International Journal of Construction Management

ISSN: 1562-3599 (Print) 2331-2327 (Online) Journal homepage: www.tandfonline.com/journals/tjcm20

Sustainable employability assessment of construction workers in Hong Kong: challenges and improvement strategies

Vivian W. Y. Tam, Ivan Wing Hong Fung, Ana C. J. Evangelista, Yijun Zhou, Lei Liu & Wing Yee Chan

To cite this article: Vivian W. Y. Tam, Ivan Wing Hong Fung, Ana C. J. Evangelista, Yijun Zhou, Lei Liu & Wing Yee Chan (17 Dec 2025): Sustainable employability assessment of construction workers in Hong Kong: challenges and improvement strategies, International Journal of Construction Management, DOI: 10.1080/15623599.2025.2591710

To link to this article: https://doi.org/10.1080/15623599.2025.2591710

INTERNATIONAL JOURNAL OF CONSTRUCTION MANAGEMENT
https://doi.org/10.1080/15623599.2025.2591710

Sustainable employability assessment of construction workers in Hong Kong: challenges and improvement strategies

Vivian W. Y. Tam[a], Ivan Wing Hong Fung[b], Ana C. J. Evangelista[c], Yijun Zhou[a], Lei Liu[a] and Wing Yee Chan[d]

[a]School of Engineering, Design and Built Environment, Western Sydney University, Penrith, Australia; [b]Southwest Petroleum University, Chengdu, China; [c]Engineering Institute of Technology, West Perth, Australia; [d]City University of Hong Kong, Kowloon, Hong Kong

ABSTRACT

The construction industry in Hong Kong faces significant labour challenges, including an ageing workforce, declining work ability, and difficulty attracting and retaining talent. A literature review of 25 relevant publications revealed few empirical studies on factors affecting the sustainable employability of construction workers, though some research has addressed issues like physical strain and job satisfaction. This study aims to explore the key factors influencing long-term employability in the industry. Using a qualitative approach, it involved site observations and semi-structured interviews with nine frontline workers across three projects. The results identified three main factors: physical, psychological, and organisational/industry-level. Key findings include: 1) musculoskeletal disorders and age-related physical decline are common but underreported due to wage models and site culture; 2) psychological factors like job control and social support are crucial for maintaining motivation and wellbeing; and 3) organisational factors, such as payment structures and safety practices, impact work ability and retention. The study suggests that sustainable employability cannot be improved through isolated interventions and proposes strategies like monthly wage systems, mentoring programs, agesensitive task allocations, and wellness measures. Despite its limited sample size, the study provides valuable insights for developing labour policies to enhance sustainable employability in Hong Kong's construction sector.

ARTICLE HISTORY
Received 1 December 2024
Accepted 30 October 2025

KEYWORDS
Construction workers; Hong Kong; musculoskeletal disorder; sustainable employability; workability

Introduction

The construction sector plays a crucial role in Hong Kong's economy. As the sixth-largest employer, it contributed 4.2% to the Gross Domestic Product (GDP) of Hong Kong in 2020 (Census and Statistics Department 2022). The Construction Industry Council (CIC) projected the industry expenditure reaching HK$250 to HK$305 billion over the next five years, showing strong market demand. However, it faces growing challenges in meeting such demand due to a persistent labour shortage and an ageing workforce. Unlike office-based or service jobs, construction work is physically demanding, often requiring prolonged standing, heavy lifting, working at heights, and under extreme weather. These unique sector characteristics amplify the impact of demographic shifts and make talent attraction and retention even more difficult. The overall labour force in Hong Kong is expected to decline after 2022, reaching 3.51 million by 2031 (Census and Statistics Department 2023). Significantly, the current average age of construction workers is around 46, with about 37.7% of skilled workers aged 55 or above (Construction Industry Council 2019). Although the experience and expertise of order workers are valued, their

CONTACT Vivian W. Y. Tam vivianwytam@gmail.com School of Engineering, Design and Built Environment, Western Sydney University, Locked Bag 1797, Penrith, NSW 2751, Australia.

retention is challenged by the natural decline in physical capacity with age (Gibb et al. 2013; Ng and Chan 2015). In response, the Hong Kong government and the CIC have implemented a range of initiatives to attract younger talent, such as career fairs, apprenticeships, and scholarships. However, due to high education attainment levels that 56.9% of those over 15 have post-secondary or degree-level education, such blue-collar jobs in the construction industry lack of attractive. Additionally, although CIC has introduced retaining programs for older workers to stay competitive, age-related physical decline leads to increased injuries and reduced performance (Arndt et al. 2005; Choi 2009; Schwatka et al. 2012). Therefore, addressing these issues is crucial to mitigating the labour shortage and enhancing employability for the long-term sustainability of Hong Kong's construction industry.

Employability refers to the qualities and competencies that enable individuals to gain and maintain employment while realising their aspirations and potential in the workplace (Confederation Of British Industry 1999). Sustainable employability is defined as the ability to remain in work while maintaining health throughout one's life, and is commonly measured by indicators such as work ability, productivity, and absenteeism (Van der Klink et al. 2018; Arends et al. 2010). Many studies have examined employability in the construction sector, identifying both physical and psychological challenges. The ageing workforce has been recognised as a key concern (Ng and Chan 2015). Given the physically intensive nature of construction work, age-related injuries, and chronic health conditions are prevalent (Choi 2009; Dong et al. 2011), and are exacerbated by the natural decline in physical capacity over time (Hedge et al. 2006). High physical demand increases the risk of work-related disabilities, often resulting in premature exit from the construction industry (Arndt et al. 2005; Schwatka et al. 2012). In addition, psychological well-being also plays a critical role. Construction is a high-risk industry for work-related stress, especially among younger workers (Frimpong et al. 2022). A fast-paced work culture and high uncertainty, coupled with complex tasks and cooperation among diverse workgroups, contribute to excessive job demands (Love et al. 2010). However, these factors adversely affect mental health and in turn sustainable employability. Although these issues have been widely studied internationally, there remains a lack of empirical studies on the specific socio-economic and cultural conditions of Hong Kong's construction industry. The persistent labour shortage and low retention rates suggest that existing knowledge has not been effectively applied in the local context. Therefore, there is a pressing need to investigate the underlying causes of unsustainable employability in Hong Kong's construction workforce. There are three research questions to be addressed: 1) What physical, psychological, and organisational factors limit the sustainable employability of construction workers in Hong Kong? 2) What are the perceived barriers that deter new entrants and reduce long-term workforce retention in Hong Kong's construction industry? and 3) What strategies can be implemented to improve sustainable employability in Hong Kong's construction sector?

This study aims to address these research questions. To achieve this, there are three objectives:

- To identify and analyse the physical, psychological, and organisational factors influencing the sustainable employability of construction workers in Hong Kong,
- To examine key organisational and industry-level challenges that hinder the attraction and retention of a sustainable construction workforce.
- To propose evidence-based strategies that address the identified issues and promote sustainable employability in the sector.

This study contributes to understanding both the internal and external factors and challenges affecting sustainable employability in the Hong Kong construction sector, addressing barriers to attraction, retention, and long-term participation through the perspective of current workforce realities. The research unfolds in three phases: literature review, field investigation, and strategy formulation, as shown in Figure 1. The whole paper is structured into six sections and followed by Section Literature review, which reviews global trends and local construction conditions for the employability of workers. Section Research methods then presents the research methods, using on-site observations and worker interviews to validate and explore additional employability challenges from real-world practice. Key factors are obtained and discussed in Section Results and discussions. Finally, Section Recommendations

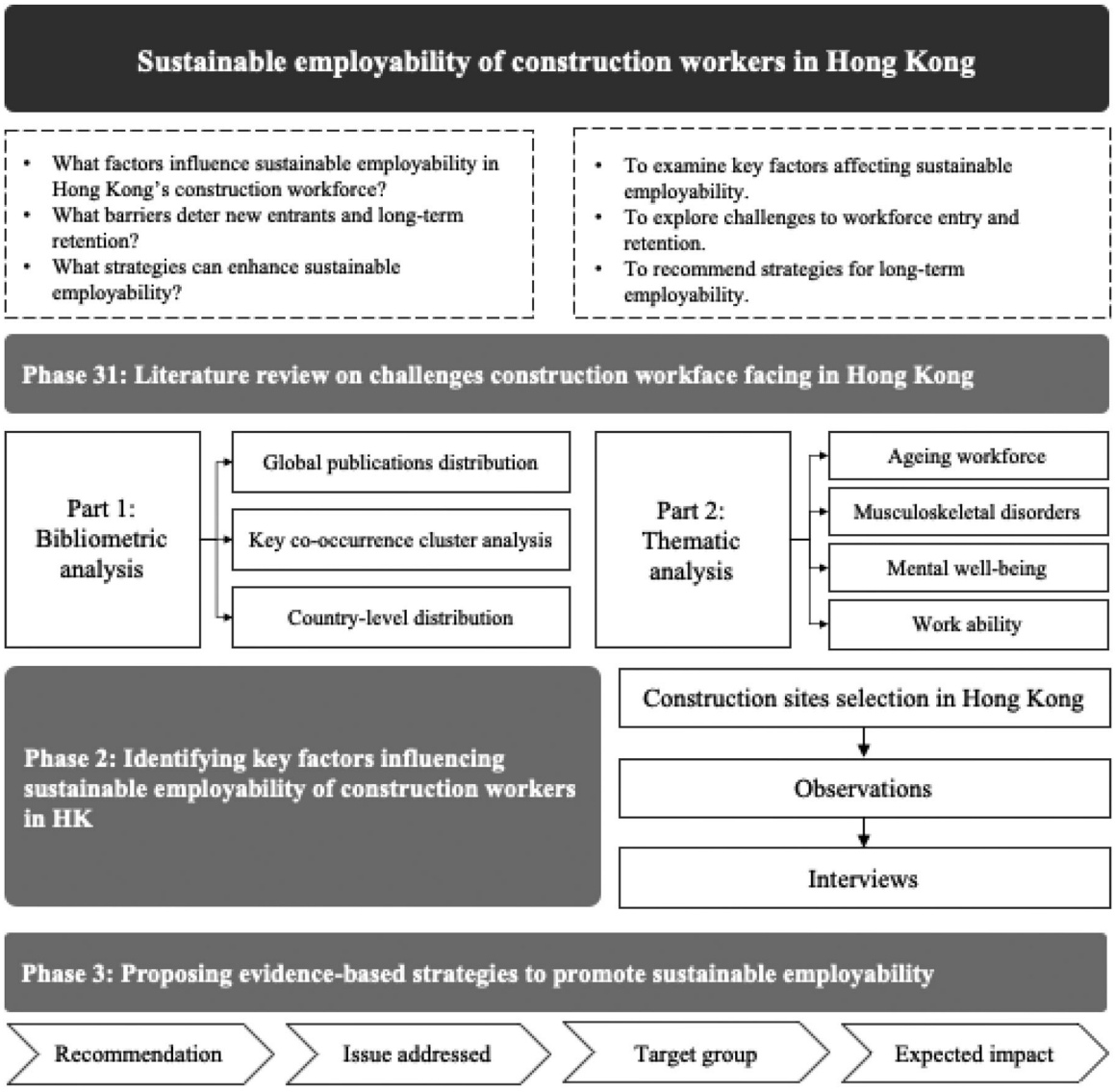

Figure 1. Three-phase research process for this study.

provides evidence-based strategies to enhance both workforce retention and industry attractiveness. The final Section Conclusion concludes the study's insights and implications.

