

**REDEFINING THE INFECTIOUS DISEASE
PREVENTION FRAMEWORK THROUGH
HIERARCHY OF CONTROLS ON
CONSTRUCTION SITES IN SARAWAK**

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CONSTRUCTION SITES IN SARAWAK**

by

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LIST OF ABBREVIATIONS

CIDB	Construction Industry Development Board
DOSH	Department of Occupational Safety and Health
TB	Tuberculosis
WF	Welfare Facilities
WASH	Water, Sanitation, Hygiene
PPE	Personal Protective Equipment
SLR	Systematic Literature Review
SPSS	Statistical Package for the Social Sciences

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**PENTAKRIFAN SEMULA RANGKA KERJA PENCEGAHAN
PENYAKIT BERJANGKIT MELALUI HIERARKI KAWALAN TAPAK
PEMBINAAN DI SARAWAK**

ABSTRAK

Kejadian penyakit berjangkit dalam kalangan pekerja binaan di tapak pembinaan kekal sebagai cabaran utama, terutamanya bagi kontraktor kecil yang mempunyai sumber terhad. Walaupun langkah pencegahan telah sedia ada, kekurangan kemudahan kebajikan dan pelaksanaan strategi kawalan yang tidak konsisten terus menimbulkan risiko yang ketara, menjejaskan kesejahteraan pekerja serta kelestarian keseluruhan projek. Kajian ini bertujuan untuk (1) menilai tahap kesedaran kontraktor kecil di Sarawak mengenai kemudahan kebajikan di tapak pembinaan, (2) mengkaji perspektif mereka terhadap pendekatan pencegahan penyakit berjangkit, dan (3) membangunkan serta mengesahkan semula kerangka hierarki kawalan yang telah diperhalusi. Pendekatan kaedah campuran eksploratori berjujukan digunakan bagi mencapai objektif ini. Kajian bermula dengan pengumpulan data kualitatif melalui semakan dokumen dan analisis tematik, diikuti dengan tinjauan terhadap 283 kontraktor kecil. Analisis statistik dijalankan bagi memastikan kesahan dan kebolehpercayaan instrumen kajian. Seterusnya, temu bual berstruktur dengan enam orang pakar daripada agensi kerajaan dan akademik dijalankan bagi mengesahkan semula kerangka hierarki kawalan yang telah diperbaharui. Penemuan kajian menunjukkan bahawa kebanyakan kontraktor mempunyai tahap kesedaran yang rendah terhadap kemudahan kebajikan, namun mereka amat menyokong pelaksanaannya sebagai langkah pencegahan penyakit berjangkit. Walaupun perspektif terhadap hierarki kawalan adalah berbeza, kebanyakan responden

menganggap peralatan perlindungan diri (PPE) sebagai langkah paling berkesan, diikuti kawalan kejuruteraan, kawalan pentadbiran, penghapusan, dan penggantian. Dapatan ini menekankan keperluan pengurus tapak bina dan pembuat dasar untuk memperkukuh penyediaan kemudahan kebajikan serta memberi keutamaan kepada langkah kawalan yang lebih mampan dan berkesan. Walau bagaimanapun, majoriti pakar menyatakan keraguan terhadap kerangka hierarki kawalan (HOC) yang telah diperhalusi, menunjukkan bahawa aplikasi praktikal dan penambahbaikan lanjut diperlukan bagi meningkatkan keberkesanannya. Dengan mengintegrasikan hasil kajian ini ke dalam amalan pengurusan tapak dan rangka kerja peraturan, industri pembinaan dapat menyokong pembangunan lestari dengan meningkatkan kesihatan pekerja, mengurangkan risiko kesihatan pekerjaan, serta mewujudkan persekitaran kerja yang lebih selamat dan berdaya tahan. Selari dengan Matlamat Pembangunan Mampan (SDG 3: Kesihatan dan Kesejahteraan Baik, SDG 8: Pekerjaan yang Sesuai dan Pertumbuhan Ekonomi, serta SDG 11: Bandar dan Komuniti Mampan), kajian ini menekankan peranan kritikal kebajikan pekerja dalam memastikan industri pembinaan yang lebih selamat dan lestari.

