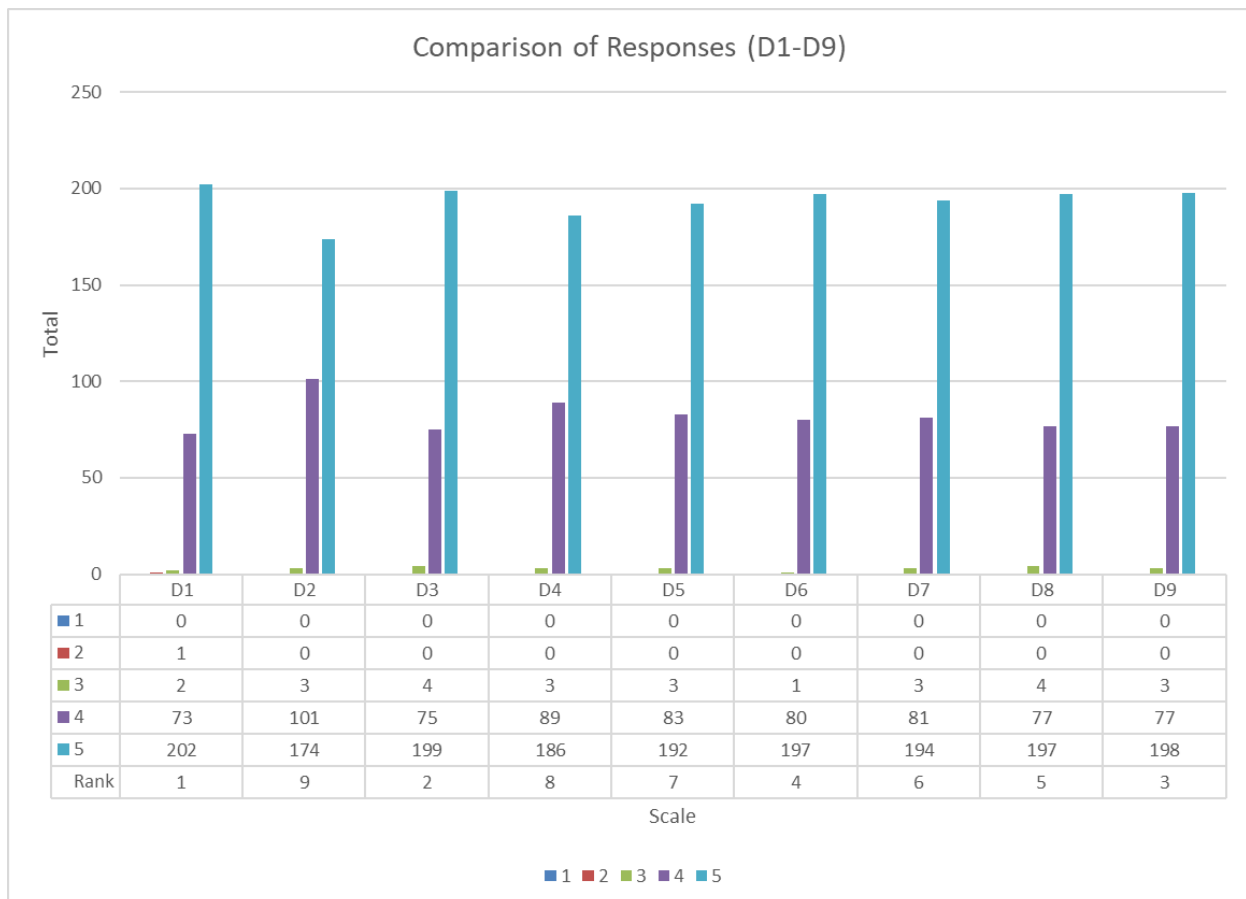
As conclusion, the analysis of Section C showed that Time Management and Productivity, Crisis and Disaster Management, and Regulatory Compliance are the areas where construction management professionals demonstrate stronger skills and capability. Meanwhile, Project Management Skills, Technical Skills, and Health, Safety, and Environment (HSE) are the most significant areas of concern, requiring immediate actions through structured training programs and capacity-building initiatives. These insights are crucial for guiding authorities, professional institutions, and industry leaders in designing targeted professional development initiatives to address the most essential skill gaps while maintaining strengths in other areas.