Literature review

To support a deeper understanding of sustainable employability in Hong Kong's construction industry, this section reviews existing studies to clarify what is already known and where knowledge gaps remain. The aim of the literature review is to establish a strong foundation for the necessity of sustainable employability assessment by key bibliometric analysis from a global perspective and thematic analysis from a local perspective.

Bibliometric analysis

To identify key factors influencing the employability of construction workers in Hong Kong, a bibliometric analysis was conducted to help filter studies from a lot of information. Also, it can identify global publication trends, thematic clusters, and geographical distributions of this theme. Two high-quality and peer-reviewed databases, Scopus and Web of Science (WoS), were used to retrieve relevant literature. Search terms comprise three parts: target areas (such as construction industry, civil engineering, and infrastructure sector) AND research boundary (like labour force, site workforce, and trade

Table 1. Summary of search strategy and screening criteria for bibliometric analysis.

	Target areas	Research boundary	Measured objects
Search terms Extension words	Construction industry • Civil Engineering • Infrastructure sector • Skilled trades	Workforce • Labour force • Construction workers • Blue-collar workforce • Site workforce • Trade professionals	Employability • Work ability • Labour retention • Workforce ageing • Physical capacity • Mental health • Sustainable employability • Productivity
Databases	Scopus and Web of Science (WoS)		
Screening criteria	Inclusion: • Peer-reviewed journal articles, conference papers, book chapters, and government documents • Published between 1980 and 2022 • Focus on employability issues in construction or related sectors • Global or country-specific studies • Different countries/regions		Exclusion: • Non-English language papers • No full-text versions • Before 1980 • Not related to the construction workforce or employability • Purely technical studies without workforce focus

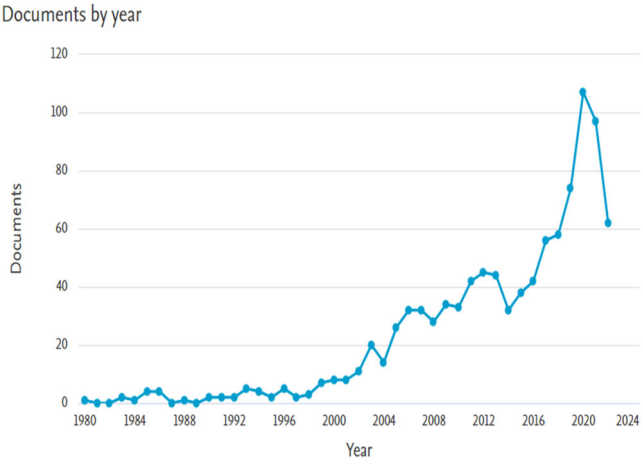

Figure 2. Publications on the theme of the construction industry workforce.

professionals) AND measured objects (employability-related dimensions). Furthermore, publications were filtered based on defined inclusion and exclusion criteria (Table 1), and the final analysis was conducted by three main steps: 1) initial keyword filtering based on the defined scope, 2) keyword co-occurrence mapping using VOSviewer to identify research clusters, and 3) analysis of country-level publication output. Overall, these steps ensure a comprehensive overview of the global academic discourse surrounding construction workforce employability.

By initial screening, 990 papers from Scopus and 815 papers from WoS were collected. After removing duplicates, the annual publication trend on the theme of the construction industry workforce from 1980 to 2022 was obtained, as shown in Figure 2. Significantly, the number of publications remained at a lower level before 2000, indicating limited attention in the construction industry. An obvious growth began around 2005, with a sharp acceleration after 2015, peaking significantly in 2021 with close to 100 documents. This growth suggests increasing interest in construction workforce challenges such as labour shortages and safety risks. However, a sudden drop in 2022 is potentially from the declining global real estate market caused by the COVID-19 pandemic.

Figure 3 shows the keyword co-occurrence clustering of the collected literature, revealing four distinct research themes. The red cluster focuses on the construction industry and its operational aspects, featuring keywords like construction equipment, management, students, and training, which highlight main issues related to workforce development, education, and productivity. The green cluster centres on health and safety, with keywords such as injuries, accidents, and occupational risk, indicating a strong focus on managing physical risks and promoting well-being on construction sites. The blue cluster is concerned with labour and employment issues, containing terms like employment, gender, trade

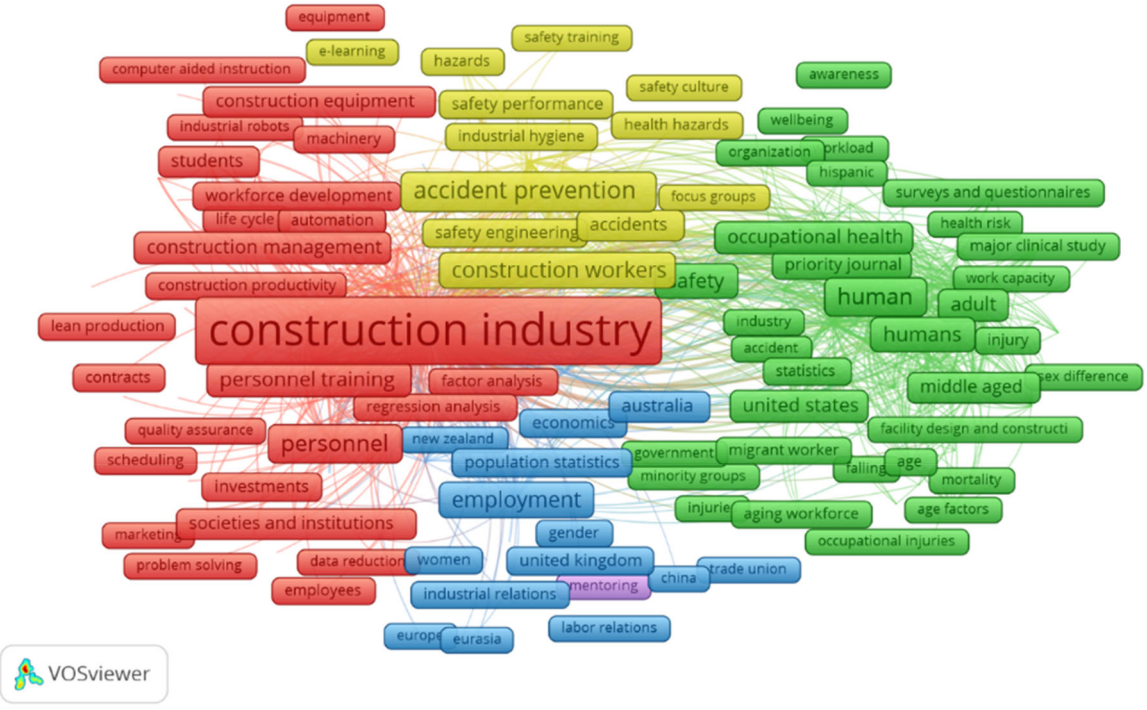

Figure 3. Keyword co-occurrence clustering of global construction workforce literature (1980–2022).

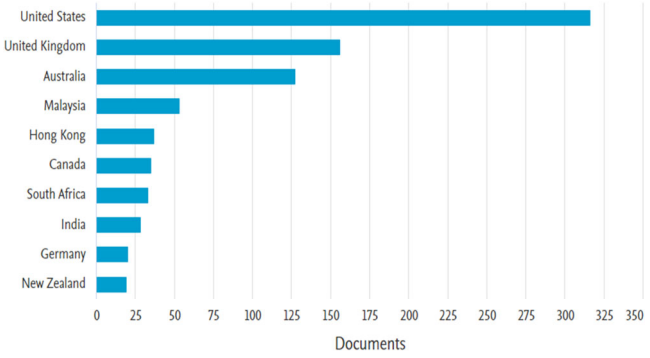

Figure 4. Country-level distribution of publications on construction workforce research (1980–2022).

unions, and labour relations, reflecting social and economic perspectives on workforce composition and conditions. Finally, the yellow cluster connects themes such as safety performance, hazards, industrial hygiene, and e-learning, indicating a more technical and training-oriented focus related to risk mitigation and safety improvement. Together, these clusters demonstrate that global research on construction workforce employability spans across managerial, social, health, and technological dimensions.

Figure 4 illustrates the country-level distribution of publications between 1980 and 2022. It was found that the USA dominates the field, followed by the UK and Australia. Although Hong Kong ranks among the top contributors, its number is not conspicuous (only 25 articles) compared to larger English-speaking countries. This indicates the construction workforce in Hong Kong is underrepresented in the global literature, although it is a major construction centre in Asia. In addition, it was found that many of these articles do not directly address sustainable employability and the physical and psychological challenges faced by local workers. Therefore, it is necessary to further investigate local employability challenges in Hong Kong.