**REDEFINING THE INFECTIOUS DISEASE PREVENTION
FRAMEWORK THROUGH HIERARCHY OF CONTROLS ON
CONSTRUCTION SITES IN SARAWAK**

ABSTRACT

The occurrence of infectious diseases among on-site construction workers remains a significant challenge, particularly for small-scale contractors with limited resources. Despite existing preventive measures, inadequate welfare facilities and inconsistent implementation of control strategies continue to present substantial risks, affecting both worker well-being and overall project sustainability. This study aims to (1) assess the awareness of Sarawak's small-scale contractors regarding on-site welfare facilities, (2) examine their perspectives on infectious disease prevention approaches, and (3) develop and validate a redefined hierarchy of controls framework. An exploratory sequential mixed-method approach was employed to achieve these objectives. The study began with qualitative data collection through document review and thematic analysis, followed by a survey of 283 small-scale contractors. Statistical analyses were conducted to ensure the validity and reliability of the instrument. Subsequently, structured interviews with six experts from government agencies and academia were carried out to validate the revised hierarchy of controls framework. The findings indicate that most contractors have limited awareness of welfare facilities but strongly support their implementation as a preventive measure against infectious diseases. While perspectives on the hierarchy of controls varied, the majority perceived personal protective equipment (PPE) as the most effective measure, followed by engineering controls, administrative controls, elimination, and substitution. Nevertheless, the majority of experts expressed reservations regarding the

newly redefined hierarchy of controls (HOC) framework, suggesting that further practical application and refinement are necessary to enhance its effectiveness. These insights highlight the need for construction site managers and policymakers to enhance welfare provisions and prioritize sustainable, higher-level control measures. By integrating these findings into site management practices and regulatory frameworks, the construction industry can promote sustainable development by improving worker health, reducing occupational health risks, and fostering safer, more resilient workplaces. Aligning with Sustainable Development Goals (SDG 3: Good Health and Well-being, SDG 8: Decent Work and Economic Growth, and SDG 11: Sustainable Cities and Communities), this study emphasizes the critical role of worker welfare in ensuring a safer, more sustainable construction industry.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Chapter 1 covers the idea of this thesis. The research aims to outline the study's main objective which focuses on-site welfare amenities and the practical strategies for preventing on-site infectious diseases. Subsequently, the awareness levels of small-scale contractors regarding on-site welfare facilities in Sarawak were examined. In addition, based on previous studies, no perspective by contractors in Sarawak for the Hierarchy of Controls in order for on-site infection disease prevention can currently be found. Therefore, the aim of this study is to redefine the hierarchy of controls on construction sites according to the perspective of small-scale contractors in Sarawak in order to develop an effective prevention framework for infectious diseases.

1.2 Research Rationale

This study was conducted based on the researcher's internship experience at a small-scale construction company in Bintangor, Sarawak. Infectious diseases, welfare facilities, efficient methods for preventing infectious diseases, and hierarchy of controls are the four primary areas of focus for further research. Based on observations and firsthand experience, it was concluded that the construction company did not offer sufficient welfare facilities to its employees.

For example, contractors failed to supply temporary restrooms and washing facilities for their on-site employees. These two basic amenities are essential for site workers and it is the employer's duty to maintain a hygienic and clean working environment (Hatem et al., 2019). These facilities are necessary to avert illnesses that

could harm employees' health and productivity (Adepu et al., 2022). This has therefore provided the rationale and motivation for further research.

According to Preventing Infectious Diseases on Construction Projects (2020), an employer's facilities may significantly impact the health of employees who work there. Observations made at a study field location in Bintangor indicated that the majority of small-scale contractors have temporary housing facilities, referred to as "mam nan" in the Chinese Fuzhou dialect. However, Figure 1.1, Figure 1.2, and Figure 1.3 show that the majority of these facilities fall short of the necessary requirements. The lack of welfare services at the construction site in Sarawak exemplifies this situation.

Datuk Seri Fadillah Yusof, speaking in Kuching in 2021, acknowledged this issue stating that contractors disregarded the housing conditions of workers, which were typically cramped and unhygienic (Minister: Onus on Contractors to Provide Standard Workers' Lodging under Act 446, 2021). As a result, this has become a pressing challenge for small construction companies in Sarawak and highlights the insufficient welfare facilities on-site.