**Figure 3.** Current skills gaps in construction management

### 1.7 The Strategic Recommendations for Enhancing Professional Development in Construction Management

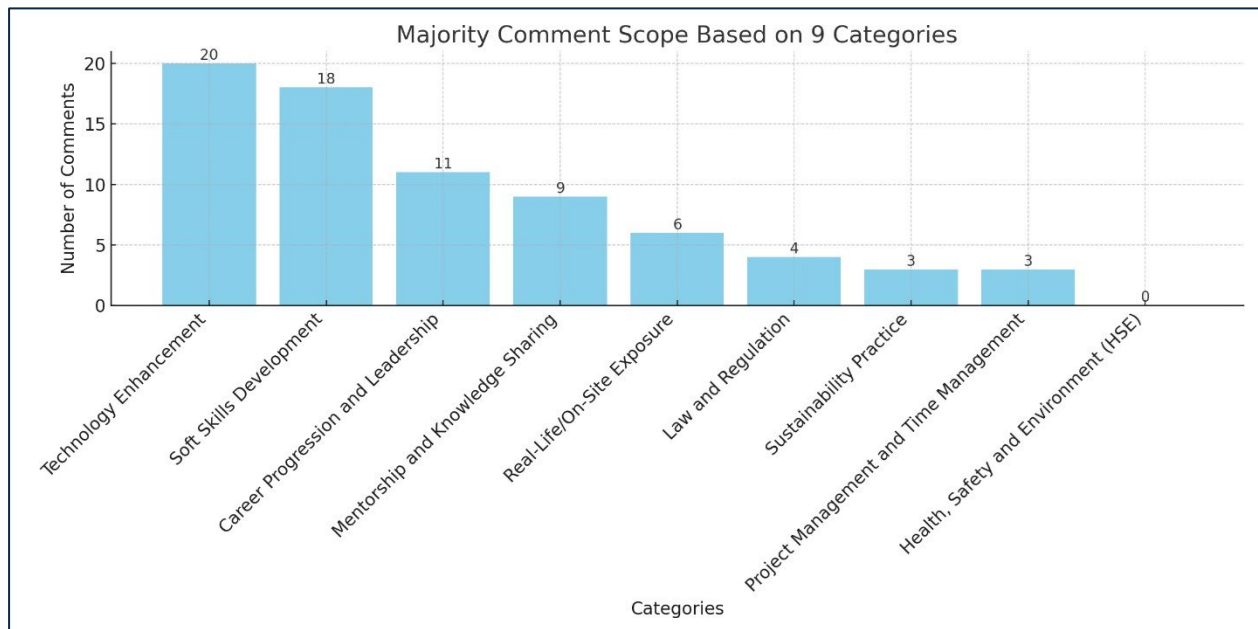
Based on Figure 4, the analysis of the graph for Section D reveals the top three recommended professional development areas that received the highest agreement from respondents. The highest-rated category is Technical Skills (D1) at Rank 1, with 202 out of 278 respondents (72.7%) selecting ‘Strongly Agree’. This indicates that hands-on workshops and technical training are considered essential by most construction professionals, as technical competencies form the foundation for efficient project execution and the effective use of modern construction technologies such as AutoCAD, BIM, and Primavera. This strong preference reflects the growing need for professionals to be proficient with current tools and construction methodologies to maintain productivity and quality standards. The second highest recommendation is Health, Safety, and Environment (D3) at Rank 2, with 199 out of 278 respondents (71.6%) selecting ‘Strongly Agree’ and supporting safety drills and environmental sustainability training. This emphasizes the industry’s recognition of the importance of prioritizing workplace safety and environmental awareness within project management practices. Given the high-risk nature of construction sites, a comprehensive understanding of health, safety protocols, and environmental regulations is vital to prevent accidents, protect workers, and ensure compliance with legal standards. The high agreement rate highlights that professionals value continuous improvement in these areas to reduce project risks and uphold industry best practices. Next, the third highest (Rank 3) is Soft Skills Development (D9), gained 198 out of 278 respondents (71.2%) in strong agreement. This highlights a clear demand for communication, leadership, teamwork, and negotiation skill training, reflecting the industry’s acknowledgment that technical expertise alone is insufficient for successful construction project delivery. Effective collaboration among stakeholders, timely decision-making, conflict resolution, and team leadership are crucial in managing complex construction projects. The result underscores the belief that well-developed soft skills complement technical capabilities, contributing to better coordination, problem-solving, and overall project success. Thus, these three areas demonstrate where the industry sees the greatest value in professional development initiatives, and they should be prioritized in future training programs to enhance the competency and performance of construction management professionals.