Thematic analysis of sustainable employability

The bibliometric analysis in Section Bibliometric analysis provided a comprehensive overview of global research trends related to the construction workforce and employability. Although the global perspective

revealed diverse research directions, ranging from occupational health to workforce ageing, it also indicates the obvious gaps in literature specifically focused on the sustainable employment capabilities of construction workers in Hong Kong. Significantly, among the 25 Hong Kong-related publications identified, many lacked direct discussion on the long-term employability and the physical or psychological pressures experienced by local workers. After reviewing all 25 Hong-Kong-focused studies, four interrelated themes were summarised and critically discussed below: (1) ageing workforce, (2) musculoskeletal disorders, (3) psychological factors, and (4) work ability. These themes represent key dimensions of workforce vulnerability and offer essential insight into the challenges shaping sustainable employability in Hong Kong's construction industry.

Ageing workforce in Hong Kong

Many older workers are encouraged or willing to prolong their working lives to improve their financial situation (Toossi 2009). Consequently, the number of older workers in the construction industry is expected to increase in the coming years. Ng and Chan (2015) highlighted that the challenges associated with an ageing workforce are projected to intensify over the next five years. The industry is anticipated to face a shortfall of 5,000 to 10,000 skilled workers in trades such as concreting, carpentry, plastering, and welding (Construction Industry Council 2019). Currently, younger workers aged 30 or below constitute only 16% of the entire construction workforce. Older construction workers often suffer from poor physical and mental health (Peng and Chan 2020). The high physical demands of construction work increase the risk of developing musculoskeletal disorders, particularly in the back and lower extremities (Boumans et al. 2008; Van Solinge and Henkens 2010). This makes it more challenging for older workers to meet the industry's physical demands, such as lifting and manually handling heavy loads. Additionally, older workers experience higher rates of severe accidents compared to their younger counterparts, and poor work ability is linked to low musculoskeletal capacity, high physical workload, and mental demands (Van Den Berg et al. 2009).

Intrinsic and extrinsic motivations perceived by older workers influence their productivity and retirement decisions (Hashiguchi et al. 2020). Studies have shown that different groups, such as males and females, are affected differently by the same factors (Larsen 2008). For example, older employees, men, and those who sometimes use force are more motivated to work longer. Moreover, older construction workers with a positive attitude towards retirement tend to have higher job satisfaction and better mental health. However, many older workers are reluctant to retire due to financial constraints and a lack of retirement planning. Factors such as the value placed on leisure time, well-developed retirement schemes, and life expectancy may influence one's preference for early retirement (Boumans et al. 2008; Van Solinge and Henkens 2010). Overall, these findings suggest that retaining older workers in construction requires addressing not only their physical vulnerabilities but also their financial concerns, psychological needs, and attitudes toward retirement. Without effective interventions, the growing dependence on ageing workers will probably undermine sustainable employability in Hong Kong's construction industry.

Musculoskeletal disorders (MSDs)

Musculoskeletal disorders (MSDs) are common among the working population, especially in the low back region, neck, and upper limbs (Waris 1979; Armstrong et al. 1982). These conditions affect muscles, tendons, joints, and peripheral nerves, often resulting from mechanical strain. Although all workers are affected, older individuals are more easily impacted due to age-related physiological decline. Particularly, the construction industry is at a higher risk for work-related MSDs compared to other occupations. Construction work requires more physical force than non-construction jobs. Broersen et al. (1995) describe the construction industry as highly physically strenuous, based on an occupational health survey comparing the general working population with construction workers. The high risk of MSDs in the construction industry results from heavy workloads, repetitive lifting, awkward positions, static work postures, lifting heavy weights, unexpected physical impacts, and working while injured or in pain (Wang et al. 2015; Palikhe et al. 2020). Additionally, the industry's tight schedules and fast-paced culture increase the speed of work, raising the risk of MSDs and acute injuries.

Figure 5. The main factors related to the work-related MSDs.

Additionally, the physical workload of construction workers varies by trade (Gram 2012). Manual lifting of heavy loads is often associated with low-back muscle strains and intervertebral disc lesions, while frequent handling of loads is related to shoulder disorders (Rijn et al. 2010). Extended standing contributes to lower limb fatigue, and working with hands above shoulder height is closely linked to neck and upper back pain. Through reviewing relevant literature, a summary of the main factors related to the work-related MSDs was obtained, as shown in Figure 5. Specific impacts caused by the factors and references are presented in the Appendix. Overall, a combination of physiological, behavioural, organisational, and psychosocial factors contributes to the high incidence of work-related MSDs in construction. MSDs not only reduce work ability but also pose a major barrier to sustainable employability in the construction sector.

Mental well-being

In addition to physical challenges, mental health is another crucial and often overlooked factor influencing workforce retention and overall employability in the construction industry, which is also considered high-risk for work-related stress (Love et al. 2010). This is due to the industry's fast-paced culture, where workers must juggle multiple tasks, keep track of ongoing changes in construction processes, and work under high uncertainty and complexity, often involving diverse workgroups. Consequently, workers face excessive job demands (Love et al. 2010). Job stress, stemming from the work environment, is a continuation of general stress (Wu et al. 2018). Some studies verified that job stress not only threatens workers' health but also negatively impacts their performance (Wei et al. 2016; Wu et al. 2018). Prolonged, high-level job stress can lead to mental fatigue, causing workers to adopt awkward body postures and engage in unsafe behaviours. These findings emphasise the interconnection between mental and physical health and highlight the need to address both aspects for overall employee well-being.

Mental wellness is a significant factor for productivity, participation, and workplace inclusion. High social support is essential for coping with stress and mental health issues (Kroll and Lampert 2011). Social support from colleagues and supervisors is also a crucial prognostic factor for returning to work, particularly for those with musculoskeletal problems (Bethge et al. 2018). However, the direct effect of social support outside of work on an individual's work ability has not been investigated.

Work ability

Given that both physical and psychological pressures affect an individual's ability to remain active in construction, the concept of work ability can serve as a comprehensive indicator of sustainable employability. It encompasses a worker's current and anticipated capacity to meet job demands, accounting for physical health, mental resources, and workplace context (Ilmarinen et al. 2005). Maintaining suitable work ability provides significant socio-economic benefits, including increased productivity and reduced

Figure 6. Main factors influencing work ability.

early retirements (Feldt et al. 2009). For industries facing workforce shortages, such as construction, identifying the criteria for achieving suitable work ability is crucial for prolonging employability.

Many studies discussed in the previous sections have confirmed that poor work ability is associated with both physical strain and mental stress, exacerbated by poor ergonomics, lack of job control, and inadequate social support (Van Den Berg et al. 2009; Ng and Chan 2015). Conversely, workers who experience good health, strong peer support, effective job design, and long-term career planning tend to report higher work ability and greater job satisfaction. As summarised in Figure 6, work ability is influenced by a broad range of factors, including age, body mass, health status, lifestyle, individual competence, job characteristics, and psychosocial support. Details are shown in the Appendix. These factors do not act in isolation, but their interplay determines a worker's capacity to remain productive and engaged over time.

Overall, enhancing work ability requires integrated strategies that go beyond addressing isolated physical and mental health concerns. Instead, policies should aim to holistically improve workplace design, promote health and well-being, foster inclusive job roles, and support long-term employability across different age groups and worker profiles.

Research gaps

This literature review has provided a two-tiered analysis of sustainable employability in the construction industry. A global bibliometric analysis outlined the prevailing research themes across psychological, physical, and organisational domains. Subsequent localised review of 25 Hong Kong-focused studies revealed four main challenges: an ageing workforce, high prevalence of musculoskeletal disorders, poor mental health support, and diminishing work ability. These issues are compounded by sector-specific characteristics such as fast-paced project cycles and labour-intensive tasks. However, despite the growing academic attention paid to employability in Hong Kong's construction industry, existing studies often focus on examining isolated factors, such as ageing, health or job satisfaction, without integrating these factors into a comprehensive framework. In addition, there is limited empirical research that concretises and studies these factors through engagement with frontline workers or the realities of construction sites. This fragmented research approach limits our ability to develop sustainable employability strategies that are tailored to local conditions, targeted and holistic.

Research methods

Study design

Given the limited empirical studies for assessing sustainable employability of construction workers in Hong Kong identified from the literature review, this study adopts a basic qualitative and field-based

approach to investigate the factors influencing sustainable employability in Hong Kong's construction industry. Through on-site observations and semi-structured interviews, the study contextualises and validates themes identified in the literature, while uncovering new insights rooted in actual construction settings. Such qualitative design allows for an in-depth understanding of the physical and psychological challenges faced by local workers, as well as the socio-organisational context that shapes their long-term employability. Data were gathered through:

1. Targeted site observations at selected representative projects,
2. Semi-structured interviews with key on-site personnel,
3. Comparative analysis of interview notes to identify commonalities and differences.

Data collection

Sites selection

To verify and explore key factors influencing sustainable employability in the construction industry in Hong Kong, three actual construction sites were representatively selected, including a private residential project (LOHAS Park (Phase 4)—Wings at Sea) and two public housing cases (Fuk Loi Estate, and Cheung Hong Estate). The difference in project scale, work scope, and management structures allows for a more representative observation of working conditions, safety practices, and worker experiences across Hong Kong's industry. Table 2 presents an overview of the three sites, including location, project type, developer, current work status, and on-site photographs.

Observations

While visiting the three construction sites, direct observations were conducted to provide contextual insights into physical working conditions, safety measures, spatial constraints, and material handling practices. Observations are a crucial step in field-based research as they can correctly identify specific behavioural patterns and environmental factors that cannot be articulated in other studies, especially in construction-related case studies. Notes and photographs were taken with permission. Table 3 presents a concise synopsis of what was observed at each location, followed by a cross-site comparison. Across the three sites, varying levels of spatial constraint, safety adherence, and material organisation were observed below:

- Space and layout: Lohas Park offered generous staging space; Fuk Loi's bathrooms and corridors were the tightest; Cheung Hong's refuse room sat between the two. Limited space clearly correlated with more awkward body positions.
- Safety adherence: The private project (Lohas Park) displayed the highest compliance with formal safety procedures (mandatory tie-offs and active supervision). Public-estate sites showed mixed practice, depending on task scope and crew size.
- Material organisation: Where materials were pre-staged and cords bundled (Lohas Park), the walking surfaces remained clear; ad-hoc placement (Fuk Loi bathrooms) created trip points.

These observations indicate that the working environment is heterogeneous across Hong Kong projects. Site type, project stage, and space constraints exert strong influence on day-to-day safety behaviour and physical ergonomics.