Figure 1.1 Temporary Housing Facilities in Jalan Kelupu, Bintangor, Sarawak

Source: On-site Survey in Bintangor, 2021



Figure 1.2 Temporary Housing Facilities in Bintangor, Sarawak

Source: On-site Survey in Bintangor, 2021



Figure 1.3 Temporary Housing Facilities in Sarikei, Sarawak

Source: On-site Survey in Sarikei, 2023

Another rationale for this study was the COVID-19 pandemic, which posed a significant risk for small-scale construction sites where infectious diseases could proliferate. Therefore, the aim of this study is to conduct an in-depth investigation into these issues and understand how the relationship between facilities can aid in the prevention of infectious diseases. Consequently, several questions emerged during the conceptualisation phase, such as "What constitutes an effective approach to prevent on-site infectious diseases according to these contractors?" and "To what extent are these contractors aware of on-site welfare facilities?".

1.3 Research Background

The construction sector in Malaysia is experiencing significant growth and can serve as a reference point for our nation's progress. However, due to the rapid pace of construction work, unwanted accidents occasionally occur at construction sites in Malaysia. Research by Rahim Abdul Hamid et al. (2019) highlights that equipment failure, major crane accidents, and falls from heights are the most common accident cases on construction sites. These accidents can lead to injuries, equipment damage, or even fatalities (Gopalakrishnan & Mohan Kumar, 2020). This issue not only impacts project timelines but also compromises the quality of work.

However, an emphasis on the safety of site worker requires prioritising their health and well-being (Zhang et al., 2020). Adverse outcomes could arise from ill employees transmitting illnesses to others. Furthermore, as a result of the COVID-19 pandemic in Malaysia, infectious diseases has become a critical issue and concern especially in Malaysia's construction sector which was heavily impacted by outbreaks of infectious diseases (Gopalakrishnan & Mohan Kumar, 2020) lists 13 different illness categories that can afflict construction workers. However, despite these 13

health concerns, research on infectious diseases at construction sites are scarce. To address the issue of infectious diseases at construction sites, this research focuses on implementing an efficient preventive approach.

The construction industry was heavily impacted by the rapid approach of the COVID-19 outbreak. Its initial emergence in Malaysia triggered widespread panic significant disruption across various sectors. Among the industries affected, the construction industry stood out (Baker et al., 2020). This is largely attributed to the challenging working conditions prevalent within the industry, which include factors such as the temporary nature of construction work, short-term employer-employee relationships, unpredictable hours, inadequate amenities, and the lack of sufficient welfare facilities. Additionally, Nuhu et al. (2020) found that contractors often neglect the basic requirements for adequate welfare facilities.

Construction is also a high-risk industry as its employees frequently have to relocate, work in dangerous settings, and live in unhygienic conditions. These factors heighten the susceptibility to severe occupational health issues as well as the spread of infectious diseases. Insufficient restrooms and hand washing facilities can lead to the transmission of illnesses among site workers who are unable to maintain proper hygiene practices after using the restroom or before meals (Thabit & Younus, 2018). Additionally, welfare amenities play a crucial in mitigating worker fatigue and overall health. These amenities include clean drinking water, laundry facilities, restrooms, shelters, changing rooms, and transportation support from home to work (Business Bliss FZE, 2018). Thus, the provision and maintenance of these facilities is typically fall under the responsibility of either a single contractor or a consortium of independent contractors (Campbell & Gunning, 2020).

Currently, COVID-19 is still a major concern at construction sites, with construction workers experiencing a higher rate of hospitalization compared to the general population. A study conducted by Pasco et al.'s (2020) found that the cumulative hospitalisation rate for the overall population was expected to be 1.5 per 1000 individuals, while for construction workers it was projected to be 6.8 per 1000 workers based on COVID-19 hospital case reports from the Austin-Round Rock Metropolitan area up until August 20, 2020 (Figure 1.4). This suggests that construction workers were particularly vulnerable to contracting the virus during the pandemic.