**Figure 4.** Strategic recommendations

### 1.8 Respondents Recommendations

Based on Figure 5, the analysis of open-ended responses from the questionnaire, most comments focused on Technology Enhancement, which was mentioned in 20 comments (27.03%). This indicates that respondents strongly emphasized the need for continuous exposure and upskilling in digital tools, software applications, and emerging technologies such as Building Information Modelling (BIM) and drone integration in construction projects. The second most highlighted area was Soft Skills Development, with 18 comments (24.32%) recommend for improved communication, leadership, teamwork, and negotiation abilities among engineers to better manage project stakeholders and on-site teams. Career Progression and Leadership opportunities were also a notable concern, receiving 11 mentions (14.86%), suggesting a need for clearer career pathways and leadership training programs. This was followed by Mentorship and Knowledge Sharing 9 comments (12.16%), where respondents agreed for more structured peer learning, mentoring systems, and regular feedback sessions within organizations. Other areas such as Real-Life/On-Site Exposure 6 comments (8.11%), Law and Regulation with 4 comments (5.41%), Sustainability Practice with 3 comments (4.05%), and Project Management and Time Management with 3 comments (4.05%) were also acknowledged, though to a lesser extent. Interestingly, Health, Safety and Environment (HSE) did not receive direct mention in the open comments, implying it may not currently be a top-of-mind issue for respondents, or that existing practices are perceived as adequate. This feedback highlights that while technical expertise remains essential, there is growing recognition of the importance of leadership, digital competency, and interpersonal skills in advancing professional development within the Malaysian construction industry.



**Figure 5.** Respondents' comments

## 5. Conclusion

This study successfully achieved its objectives by systematically examining current professional development practices, identifying specific skill gaps, and proposing targeted strategies to enhance the competencies of civil engineers in construction management within Selangor, Malaysia. This study is limited to Selangor-based respondents, which may not fully reflect the national context of Malaysia's construction sector. Future research should expand the sample to other regions and incorporate qualitative methods such as interviews to capture in-depth insights into skill development pathways. The findings reveal substantial discrepancies between existing training provisions and the skills required to address the increasing demands of the modern construction industry. Notably, technical skills, project management, health and safety, and soft skills demonstrated significant gaps between their current application and perceived importance. The technical and management gaps identified in this study directly inform the proposed strategies of blended learning, hands-on workshops, and mentorship schemes. These targeted approaches address the precise areas of deficiency of technical skills, HSE compliance, and leadership capacity to ensuring alignment between diagnosed needs and development interventions.

The analysis further confirmed that many professionals lack practical capabilities, particularly in digital construction tools, regulatory compliance, sustainability practices, and crisis management. Open-ended responses also underscored a strong industry demand for continuous upskilling in technological proficiency, leadership development, and structured mentorship. These results directly address the research problem, affirming that current professional development initiatives remain insufficiently aligned with evolving industry complexities, technological advancements, and regulatory requirements. The proposed strategies including blended learning models, hands-on workshops, real-world case studies, and knowledge-sharing platforms offer practical pathways to bridge these gaps. Beyond addressing immediate needs, the study contributes to the construction industry's long-term resilience by fostering continuous professional learning, strengthening leadership capacity, and enhancing digital competencies among civil engineers. Ultimately, this research underscores the necessity of a responsive, integrated, and competency-based professional development framework to cultivate a workforce capable of navigating the dynamic challenges of the construction sector. It provides a valuable reference for regulatory bodies, industry leaders, and academic institutions in designing forward-looking, practice-oriented development initiatives. Although this study is regionally focused on Selangor, its implications extend to other Malaysian states and developing countries facing comparable challenges in professional training, resource allocation, and competency standardization within the construction sector. The proposed strategies may be implemented through partnerships between the Board of Engineers Malaysia (BEM), construction associations, and academic institutions to design blended learning programs, technical workshops, and leadership training initiatives. Such collaborations will ensure that professional development frameworks remain responsive to industry needs and aligned with national competency standards.

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## Declaration of Conflicting Interests

All authors declare that they have no conflicts of interest.

## Author Contribution

Conceptualization, Norfazrin Yasmin and Nurul Elma Kordi; Methodology, Norfazrin Yasmin and Nurul Elma Kordi; Formal Analysis, Norfazrin Yasmin; Investigation, Norfazrin Yasmin; Data Curation, Norfazrin Yasmin; Writing – Original Draft Preparation, Norfazrin Yasmin; Writing – Review & Editing, Nurul Elma Kordi; Supervision, Nurul Elma Kordi; Project Administration, Nurul Elma Kordi; Funding Acquisition, Nurul Elma Kordi.

All authors have read and agreed to the published version of the manuscript.

## **Declaration of Generative Ai in The Writing Process**

During the preparation of this work, the author(s) used ChatGPT (OpenAI) to assist in language editing, sentence refinement, and improving the overall readability of the manuscript. The authors subsequently reviewed and revised the generated content as necessary and assumed full responsibility for the final content of the publication.

## **Data Availability Statement**

The data supporting the findings of this study are available within the article. Additional data may be obtained from the corresponding author upon reasonable request.

## **Ethics Statement**

This study involved voluntary participation from civil engineers through a structured survey. The research procedures were conducted in accordance with the ethical standards and institutional guidelines of Universiti Teknologi MARA (UiTM). Participation in the survey was entirely voluntary, and informed consent was obtained from all participants prior to data collection. All responses were anonymised, and the confidentiality of the participants was strictly maintained throughout the research process.

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