Interviews

Based on the site observations, semi-structured interviews were conducted with nine respondents across the three selected sites. Such a qualitative approach can gain a deeper understanding of how physical and psychological factors influence sustainable employability in the construction industry in Hong Kong. The participants included a mix of frontline workers, on-site supervisors, safety officers, and one safety auditor. The selection of multiple roles ensured triangulation of perspectives across different levels of the construction hierarchy. The interviews focused on trades known for their high physical demands, including plastering, bricklaying, tiling, and carpentry, where repetitive motion, awkward postures, and MSDs are commonly reported. These roles typically involve high manual labour intensity,

Table 2. Overview of the three construction sites.

Site name	LOHAS Park (Phase 4)—Wings At Sea	Fuk Loi Estate	Cheung Hong Estate
Location	1 Lohas Park Road, Tseung Kwan O	Tsuen Wan, New Territories	Tsing Yi, New Territories
Type of project	Private residential	Public housing improvement	Public housing maintenance
Developer/Owner	MTR Corporation	Hong Kong Housing Authority	Hong Kong Housing Authority
Project stage (at visit)	Final stage: interior finishing & minor works	Ongoing improvement & refurbishment works	Maintenance and renewal work
			

Table 3. Site-specific working conditions and key safety and ergonomics observations.

Site name	Snapshot of the working environment	Illustrative safety/ergonomics notes
LOHAS Park (Phase 4)- "Wings at Sea"	Podium-level finishing of ceilings and walls on a large private residential project	• Full-height aluminium scaffolds, each worker tied off with a safety line. • Unused tools and cable run neatly stowed to keep walkways clear. • Dedicated ground-spotter monitoring work-at-height tasks. • Wide and unobstructed walkways improved material handling
Fuk Loi Estate	Small-scale improvement works inside an occupied public housing block (refuse-room upgrade and vacant-flat refurbishment)	• Minimal equipment (trolley, small buckets) keeps clutter low. • Constrained bathrooms force awkward postures. • Overcast lighting made some work areas dim, raising trip risk.
Cheung Hong Estate	Public-housing maintenance (floor renewal in the refuse room)	• Work zone fully isolated; no loose equipment on the floor. • Clean, obstruction-free surface lowered slip/trip hazards.

Table 4. Profile of nine interview respondents (A–I).

Respondent	Role	Work Trade(s)	Site Location	Age	Years of Experience	Additional Notes
A	Worker	Plasterer	Fuk Loi Estate	39	15+ years	Senior worker; deep trade knowledge; likely experiencing MSDs
B	Worker	Plasterer	LOHAS Park	58	30+ years	Mid-career; still physically active; potential early MSD signs
C	Worker	Bricklayer	LOHAS Park	45	20+ years	Heavy manual tasks; high exposure to physical strain
D	Worker	Tiler, bricklayer, and plasterer	Cheung Hong Estate	52	20+ years	Versatile; works in small and confined spaces (such as bathrooms)
E	On-site supervisor	—	Cheung Hong Estate	23	5+ years	Oversees worker coordination and trade supervision
F	On-site supervisor	—	LOHAS Park	45	20+ years	Monitors the quality and productivity of tasks
G	Safety officer	—	Fuk Loi Estate	40	15+ years	Responsible for safety protocols and hazard reporting
H	Safety officer	—	Cheung Hong Estate	42	15+ years	Enforces safety compliance; monitors new worker behaviour
I	Safety auditor	—	All three sites	55	25+ years	Conducts compliance checks; assesses overall safety culture

awkward working postures, and long work hours, making them particularly relevant for exploring sustainable employability challenges in the local construction context. Additionally, each interviewee had more than 15 years of experience, with most surpassing 20 years in their trade. Their work settings varied: from confined interiors in public housing to structured environments in private residential projects. A summary of their profiles is presented in Table 4. Interview questions were designed around two key domains:

- Physical factors, including the experiences of body pain, and the perceived impacts of ageing,
- Psychological and social factors, including the motivation for entering and remaining in the construction industry, and the perceptions of safety culture, particularly the behavioural differences between novice and experienced workers.

Data analysis

After collecting observations and interview data, all interview recordings were transcribed verbatim and examined manually in three steps. First, salient phrases that reflected workability issues, such as pain descriptions, safety perceptions and career motives, were highlighted directly in the text. Next, those highlights were grouped into provisional categories that naturally aligned with the study's three analytic lenses: physical, psychological, and organisational and industry-level factors. A final consolidation merged overlapping categories and named the factors in Section Results and discussions. Throughout the process, quotations are placed together with each category to maintain context and check if subsequent explanations are faithful to the respondents' words. Representative excerpts are presented in Appendix Table A-2, where each quote is mapped to its interviewee (A–I) and the question that prompted it; these samples illustrate how raw statements underpin the themes. Because only nine

highly experienced respondents were involved, the entire procedure was conducted without qualitative-analysis software, ensuring every comment was reviewed directly by the research team.

Results and discussions

This section presents the key findings derived from field observations and semi-structured interviews conducted across three representative construction sites in Hong Kong. Given the exploratory nature of the study and the limited number of interviewees and site observations, the results focus on the most consistently observed and strongly supported themes. As illustrated in Figure 7, these findings are grouped into three interconnected categories: physical factors, psychological factors, and organisational and industry-level factors. This thematic structure reflects both field patterns and insights from relevant local literature, offering a targeted yet meaningful lens through which to examine the sustainable employability of construction workers.

Physical factors

The construction industry is inherently physically demanding, and physical strain plays a decisive role in workers' willingness and ability to remain in the sector. Not only literature such as from Ng and Chan (2018) but also the observation and interviews verified that physical health is the strongest predictor of sustainable employability, mainly including MSDs and ageing.

Musculoskeletal discomfort

All interviewed workers reported experiencing some level of body discomfort. However, none described their symptoms as chronic or severe. Mr. A mentioned he may be suffering from a frozen shoulder, but was unsure whether it was work-related. Others characterised their pain as mild or occasional. According to the National Institute for Occupational Safety and Health (1997), MSDs are defined as symptoms occurring at least once per week. By this definition, all participants met the clinical threshold for an MSD. However, many workers appeared to accept physical discomfort as a normal part of their job. As Mr. C remarked, "Of course, you'll suffer from body pain working in such an industry." This cultural acceptance of pain reveals a critical disconnect between formal medical definitions and lived experience. When pain is normalised or underreported, it may delay necessary interventions, increasing the risk of long-term health deterioration and reduced employability, as also noted by Reid et al. (2001). However, such MSDs can also erode psychological well-being, such as frustration, fatigue, and reduced motivation. Additionally, the current payment systems may lead workers to avoid reporting pain as they are afraid of losing their income. Therefore, addressing MSDs effectively requires not only ergonomic solutions but also changes in site culture, wage models, and supervisory attitudes.

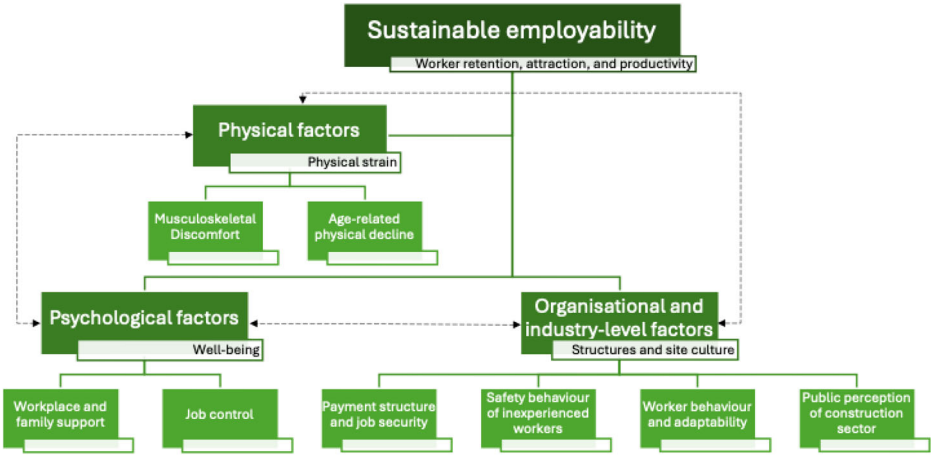

Figure 7. Thematic framework of factors influencing sustainable employability in construction.

Age-related physical decline

Interviewees confirmed that increased age has led to decreased productivity compared to their younger years. "I used to carry more weights (of material) at a time, now I carry less," said Mr. D, aged 45. This aligns with previous research indicating that increased age adversely affects work ability, especially for construction workers (Houston et al. 2009). However, the average age of skilled workers in Hong Kong is 51.4 (Development Bureau of Hong Kong, 2018). If workers at age 45 already experience a decrease in physical strength, this implies an immediate need for policies and equipment to help prolong workers' work ability. Physical decline can also lead to increased stress and reduced confidence. Without organisational support, older workers may exit the workforce early. Therefore, sustaining their employability requires strategies that address not only physical decline but also the psychological and structural pressures that accompany it.

Psychological factors

In addition to physical factors, psychological factors also play a critical role in shaping the sustainable employability of construction workers, linking to both physical performance and organisational conditions. Workers who experience low stress and strong interpersonal support are more likely to maintain healthy behaviours. This section summarised two key dimensions: social support and job control, which emerged prominently from the interviews as influencing workers' motivation, health, and long-term engagement in the industry.

Workplace and family support

Across all three sites, workers consistently described positive relationships with colleagues and supervisors. At LOHAS Park, interviews revealed strong interpersonal bonds. Mr. A shared that they often played mahjong with their supervisors after work, indicating a high level of camaraderie. Similarly, respondents from the maintenance projects at Fuk Loi Estate and Cheung Hong Estate also reported supportive interactions, though not as close-knit as at LOHAS Park. This result has reflected a higher tendency for these workers to have healthier behaviours and better adherence to medical regimens while being free from adverse effects from low levels of social support, such as high mortality rates, according to Uchino (2006). Such workers' workability is also higher (Ng and Chan 2015). Therefore, promoting supportive cultures to the whole organisation can serve as a low-cost but powerful way to improve both morale and long-term employability.