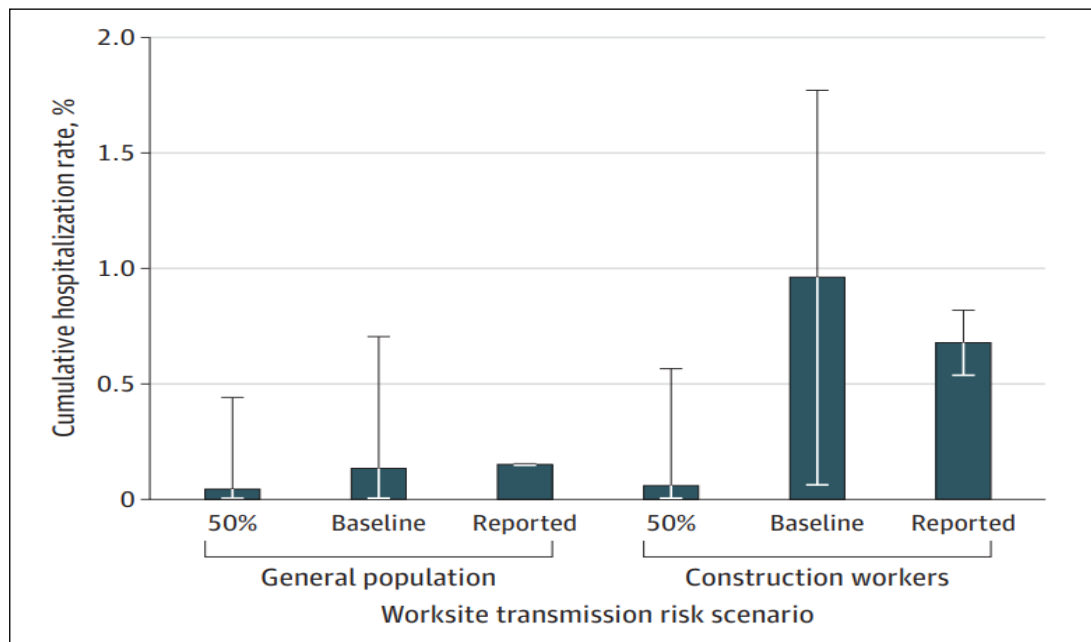


Figure 1.4 Estimated Number of Hospitalizations Caused by Coronavirus Disease in the Austin–Round Rock Metropolitan Area in 2019

Source: (Pasco et al., 2020)

Furthermore, a major challenge to safeguarding construction site workers against infectious diseases is the provision of adequate welfare facilities. Resources provided by the Preventing Infectious Diseases on Construction Projects (2020) have been invaluable in designing welfare facilities that are essential for preventing on-site

infectious diseases. These resources also help in ensuring that all individuals in the workplace understand their responsibilities under the Occupational Health and Safety Act (OHSA) and its guidelines. It is a legal requirement for employers to provide their workers with safe, satisfactory, and sufficient welfare facilities. The primary objective of adequate welfare facilities is to maintain cleanliness and by providing sufficient on-site facilities, employees can practice good personal hygiene and curb the transmission of illness.

The need for a framework to prevent infectious diseases on construction sites is further highlighted by the most recent coronavirus outbreak. Protecting construction workers from a variety of on-site illnesses and developing a standard prevention framework for diseases encountered on-site are therefore extremely important. A systematic approach to infection and disease prevention on the job site is through the hierarchy of controls, which consists of five levels: elimination, substitution, engineering controls, administrative controls, and PPE. Consequently, contractors can mitigate the risk of on-site diseases transmission by adhering to these five levels. However, there are notably very few studies that examine frameworks encompassing comprehensive infectious disease prevention strategies, a hierarchy of on-site control practices, the perspectives from users (contractors), and the use of welfare facilities by workers as a preventive approach on construction sites in Sarawak. As a result, this study emphasises on how welfare facilities can integrate into the hierarchy of controls on construction sites. It highlights the limited research that has been conducted and the correlation between welfare facilities and on-site illness prevention.

Heading 1.5 (page 13) outlines the three objectives developed in order to accomplish the research aims. The respondents in this study are small-scale Sarawakian contractor companies registered with CIDB under the B04: Kerja-Kerja

Pembinaan Bangunan category. The prevention framework that was developed was verified through consultation with a few selected experts. Questionnaires and interview schedules were distributed for data collection to contractors in Sarawak as well as the relevant experts. The gathered data were analysed using Atlas—ti software for thematic analysis and interview data, and Excel and SPSS for both the pilot study and actual data collection.

1.4 Problem Statement

The primary goal of occupational health and safety (OHS), a subset of public health, is to improve the well-being and safety of employees in the workplace. Laws and regulations are essential for safeguarding employees against diseases. Given the significant impact of infectious diseases on employee health, addressing this issue has emerged as a top priority for OHS. The OSH division is responsible for overseeing matters pertaining to health and safety. Additionally, the Lembaga Pembinaan Industri Pembinaan Malaysia (CIDB), a government agency in Malaysia, has endeavored to promote safety and health standards within the construction industry (Construction Safety Management in Malaysia with CIDB Standard, 2021).