Job control

Job control refers not only to the control that the employee has over their work but also to job security (Ilmarinen et al. 2005). Most plasterers and bricklayers interviewed reported a strong sense of control over their work and stability in their employment conditions. Mr. B (aged 58) explained: "I used to be paid on a daily wage basis. I used to try my best to do as much work as I can since the more you work, the more you earn. But now I don't have to, because now I'm paid every month." This transition from daily to monthly pay reflects a shift toward greater security, reducing financial pressure and improving overall well-being. Smith et al. (2008) emphasised that higher job control is associated with better health outcomes, ultimately contributing to stronger work ability.

However, this sense of security was not universal. Carpenters, as noted by Mr. I (a safety auditor), are often paid per job, creating pressure to complete work quickly to secure future opportunities. This was corroborated by Mr. E (on-site supervisor), who observed that such time constraints often lead carpenters to rush, adopt awkward postures, and neglect safety practices. These behaviours increase the risk of musculoskeletal disorders (MSDs), thereby reducing both health and productivity in the long term. These findings underscore the importance of payment structure and task pacing in shaping both psychological well-being and physical safety on site.

Organisational and industry-level factors

In addition to physical and psychological factors, a range of external organisational and industry-level factors also affect construction workers to remain in or be attracted to the sector. The section summarised four factors and discussed how wage systems, safety protocols, site culture, and public perception align with sustainable employability in Hong Kong's construction industry.

Payment structure and job security

The payment model significantly impacts workers' mental and physical health. In Hong Kong, construction workers are typically paid either monthly or on a job-by-job basis. All interviewees in this study received monthly wages, which they associated with greater job security and reduced stress. For instance, Mr. B explained, "I don't need to rush between jobs anymore because I'm paid monthly." Conversely, when previously paid daily, Mr. B noted he felt pressure to maximise output: "The more you work, the more you earn." Mr. I, a safety auditor, highlighted that carpenters often work under job-based contracts, forcing them to complete tasks quickly to remain competitive: "If it is a 3-day job, they have to finish it in three days, whatever. Once they finish, they have to immediately switch to find the next."

Time pressure resulting from job-based payments is linked to fatigue and MSDs (Wu et al. 2018; Araújo et al. 2022). Gram (2012) similarly argued that fatigue heightens the risk of physical injury. Additionally, Henry and Stephens (2013) emphasised that the imbalance between high effort and low reward may trigger strong emotional stress responses and physiological strain. Mr. G, an on-site supervisor, observed that rushed work often results in awkward postures, which (Holmström et al. 1992) linked to increased MSDs risk. Thus, job-based payment systems can reduce both safety and long-term employability.

Safety awareness of inexperienced workers

Despite well-documented safety protocols across the three sites, including scaffolding use, safety ropes, and visible emergency action plans, interviewees reported concerns about new workers' safety awareness. Mr. E, a 23-year-old supervisor, noted, "New workers don't tend to pay attention to the environment." Under Hong Kong's Construction Workers Registration Ordinance (Cap.583), all workers must complete safety training. However, supervisors (E and F) reported that new hires often neglect or forget protocols soon after training. Mr. G specifically mentioned a knowledge gap among newcomers, who were unaware of practical safety nuances such as stepping on the second bamboo pole for stability. As he explained, "These things won't be taught during training because they are too minor." This reveals a critical shortcoming in current training regimes. Although theoretical knowledge is delivered, practical safety competencies remain underdeveloped. Bridging this gap is essential for protecting newer workers and maintaining a safety culture on-site.

Worker behaviour and adaptability

Interviews indicated that behavioural attributes, such as patience, caution, and discipline, are also important in workplace safety and employability. Mr. H noted that younger workers are more likely to rush or lift heavy materials improperly, heightening their risk of injury. He linked these behaviours to inexperience and a lack of maturity. Mr. G described this inattentiveness as "daydreaming," adding that it often leads to minor accidents that may escalate if left unchecked. Prolonged work while injured, as highlighted by Schwatka et al. (2012), may result in chronic pain and long-term productivity loss. These findings suggest that fostering self-awareness, discipline, and risk consciousness is just as important as technical training.

Public perception of the construction sector

Addressing Hong Kong's projected labour shortfall in construction requires enhancing the sector's appeal Construction Industry Council (2019). Interviews revealed that financial compensation was a major motivator. Mr. D cited higher salaries relative to other blue-collar jobs as his primary reason for entering the field. Flexibility also emerged as a desirable feature. Workers appreciated the freedom to

switch employers if dissatisfied, which helps alleviate job-related stress. However, concerns about the industry's image persist. Mr. G pointed out that negative public perceptions deter younger entrants. As Cable and Turban (2003) noted, employer image plays a central role in attracting talent. Improving the construction sector's reputation through public campaigns, scholarships, and community outreach could encourage greater participation while potentially reducing the need for inflated wages.

Recommendations

Based on the identified influencing factors across physical, psychological, and industry-related perspectives, six targeted recommendations are proposed to improve the sustainable employability of construction workers in Hong Kong. These strategies aim at reducing physical strain, mental fatigue, and labour attrition while they are compatible with the current regulations and funding regime. The mapping of recommendations to key factors is illustrated in Figure 8. Details are as follows.

Predictable wage cycle

Daily wage systems often subject workers to time pressure, leading to mental fatigue and musculoskeletal disorders. Though monthly payment provides higher stability and employment satisfaction, most Hong Kong sites are already paid in bi-weekly or monthly cycles, as stipulated by the Labour Ordinance. For balancing predictability against flexibility, it is advisable to use a hybrid "base + productivity bonus" model, especially for small subcontracting crews, which depend upon task-based payment. This approach fits payroll stability studies and promotes long-term retention of the workforce as well as talent acquisition. A potential barrier is subcontractors' concern over cash flow gaps. To address this, it was suggested that the Development Bureau's "Pay for Safety" aspects can be used to provide advance payment avenues, bridging transitional payment cycles.

On-site mentoring scheme

Despite receiving basic induction, inexperienced workers usually do not possess situational safety knowledge and hands-on competence. A formalised mentoring program is suggested to be incorporated with established systems like the CIC's "Trade-Tester" rebate or Mandatory Basic Safety Training hours. Experienced workers can serve as mentors to fill skill gaps and boost safety while extending their own industry engagement. A key concern is that mentoring hours may be perceived as lost time. To mitigate this, mentorship time should be recorded under the Trade-Tester subsidy towards partial wage reimbursement and tracked in regular daily safety briefings as a means of showing operational benefit. Incentives for additional training through the Development Bureau can further reduce cost burdens on employers.

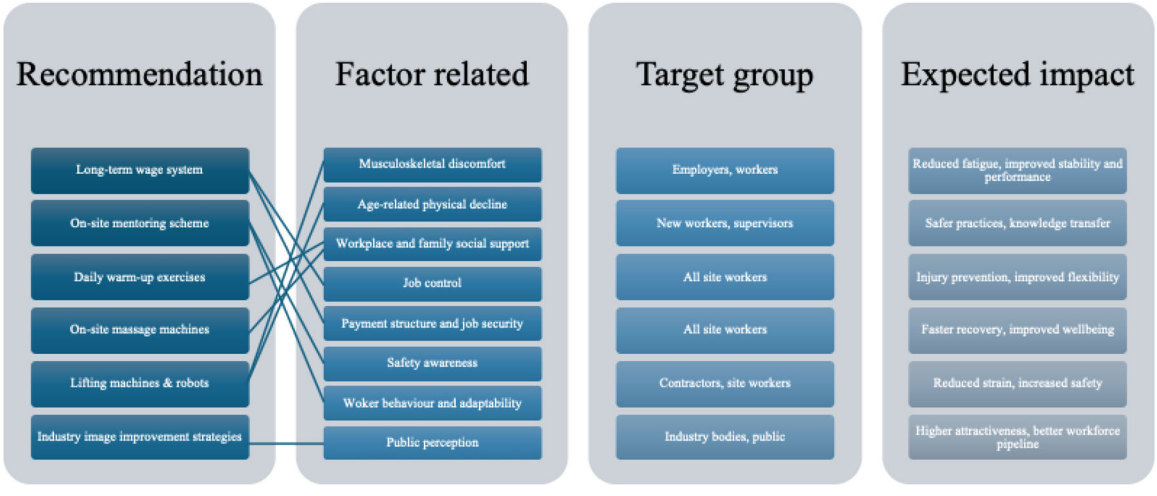

Figure 8. Recommendation-factor-impact map for HK construction workers.

Daily warm-up exercises

Warm-up exercises are proven to reduce musculoskeletal injuries by increasing flexibility and muscular preparedness (Holmström et al. 1992). However, workers are often skipped at the site due to perceived time losses. Japan and Singapore implemented 3-minute "Radio Taiso" exercises as part of pre-shift routines, which demonstrate the benefit of short stretches incorporated into regular meetings. Afonso et al. (2024) showed that such daily warm-up exercises can reduce strain-related injuries by up to 20%. Although some managers and employers thought it will cause schedule delays, restricting the regime to a maximum of 3 min and combining it as part of required safety briefs minimises time losses. While optimising the health of workers, no extra manpower or programme float is needed.

On-site massage machine

Given the physically demanding nature of construction work, muscle recovery and stress relief are essential. Although full-scale massage equipment is not impractical, it is possible to adopt some cost-effective solutions such as providing portable massage guns (approximately HK$600 each) and vouchers for 10-minute sessions during meal breaks, as implemented in the HK Airport Authority's pilot. These devices can be used voluntarily during statutory rest periods, which can significantly improve psychological and physical health without affecting workflow. If it were only regarded as a low-capital, well-being enhancement rather than a fixed infrastructure investment, the cost and feasibility can be mitigated.

Lifting machines and robots

Manual handling remains a significant source of MSDs in workplaces in the building industry (Arndt et al. 2005; Schwatka et al. 2012). According to the Labour Department's "Guidance Notes of Practice on Manual Handling Operations," employers are required to provide mechanical aids where reasonably practicable (Labour Department 2017). The employment of lifting devices and robots can minimise the risk of injury significantly. The CIC's Construction Innovation and Technology Fund (CITF) now provides up to 70% of the cost of exoskeletons and mini lifters. Although small contractors may be reluctant due to initial costs, increased awareness of the legal obligation and the availability of financial support can offer a tangible pathway to safer practice.

Industry image improvement strategies

A positive industry image is essential in attracting and retaining workers (Cable and Turban 2003). Public perceptions can be improved by tying initiatives to the "Designated Worker Training Scheme" and "Build Your Life in Construction" similar campaigns. Awareness can be generated and appeal to the young age groups through outreach strategies of competitions, scholarships, and active use of the Internet. An aspirational KPI, like a 15% rise in apprenticeship intake, can be a practical assessment indicator. Although pre-efforts are needed to fit in with the current frameworks, these strategies fit the overall workforce development strategies and can alleviate the current labour gap.

All six recommendations are designed to integrate with existing Hong Kong mechanisms rather than introduce new layers of bureaucracy. Although barriers such as cost, time pressure, and supervisor buy-in exist, practical mitigation strategies have been outlined for each recommendation. Overall, these measures offer a coherent and feasible path to enhancing the sustainable employability of construction workers in Hong Kong.

Conclusion

The construction industry in Hong Kong is grappling with significant challenges, including a labour shortage and an ageing workforce. Addressing these issues is crucial for meeting the growing demand for construction services. To tackle these challenges, it is essential to focus on both the physical and mental health of workers, as well as attract new talent to the industry. This study identifies key physical

and mental issues affecting workers and proposes solutions to extend the employability of current workers while drawing new entrants into the sector. An in-depth literature review provided the foundation for understanding these issues, which was further explored through observations from site visits and interviews with nine construction workers. These insights revealed current problems and informed recommendations aimed at improving the employability of workers and overall working conditions.

The study highlighted the importance of addressing both psychological and physical factors impacting workers. Psychological factors such as social support and job control, along with physical factors including musculoskeletal disorders and age-related issues, were examined. Additional factors like payment structure, on-site safety awareness, training for new workers, and the industry's attractiveness were also considered. Recommendations included employing workers on a monthly wage basis, implementing an on-site mentoring scheme, mandating daily warm-up exercises, providing massage machines on-site, using lifting machines, and improving the industry's image. These measures are designed to enhance working conditions, attract new job seekers, and retain existing workers.

However, this study is subject to several limitations. First, the fieldwork was confined to three construction trades and a small number of nine participants. Although both public and private sector projects were included, the limited scope may restrict the generalisability of the findings across the wider construction workforce in Hong Kong. Second, due to time and resource constraints, the proposed strategies were not tested and implemented in practice. As such, their practical effectiveness remains to be validated further. Third, the identification of employability-related factors was shaped by the availability of local literature and expert input. Since there are only 25 publications in Hong Kong to be retrieved, some dimensions may not have been captured. Future studies should seek to include a broader and more representative sample of trades, project types, and stakeholder groups. Additionally, intervention-based and longitudinal research can be conducted to pilot and assess the outcomes of the proposed strategies. Despite these limitations, this study offers a timely and contextually grounded understanding of the multifaceted barriers to sustainable employability in Hong Kong's construction sector, and provides a foundation for the development of targeted and evidence-based workforce interventions.

Acknowledgment

The authors would like to thank Sun Hung Kai Properties Ltd., Sing Fat Construction Co., Ltd., Mr. Joe C. H. Chan and Mr. Tong C. L. Lo for their kindness in allowing the site visits and arranging workers for the interview. Without such approval and arrangements, it would not be possible to collect the necessary information for this study. The authors express our gratitude to all of the interviewees for their patience in answering the questions.

Author contributions

CRediT: **Lei Liu**: Validation, Visualization, Writing – review & editing.

Credit author statement

Vivian WY Tam: Supervision, Conceptualization, Methodology, Writing- Original draft preparation, Writing- Reviewing and Editing

Ivan Wing Hong Fung: Supervision, Conceptualisation, Methodology, Writing- Original draft preparation, Writing- Reviewing and Editing

Ana Evangelista: Supervision, Validation, Writing- Original draft preparation, Writing- Reviewing and Editing

Yijun Zhou: Writing- Original draft preparation, Writing- Reviewing and Editing

Lei Liu: Writing- Reviewing and Editing

Wing Yee Chan: Conceptualization, Methodology,

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Afonso J et al. 2024. Revisiting the 'whys' and 'hows' of the warm-up: are we asking the right questions? Sports Med. 54(1):23–30. https://doi.org/10.1007/s40279-023-01908-y

Araújo TM, de Sousa CC, Siegrist J. 2022. Stressful work in primary health care and mental health: the role of gender inequities in Brazil. Am J Ind Med. 65(7):604–612. https://doi.org/10.1002/ajim.23360

Arends I, van der Klink JJL, Bültmann U. 2010. Prevention of recurrent sickness absence among employees with common mental disorders: design of a cluster-randomised controlled trial with cost-benefit and effectiveness evaluation. BMC Public Health. 10(1):132. https://doi.org/10.1186/1471-2458-10-132

Armstrong TJ et al. 1982. Investigation of cumulative trauma disorders in a poultry processing plant. Am Ind Hyg Assoc J. 43(2):103–116. https://doi.org/10.1080/15298668291409433

Arndt V et al. 1996. Older workers in the construction industry: results of a routine health examination and a five year follow up. Occup Environ Med. 53(10):686–691. https://doi.org/10.1136/oem.53.10.686

Arndt V et al. 2005. Construction work and risk of occupational disability: a ten year follow up of 14 474 male workers. Occup Environ Med. 62(8):559–566. https://doi.org/10.1136/oem.2004.018135

Bernard BP, Putz-Anderson V. 1997. Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. Atlanta (GA): U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

Bethge M et al. 2018. Rehabilitation access and effectiveness for persons with back pain: the protocol of a cohort study. BMC Public Health. 18(1):1–11. https://doi.org/10.1186/s12889-017-4588-x

Boumans NPG, De Jong AHJ, Vanderlinden L. 2008. Determinants of early retirement intentions among Belgian nurses. J Adv Nurs. 63(1):64–74. https://doi.org/10.1111/j.1365-2648.2008.04651.x

Bridger RS, Bennett AI. 2011. Age and BMI interact to determine work ability in seafarers. Occup Med (Lond). 61(3):157–162. https://doi.org/10.1093/occmed/kqr003

Broersen JPJ et al. 1995. The Atlas of health and working conditions by occupation - 2. A comparison with the "atlas of health and working conditions in the construction industry. Int Arch Occup Environ Health. 67(5): 337–342. https://doi.org/10.1007/BF00385649

Cable DM, Turban DB. 2003. The value of organisational reputation in the recruitment context: a brand-equity perspective. J Applied Social Pyschol. 33(11):2244–2266. https://doi.org/10.1111/j.1559-1816.2003.tb01883.x

Census and Statistics Department. 2022. Gross Domestic Product (GDP) by economic activity at current prices. Hong Kong. https://www.censtatd.gov.hk/en/web_table.html?id=36

Census and Statistics Department. 2023. Hong Kong Labour Force Projections for 2022 to 2046. Hong Kong. https://www.censtatd.gov.hk/en/EIndexbySubject.html?scode=220&pcode=FA100042

Chan APC, Javed AA, Wong FKW, Hon CKH, Lyu S. 2017. Evaluating the safety climate of ethnic minority construction workers in Hong Kong. J Prof Issues Eng Educ Pract. 143(4):4017006. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000333

Chan APC, Wong FK, Hon CK, Ali Javed A, Lyu S. 2017. Construction safety and health problems of ethnic minority workers in Hong Kong. Eng Constr Archit Manag. 24(6):901–919. https://doi.org/10.1108/ECAM-09-2015-0143

Chan APC et al. 2016. Strategies for improving safety and health of ethnic minority construction workers. J Constr Eng Manage. 142(9):5016007. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001148

Chiang YH et al. 2015. The nexus among employment opportunities, life-cycle costs, and carbon emissions: a case study of sustainable building maintenance in Hong Kong. J Cleaner Prod. 109:326–335. https://doi.org/10.1016/j.jclepro.2014.07.069

Choi SD. 2009. Safety and ergonomic considerations for an aging workforce in the US construction industry. Work. 33(3):307–315. https://doi.org/10.3233/WOR-2009-0878

Ciriello VM et al. 1999. Distributions of manual materials handling task parameters. Int J Ind Ergon. 24(4):379–388. https://doi.org/10.1016/S0169-8141(99)00005-0

Confederation Of British Industry. 1999. Making employability work: an agenda for action. CBI.

Construction Industry Council. 2019. Skilled construction workers forecast (2019-2023). Hong Kong. https://www.cic.hk/files/page/56/Manpower Forecast - Workers (2019-2023)_e_20190503.pdf

Costa G, Sartori S. 2007. Ageing, working hours and work ability. Ergonomics. 50(11):1914–1930. https://doi.org/10.1080/00140130701676054

Dong XS et al. 2011. Chronic diseases and functional limitations among older construction workers in the United States: a 10-year follow-up study. J Occup Environ Med. 53(4):372–380. https://doi.org/10.1097/JOM.0b013e3182122286

Du Q et al. 2020. Prioritising operational considerations of crane operator training for modular integrated construction. In Construction Research Congress 2020. Reston, VA: American Society of Civil Engineers. p 743–752.