The Department of Occupational Safety and Health (DOSH) and CIDB are in charge of overseeing the safety and the health of workers in Malaysia. Nevertheless, contractors remain largely unaware of the recommendations provided by these two agencies regarding the protection of employees' rights. Mohd Bakri (2020) asserts that contractors' ignorance of the OSH management protocols may have contributed to accidents on construction sites. Additionally, high rates of injury and fatality can be attributed to factors such as subcontracting, insufficient safety training, a lack of awareness regarding safety practices, ineffective safety regulations, and unsupportive

upper management (Halim et al., 2020). Furthermore, according to Hassan et al. (2018), there is a disregard for hygiene policies and practices within the construction industry. Thus, it is imperative to assess the level of awareness among contractors and subsequently avoid unintended illnesses.

In order to support the survival of the construction industry during critical situations, especially for small contractor companies, CIDB has introduced the "CIDB Prihatin Initiative," which encompasses nine schemes, including the suspension of levy payments, delay in construction personnel skill training, and funding for skill competency assessment (Esa et al., 2020). For example, some contractors took the initiative to educate their workers on COVID-19 safety measures during the outbreak. The government has also implemented new restrictions in workplaces to prevent the spread of the virus, while CIDB Malaysia has conducted inspections on construction sites to ensure compliance among workers. Surprisingly, only 50% of Malaysian workers are seen wearing masks (Olanrewaju et al., 2021). This raises the question of why the remaining percentage of workers have failed to adhere to this important safety measure.

One of the main topics of this study is construction site hygiene. Maintaining cleanliness on construction sites is difficult, and poor sanitation practices could hasten the spread of infectious diseases. In addition to operational safety concerns, during COVID-19 outbreaks, it is imperative that the issues of hygiene among on-site employees and maintaining site cleanliness be addressed. Therefore, the most common and crucial method of preventing infections on construction sites is ensuring cleanliness and personal hygiene (Hassan et al., 2018).

By providing personal hygiene amenities and on-site sanitation, welfare facilities are an effective strategy to mitigate pandemics and disease outbreaks on sites (Gyamfi et al., 2021). This approach is supported by Adepu et al. (2022), who note that exposure to infectious diseases can occur on building sites due to a lack of restrooms and laundry facilities. The researcher emphasises that these basic yet crucial amenities are essential for workers living on construction sites. Despite these approaches, poor hygiene conditions are prevalent in many construction sites, making them fertile breeding grounds for infectious diseases. Particularly in regions such as Singapore and Malaysia, common infectious diseases found on construction sites include cholera, malaria, and dengue fever. Similarly, in Kuching, Sarawak, according to the Dayak Daily (2019) there is a lack of contractor awareness regarding on-site health and safety for construction workers. Also, the hierarchy of controls framework for preventing infectious diseases on sites based on the contractor's opinion is unclear. A proactive approach to prevention on-site can be fruitful, although most concentrate on a single disease or preventive strategy, according to the prior study.

The Singaporean dengue control programme serves as an example of a dengue prevention strategy on building sites (Sim et al., 2020). Ammad et al. (2021) discussed the significance of Personal Protective Equipment (PPE) and suggested reexamining how protective equipment is used in the construction industry. The study used the hierarchy of controls framework for the prevention of infectious disease on construction sites, as adopted by Adepu et al. (2022). The five levels of the hierarchy of controls were used to analyse and discuss the disease prevention strategy related to each level. According to V. Wong et al. (2023a) and V. Wong et al. (2023b), the reliability and validity of HOC instruments are crucial for effective implementation. These aspects can be enhanced by incorporating feedback from contractors. Hence,

this research tends to present different views on why it is crucial to address these five levels. For instance, different perspectives affect the extent of elimination at level 1. The success of preventing infectious diseases on-site varies across levels based on the contractor's perspectives. Prior studies have noted that welfare facilities are essential for preventing infectious diseases on-site. Consequently, the purpose of this study is to ascertain the contractors' level of awareness regarding welfare facilities (Objective 1) and determine the optimal strategy for preventing on-site illnesses (Objective 2). Finally, objective 3 involves validating the revised hierarchy of controls prevention framework with selected experts.