El Fassi M et al. 2013. Work ability assessment in a worker population: comparison and determinants of Work Ability Index and Work Ability score. BMC Public Health. 13(1):305. https://doi.org/10.1186/1471-2458-13-305

Feldt T et al. 2009. Development trajectories of Finnish managers' work ability over a 10-year follow-up period. Scand J Work Environ Health. 35(1):37–47. https://doi.org/10.5271/sjweh.1301

Fitzgerald MD et al. 1997. Age-related declines in maximal aerobic capacity in regularly exercising vs. sedentary women: a meta-analysis. J Appl Physiol. 83(1):160–165. https://doi.org/10.1152/jappl.1997.83.1.160
Frimpong S et al. 2022. Domains of psychosocial risk factors affecting young construction workers: a systematic review. Buildings. 12(3):335. https://doi.org/10.3390/buildings12030335
Fung IWH, Tam VWY. 2013. Occupational health and safety of older construction workers (aged 55 or above): their difficulties, needs, behaviour and suitability. Int J Construct Manag. 13(3):15–34. https://doi.org/10.1080/15623599.2013.10773214
Gibb A, Leaviss J, Bust P. 2013. Older construction workers: needs and abilities. In: Proceedings of the 29th Annual ARCOM Conference; Reading, United Kingdom. Association of Researchers in Construction Management. p 261–271.
Gram VHB. 2012. A randomised controlled intervention study.
Hashiguchi N et al. 2020. Age-dependent influence of intrinsic and extrinsic motivations on construction worker performance. Int J Environ Res Public Health. 18(1):1–21. https://doi.org/10.3390/ijerph18010111
Hedge JW, Borman WC, Lammlein SE. 2006. The aging workforce: realities, myths, and implications for organisations. American Psychological Association.
Henry JP, Stephens PM. 2013. Stress, health, and the social environment: a sociobiologic approach to medicine. Springer Science & Business Media.
Holmström EB, Lindell J, Moritz U. 1992. Low back and neck/shoulder pain in construction workers: occupational workload and psychosocial risk factors. Spine (Phila Pa 1976). 17(6):672–677. https://doi.org/10.1097/00007632-199206000-00006
Houston DK, Nicklas BJ, Zizza CA. 2009. Weighty concerns: the growing prevalence of obesity among older adults. J Am Diet Assoc. 109(11):1886–1895. https://doi.org/10.1016/j.jada.2009.08.014
Ilmarinen J, Tuomi K, Seitsamo J. 2005. New dimensions of work ability. Int Cong Ser. 1280:3–7.
Kroll LE, Lampert T. 2011. Unemployment, social support and health problems: results of the GEDA study in Germany, 2009. Dtsch Arztebl Int. 108(4):47–52. https://doi.org/10.3238/arztebl.2011.0047
Labour Department. 2017. Guidance Notes on Manual Handling Operations. Occupational Safety and Health Branch, Hong Kong: HK Labour Department. https://www.labour.gov.hk/text_alternative/pdf/eng/GN-MHO.pdf
Lai JHK. 2017. Building operation and maintenance: manpower in Hong Kong. Facilities. 35(3/4):220–241. https://doi.org/10.1108/F-03-2016-0029
Larsen M. 2008. Does quality of work life affect men and women's retirement planning differently? Appl Res Qual Life. 3(1):23–42. https://doi.org/10.1007/s11482-008-9045-7
Lian Y et al. 2015. Associations between insomnia, sleep duration and poor work ability. J Psychosom Res. 78(1):45–51. https://doi.org/10.1016/j.jpsychores.2014.09.009
Lo T, Fung I, Tung K. 2006. Construction delays in Hong Kong civil engineering projects. J Constr Eng Manag. 132(6):636–649. https://doi.org/10.1061/(ASCE)0733-9364(2006)132:6(636)
Love PED, Edwards DJ, Irani Z. 2010. Work stress, support, and mental health in construction. J Constr Eng Manage. 136(6):650–658. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000165
Lyu S et al. 2018. Relationships among safety climate, safety behavior, and safety outcomes for ethnic minority construction workers. Int J Environ Res Public Health. 15(3):484. https://doi.org/10.3390/ijerph15030484
Ng JYK, Chan AHS. 2015. The ageing construction workforce in Hong Kong: a review. In: Proceedings of the International Multi Conference of Engineers and Computer Scientists 2015, Vol. II (IMECS 2015); 2015 Mar 18–20; Hong Kong. International Association of Engineers.
Ng JYK, Chan AHS. 2017. Proposing a conceptual model for examining the influence of individual and work-related factors on work ability. In: Goossens R, editor. Advances in social & occupational ergonomics. Advances in Intelligent Systems and Computing, vol. 487. Proceedings of the International Conference on Applied Human Factors and Ergonomics; 2017; Los Angeles, CA. Springer. p 145–151.
Ng JYK, Chan AHS. 2018. The work ability of Hong Kong construction workers in relation to individual and work-related factors. Int J Environ Res Public Health. 15(5):990. https://doi.org/10.3390/ijerph15050990
Palikhe S et al. 2020. Analysis of musculoskeletal disorders and muscle stresses on construction workers' awkward postures using simulation. Sustainability (Switzerland). 12(14):5693. https://doi.org/10.3390/su12145693
Pan W et al. 2018. A methodological approach to implement on-site construction robotics and automation: a case of Hong Kong. In: Proceedings of the 35th International Symposium on Automation and Robotics in Construction (ISARC); 2018; Berlin, Germany. p 362–369.
Pan W, Chen L, Zhan W. 2020. Implications of construction vocational education and training for regional competitiveness: case study of Singapore and Hong Kong. J Manage Eng. 36(2):5019010. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000750
Peng L, Chan AHS. 2020. Adjusting work conditions to meet the declined health and functional capacity of older construction workers in Hong Kong. Saf Sci. 127:104711. https://doi.org/10.1016/j.ssci.2020.104711
Peters E et al. 2018. Influence of social support among employees on mental health and work ability—a prospective cohort study in 2013–15. Eur J Public Health. 28(5):819–823. https://doi.org/10.1093/eurpub/cky067
Petersen JS, Zwerling C. 1998. Comparison of health outcomes among older construction and blue-collar employees in the United States. Am J Ind Med. 34(3):280–287. https://doi.org/10.1002/(SICI)1097-0274(199809)34:3<280::AID-AJIM11>3.0.CO;2-Q

Poon SW et al. 2013. Job burnout and safety performance in the Hong Kong construction industry. International Journal of Construction Management. 13(1):69–78. https://doi.org/10.1080/15623599.2013.10773206
Pransky G et al. 1999. Under-reporting of work-related disorders in the workplace: a case study and review of the literature. Ergonomics. 42(1):171–182. https://doi.org/10.1080/001401399185874
Reid A, Pinder ADJ, Monnington S. 2001. Musculoskeletal problems in bricklayers, carpenters and plasterers: literature review and results of site visits. Health and Safety Laboratory.
Rijn RMV et al. 2010. Associations between work-related factors and specific disorders of the shoulder—a systematic review of the literature. Scand J Work Environ Health. 36(3):189–201.
Rutledge T et al. 2004. Social networks are associated with lower mortality rates among women with suspected coronary disease: the National Heart, Lung, and Blood Institute-Sponsored Women's Ischemia Syndrome Evaluation study. Psychosom Med. 66(6):882–888. https://doi.org/10.1097/01.psy.0000145819.94041.52
Sattelmair JR, Pertman JH, Forman DE. 2009. Effects of physical activity on cardiovascular and noncardiovascular outcomes in older adults. Clin Geriatr Med. 25(4):677–702. https://doi.org/10.1016/j.cger.2009.07.004
Schwatka NV, Butler LM, Rosecrance JR. 2012. An aging workforce and injury in the construction industry. Epidemiol Rev. 34(1):156–167. https://doi.org/10.1093/epirev/mxr020
Sing C, Love PED, Tam C-M. 2012. Multiplier model for forecasting manpower demand. J Constr Eng Manage. 138(10):1161–1168. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000529
Sing C, Love PED, Tam CM. 2012. Stock-flow model for forecasting labor supply. J Constr Eng Manage. 138(6):707–715. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000485
Sing C-P, Love PED, Tam C-M. 2014. Forecasting the demand and supply of technicians in the construction industry. J Manage Eng. 30(3):4014006. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000227
Sing MCP et al. 2017. Critical analysis of construction workforce sustainability in a developed economy–case study in Hong Kong. In Proceedings of the Institution of Civil Engineers-Engineering Sustainability. Thomas Telford Ltd, p 342–350.
Smith PM et al. 2008. Examining the relationships between job control and health status: a path analysis approach. J Epidemiol Community Health. 62(1):54–61. https://doi.org/10.1136/jech.2006.057539
Strandberg TE, Tilvis RS. 2000. C-reactive protein, cardiovascular risk factors, and mortality in a prospective study in the elderly. Arterioscler Thromb Vasc Biol. 20(4):1057–1060. https://doi.org/10.1161/01.atv.20.4.1057
Thomas DR. 2010. Sarcopenia. Clin Geriatr Med. 26(2):331–346. https://doi.org/10.1016/j.cger.2010.02.012
Tin SPP et al. 2016. Workplace health promotion: assessing the cardiopulmonary risks of the construction workforce in Hong Kong. PLoS One. 11(1):e0146286. https://doi.org/10.1371/journal.pone.0146286
Toossi M. 2009. Employment outlook: 2008-18-labor force projections to 2018: older workers staying more active. Mon Labor Rev. 132:30.
Uchino BN. 2006. Social support and health: a review of physiological processes potentially underlying links to disease outcomes. J Behav Med. 29(4):377–387. https://doi.org/10.1007/s10865-006-9056-5
Van Den Berg TIJ, Elders LAM, Burdorf A. 2009. The effects of work-related and individual factors on work ability: a systematic review. In: Kumashiro M, editor. *Promotion of work ability towards productive aging. Selected papers of the 3rd International Symposium on Work Ability*; 1st ed. CRC Press. p 15–18. https://doi.org/10.1201/9780203882511-7
Van der Klink JJL et al. 2018. Development of an instrument to measure sustainable employability. ZonMw.
Van Solinge H, Henkens K. 2010. Living longer, working longer? the impact of subjective life expectancy on retirement intentions and behaviour. Eur J Public Health. 20(1):47–51. https://doi.org/10.1093/eurpub/ckp118
Viikari-Juntura E et al. 1994. Neck trouble in machine operating, dynamic physical work and sedentary work:. A prospective study on occupational and individual risk factors. J Clin Epidemiol. 47(12):1411–1422. https://doi.org/10.1016/0895-4356(94)90085-x
Wang D, Dai F, Ning X. 2015. Risk assessment of work-related musculoskeletal disorders in construction: state-of-the-art review. J Constr Eng Manage. 141(6):1–15. https://doi.org/10.1061/(asce)co.1943-7862.0000979
Waris P. 1979. Occupational cervicobrachial syndromes: a review. Scand J Work Environ Health. 5 suppl 3(3):3–14. https://doi.org/10.5271/sjweh.2688
Wei W et al. 2016. Work-family conflict and safety participation of high-speed railway drivers: job satisfaction as a mediator. Accid Anal Prev. 95(Pt A):97–103. https://doi.org/10.1016/j.aap.2016.06.022
Welch LS et al. 2008. Age, work limitations and physical functioning among construction roofers. Work. 31(4):377–385. https://doi.org/10.3233/WOR-2008-00751
Wong JMW, Chan APC, Chiang YH. 2005. Time series forecasts of the construction labour market in Hong Kong: the Box-Jenkins approach. Constr Manag Econ. 23(9):979–991. https://doi.org/10.1080/01446190500204911
Wong JMW, Chan APC, Chiangn YH. 2006. The changing construction labour market: a case of Hong Kong. J Eng Des Technol. 4(1):1–17. https://doi.org/10.1108/17260530610818615
Wong KKW et al. 2012. Utilising societal engagement as a vehicle for enhancing the image and sustainability of the construction industry. Sustain Dev. 20(3):222–229. https://doi.org/10.1002/sd.1538
Wu X et al. 2018. Development of construction workers job stress scale to study and the relationship between job stress and safety behavior: an empirical study in Beijing. Int J Environ Res Public Health. 15(11):2409. https://doi.org/10.3390/ijerph15112409

Yi W, Chan A. 2016. Health profile of construction workers in Hong Kong. Int J Environ Res Public Health. 13(12):1232. https://doi.org/10.3390/ijerph13121232
Zhan W, Pan W. 2020. Formulating systemic construction productivity enhancement strategies. J Constr Eng Manage. 146(8):5020008. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001886
Zhao Y et al. 2022. Manpower forecasting models in the construction industry: a systematic review. Eng Constr Archit Manag. 29(8):3137–3156. https://doi.org/10.1108/ECAM-05-2020-0351

Appendix

Table A-1. Summary of factors related to the work-related MSDs.

Factors	Effects	References
Age	- Decrease in cardiac output and tolerance to physical activity.	(Fitzgerald et al. 1997)
	- Decrease in strength.	(Thomas 2010)
	- Decrease in bone density.	(Sattelmair et al. 2009)
	- Increases in risk of chronic inflammatory disorders.	(Strandberg and Tilvis 2000)
	- Reduction in flexibility with changes in weight and body composition.	(Houston et al. 2009)
	- Low back, neck and shoulder troubles.	(Petersen and Zwerling 1998)
Obesity	- High Body Mass Index (BMI) increases the risk of MSDs.	(Arndt et al. 1996)
Smoking and alcohol consumption	- Weak relationship between neck-shoulder problems and smoking.	(Bernard and Putz-Anderson 1997)
	- Smoking as a predictor of severe neck trouble with substantial physical work	(Viikari-Juntura et al. 1994)
	- Association between smoking and increased risk of sciatic pain in blue-collar workers.	(Bernard and Putz-Anderson 1997)
Physical workload	- 31% of insurance claims involve manual handling in construction, trucking, and service industries.	(Ciriello et al. 1999)
	- Frequent material handling increases the risk of neck-shoulder trouble.	(Viikari-Juntura et al. 1994)
	- Repetitive motions associated with several injuries and illnesses.	(Reid et al. 2001)
Organisational factors	- Rewarding employees for the absence of lost time due to work-related accidents encourages workers to continue working with discomfort and pain by underreporting of illnesses and injuries.	(Pransky et al. 1999)
	- Exposure to whole-body vibration from construction equipment increases the risk of back problems.	(Reid et al. 2001)
Psychosocial factors	- Construction workers often accept injury or pain as part of the job.	(Reid et al. 2001)
	- High levels of psychosomatic and psychic indices are linked to MSDs.	(Holmström et al. 1992)
	- Increased static muscle activity and pain in individuals who are anxious, nervous, or under high mental strain.	(Welch et al. 2008)

Table A-2. Summary of factors influencing work ability.

Factor	Effect	Reference
Age	- Increase in age generally leads to a decline in work ability, particularly for physically demanding work.	(Costa and Sartori 2007)
Body mass	- Healthy weight individuals have better work ability than those who are slim or obese. High Body Mass Index (BMI) is associated with lower work ability.	(Bridger and Bennett 2011)
Lifestyle	- Smoking is linked to lower work ability, although findings are inconsistent.	(Lian et al. 2015; Ng and Chan 2015)
	- Short sleep duration lowers work ability, whereas higher leisure-time physical activity improves work ability.	
Health	- Mental diseases and musculoskeletal disorders negatively influence work ability. Self-perceived poor health is the most influential factor among health-related aspects.	(El Fassi et al. 2013; Ng and Chan 2015)
Individual Competence	- Higher career competencies and comprehensive career plans are associated with better work ability.	(Ng and Chan 2018)
Work-related factors	- High physical and psychological demands in jobs lower work ability. A mismatch between work demands and physical capacity increases the risk of musculoskeletal disorders, reducing work ability and leading to early retirement.	(Van Den Berg et al. 2009; Ng and Chan 2015)
Job control	- Higher job control leads to better health and increased work ability. Job security also influences work ability.	(Smith et al. 2008; Ng and Chan 2015)
Social support	- Social support positively affects health and work ability. Supervisor and co-worker support significantly improve work ability.	(Rutledge et al. 2004)
Other factors	- Financial security, respectful treatment in the workplace, and resource facilitation also impact work ability.	(Ilmarinen et al. 2005)

Table A-3. Twetny-five publications related to the sustainable employability of construction workers in Hong Kong.

No	Title	Reference	Year
1	Manpower forecasting models in the construction industry: a systematic review	(Zhao et al. 2022)	2021
2	Formulating Systemic Construction Productivity Enhancement Strategies	(Zhan and Pan 2020)	2020
3	Implications of Construction Vocational Education and Training for Regional Competitiveness: Case Study of Singapore and Hong Kong	(Pan et al. 2020)	2020
4	Adjusting work conditions to meet the declined health and functional capacity of older construction workers in Hong Kong	(Peng and Chan 2020)	2020
5	Prioritising Operational Considerations of Crane Operator Training for Modular Integrated Construction	(Du et al. 2020)	2020
6	Relationships among safety climate, safety behavior, and safety outcomes for ethnic minority construction workers	(Lyu et al. 2018)	2018
7	A methodological approach to implement on-site construction robotics and automation: A case of Hong Kong	(Pan et al. 2018)	2018
8	Critical analysis of construction workforce sustainability in a developed economy - case study in Hong Kong	(Sing et al. 2017)	2018
9	Evaluating the Safety Climate of Ethnic Minority Construction Workers in Hong Kong	(Chan, Javed, et al. 2017)	2017
10	Construction safety and health problems of ethnic minority workers in Hong Kong	(Chan, Wong, et al. 2017)	2017
11	Building operation and maintenance: manpower in Hong Kong	(Lai 2017)	2017
12	Proposing a Conceptual Model for Examining the Influence of Individual and Work-Related Factors on Work Ability	(Ng and Chan 2017)	2017
13	Health profile of construction workers in Hong Kong	(Yi and Chan 2016)	2016
14	Strategies for improving safety and health of ethnic minority construction workers	(Chan et al. 2016)	2016
15	Workplace Health Promotion: Assessing the Cardiopulmonary Risks of the Construction Workforce in Hong Kong	(Tin et al. 2016)	2016
16	The nexus among employment opportunities, life-cycle costs, and carbon emissions: a case study of sustainable building maintenance in Hong Kong	(Chiang et al. 2015)	2015
17	Forecasting the Demand and Supply of Technicians in the Construction Industry	(Sing et al. 2014)	2014
18	Occupational health and safety of older construction workers (aged 55 or above): Their difficulties, needs, behaviour, and suitability	(Fung and Tam 2013)	2013
19	Job burnout and safety performance in the Hong Kong construction industry	(Poon et al. 2013)	2013
20	Utilising Societal Engagement as a Vehicle for Enhancing the Image and Sustainability of the Construction Industry	(Wong et al. 2012)	2012
21	Multiplier Model for Forecasting Manpower Demand	(Sing, Love and Tam, 2012)	2012
22	Stock-Flow Model for Forecasting Labor Supply	(Sing, Love and Tam, 2012)	2012
23	Construction delays in Hong Kong civil engineering projects	(Lo, Fung and Tung 2006)	2006
24	The changing construction labour market: A case of Hong Kong	(Wong et al. 2006)	2006
25	Time series forecasts of the construction labour market in Hong Kong: The Box-Jenkins approach	(Wong et al. 2005)	2005

Table A-4. Supporting interview excerpts.

Perspective	Question	Reason		Answers
Physical factors	Body pain	Work-related physical strain	A	- This (frozen shoulder) might not be as a result of my work, it can be from something else.
			B	- Whenever there's pain, I'll ask my wife to give me a massage.
			C	- I might apply bone-setting mediated liquor to that area (pain area), but normally I just leave it there, it doesn't hurt that much anyway.
			B	- Sure. If it is needed, I will put on Salonpas, but that is very rare.
			D	- Of course, you need to go to work the day after, it (the pain) is seldom that serious.
	Ageing	Work-related ageing	C	- I used to carry more weights (of material) at a time, now I carry less.
			D	- I didn't feel tired when I was younger, but now I do.
Psychological factors	Motivation to join the construction industry On-site supervisor	Family background	A	- My father was a construction worker, that's why I join the industry as well, it's what we called child inheritance.
		Interpersonal relationship	B	- I worked in a hotel before I started this (job), but the human relation there is complicated, it's nothing like here (the construction industry). People here (the construction industry) are simpler, people there (the hotel industry) were complicated.
		Career flexibility	B	- The mobility here (the construction industry) is high, if I'm not happy in this company, I can just switch to another one. But it wasn't like this (high mobility) there (hotel industry).
		Limited education access	C	- I didn't get much education, that's why I started (working as a plasterer)," he further suggested, "The salary here (construction industry) is higher, that's the other reason."
			D	- lacking education is the reason I started working in the industry"
	Behavioural aspects	Maturity and experience	G	- There are some skills that they don't know because they're not experienced enough, for example, when you have to work on a bamboo scaffolding, an experienced worker would have known that stepping on the second bamboo pole is safer because it won't break easily, but the newcomers don't know about that.
			H	- It's a matter of experience. These are the things that won't be taught during their training program because these are too minor. - New workers don't tend to pay attention to the environment. Sometimes when there's a hole in the middle of the floor, even there's all these signs and canvas to warn and cover it, they still fall into the hole. They tend to look at something else instead of paying attention to what they're stepping on.
			I	- Carpenters are always in a hurry (when doing their work). Unlike the other two (bricklayers and plasterers), they have to tender job by job and they're not paid monthly. To be competitive enough, they must maintain their productivity. If it is a 3-day job, they have to finish the job within three days no matter what. Once they finish a job, they'll immediately switch to another one.