Furthermore, sustainable construction development remains a challenge, particularly in Sarawak (Zainordin, 2019). A comprehensive approach to worker welfare and occupational health is necessary in alignment with international best practices and regulatory frameworks, such as those established by the Occupational Safety and Health Administration (OSHA) (Koh et al., 2022). However, there remains a significant gap in empirical data regarding the awareness levels of small-scale contractors concerning welfare facilities, as well as their perspectives on effective infectious disease prevention strategies (V. Wong et al., 2024). One of the key approaches to mitigating occupational health risks is the Hierarchy of Controls (HOC) framework, which systematically ranks control measures based on their effectiveness. However, its application within small-scale construction projects in Sarawak remains poorly documented, leading to inconsistent implementation of higher-level control measures such as elimination, substitution, and engineering controls. This gap raises concerns about the long-term sustainability of health and safety practices in the industry. To address this issue, a redefined HOC framework is necessary to better guide small-scale contractors in selecting and implementing appropriate control

measures for infectious disease prevention. By validating this framework, the study aims to enhance occupational health standards, support regulatory compliance, and promote sustainable construction development by prioritizing higher-level preventive strategies over-reactive measures such as PPE alone.

Hence, this study seeks to assess the awareness levels of small-scale contractors in Sarawak regarding welfare facilities on construction sites and to examine their perspectives on the most effective approaches for infectious disease prevention based on the HoC framework. By identifying gaps in knowledge and preferred preventive measures, the findings of this research aim to contribute to the enhancement of occupational health standards and the promotion of sustainable construction practices in the region.

1.5 Research Questions

The three research questions are:

- Q1.** Which level of contractor awareness provides welfare facilities on-site in Sarawak?
- Q2.** What are the contractors' perspectives on infectious disease prevention based on the hierarchy of controls in Sarawak?
- Q3.** Is the ranking in the hierarchy of controls in the new framework suitable, as agreed by the experts?

1.6 Research Aim and Objectives

The goal of this study is to reinterpret the hierarchy of controls framework and demonstrate the critical role welfare facilities play in preventing infectious diseases on construction sites. Therefore, three objectives have been created to achieve the goal, which are as follows:

Objective 1: To ascertain the contractor's awareness of suitable welfare facilities for construction sites in Sarawak.

Small-scale contractors in Sarawak have the greatest number of practitioners enrolled in CIDB Sarawak, according to data from Table 2.7. Objective one centres on the contractor's cognizance of the insufficiency of welfare amenities available on the specific site in Sarawak, as determined by the data. The results of the first objective determined how many contractors prioritise the health and safety of their employees while upholding appropriate sanitation standards and adhering to legal and regulatory requirements for on-site facilities.

Objective 2: To evaluate the most effective on-site infectious disease prevention approach among Sarawak's small-scale contractors using the hierarchy of controls.

In order to achieve this goal and have a successful strategy for preventing infectious diseases among employees, the hierarchy of controls was modified. Small-scale contractors in Sarawak were

given a set of questionnaires via Google Forms to complete in order to learn more about their attitudes and knowledge regarding infectious diseases as well as their plans for preventing them on the job site. Consequently, the opinions of the selected contractors regarding the prevention of infectious diseases within the five-level hierarchy of the control system were determined.

Objective 3: To develop and validate a redefined hierarchy of controls framework for on-site infectious disease prevention.

Based on the information gathered from objective two, the framework was constructed. Experts were consulted in order to confirm the information that was obtained. Eventually, a framework was developed in Sarawak that was focused on small-scale contractors.

1.7 Significance of the Study

The construction industry is essential for the Malaysian economy and is key to the development of national economies worldwide. Since the COVID-19 pandemic, the Malaysian government has been prioritising the safety and welfare of workers in the construction industry. Therefore, this study is important for comprehending the implementation of welfare facilities and the management of disease control at construction sites in Malaysia.

1.7.1 Site Workers

Construction sites can be a breeding ground for infectious diseases because of the variety of hazards and the fact that workers come from different backgrounds. Preventive measures help protect the health and safety of workers by reducing the risk of illnesses that could cause them to miss work, develop long-term health problems, or even fatalities.

1.7.2 Contractors and Personnel

This study offers contractors a comprehensive analysis of welfare facilities available on construction sites, an important resource for ensuring the provision of adequate amenities for on-site construction. By consulting this framework, contractors gained a comprehensive understanding of the requirements for staff provisions. This is an important step in improving illness prevention and reducing the spread of infectious diseases. Also, improved health and safety practices at construction sites can benefit personnel (personnel who visit the construction sites) by reducing the risk of illness and injury.

1.7.3 Knowledge Gap

Despite the recognition of infectious disease risks in construction, there may still be gaps in understanding the effective control measures in the hierarchy of controls based on small-scale contractors. Hence, this research can help fill these knowledge gaps, leading to more informed decision-making and better protection of workers' health.

1.8 Scope of the Study

The research aims determined the parameters for the analysis of the subjects and the domains that were explored, taking into account the limitations and extent of the study. Due to constraints on time and resources, the research's scope and limitations are described in the following section.

1.8.1 Population Sample

The study collected data from small-scale construction companies in Sarawak registered with CIDB under the "B04: Kerja-Kerja Pembinaan Bangunan" category. The data was verified by Kerajaan Negeri Sarawak (2021) and the Contractor Company (2022). The research focused on statutory measures and intramural facilities. As a result, the sample size or respondents for this study were restricted to independent contractors.

1.8.2 Infectious diseases

According to the Representative Office for Malaysia (2019), the study of infectious diseases is restricted to the top ten illnesses prevalent on construction sites in Malaysia. These include dengue, HIV, HFMD, TB, gonorrhea, hepatitis B, hepatitis C, leptospirosis, syphilis, and malaria. However, a systematic review of the literature identified only eight categories of infectious diseases, which were taken into account in this investigation and are one of the questions in the questionnaire form.

1.8.3 Scope of Objectives

The scope of objectives in this study focused on the level of awareness among small-scale contractors in Sarawak regarding the provision of welfare amenities on construction sites. The aim of this investigation is to determine whether these contractors have a high, medium, or low level of awareness. Additionally, a hierarchy

of controls framework was employed based on the contractors' opinions and perspectives on the most effective approach to prevent infectious diseases on construction sites. This hierarchy consists of five levels: elimination, substitution, engineering controls, administrative controls, and PPE. According to this framework, the classification for welfare facilities falls under level three, which is engineering controls. This concept is supported by research conducted by Adepu et al. (2022).

1.9 Research Methodology

Numerous methods, processes, and models are available in research techniques to assist researchers in achieving their objectives. A thorough discussion of the methodology is covered in this chapter. In order to combine qualitative and quantitative research methods, this study used a mixed-methods approach (exploratory sequential mixed method complex). However, the majority of this study was more quantitative as it focused primarily on numbers. The qualitative approach was only used in the thematic analysis of documents from the interview data for objective 3. The methodological framework of this research is shown in Figure 1.5.

This study begins with the conceptualisation of the research, as shown in Figure 1.5. Subsequently, by selecting pertinent keywords, a review of the literature was conducted. From the literature review, the research problem was identified, and the most cited research paper was analysed to consider the research gap. Questions were then formulated, and research objectives were established based on the research problem. Following the literature review, chapters two and three proceeded to develop a theoretical and conceptual framework.

This study employed the research onion method which consists of six levels. The steps involved in forming a research study are covered in each level. The primary strategy adopted in this study is the quantitative approach. To ascertain the validity and reliability of the questionnaire, the content validity (content validity index), kappa statistics, and face validity (face validity index) tests have been carried out by experts and analysed by using Excel. Then, a pilot study (construct validity and internal consistency reliability) was conducted, and relevant small-scale contractors validated the questionnaire by using SPSS. Data collection continued for specific contractors

(283 sample sizes) by questionnaire through Google form. SPSS was used to analyse the data, and a pre-defined framework was developed.

Furthermore, the revised framework was validated through organised email interviews with OSHA personnel and academic specialists. Atlas Ti was used to review the outcome of the interviews. Ultimately, the thesis encompasses comprehensive sections, including data collection, data analysis, concluding remarks, and recommendations. Consequently, a novel framework featuring a hierarchy of controls was formulated to prevent the spread of infectious diseases on construction sites. This framework seeks to achieve three specific research objectives.

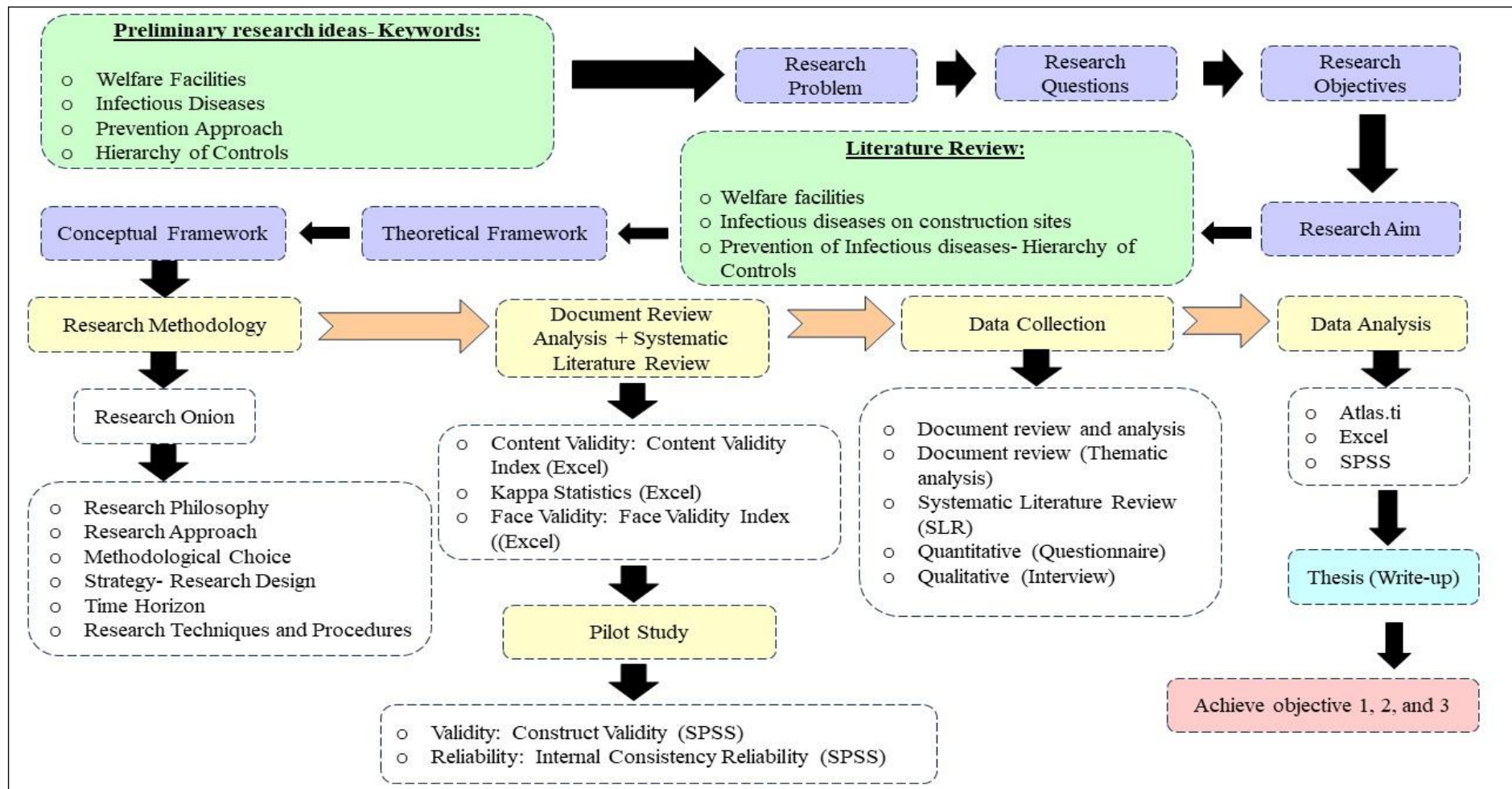


Figure 1.5 Methodological Framework

1.10 Thesis Structure

The thesis consists of five chapters. Each chapter discusses details in the following manner:

Chapter 1: Introduction

The study's introduction, which includes the problem statement, aim and objectives, research questions, significance of the study, scope of the study, and thesis structure, is presented in chapter one.

Chapter 2: Literature Review

Chapter two summarises earlier research on infectious diseases, welfare laws, and practices by construction contractors in Sarawak. To determine the types of infectious diseases present on construction sites, a thorough analysis of infectious disease cases in Malaysia was conducted. Additionally, this chapter provides a deeper exploration of the application of the hierarchy of controls framework in preventing infectious diseases.

Chapter 3: Research Methodology

Chapter three describes the research methodology used for this study with a particular emphasis on the techniques employed to conduct the study. It explains the mixed-method approach used in this investigation, detailing the methods for data collection and analysis, the construction of instruments, and the validity and reliability of designed questionnaire in Google Form.

Chapter 4: Data Analysis and Findings

Chapter four presents the outcomes derived from both the quantitative and qualitative approaches. Data collection methods included questionnaires, structured interviews, content analysis, and thematic analysis. The findings were systematically presented ensuring coherence and logical progression. Following this, the chapter proceeds to summarise the data in conjunction with the document review, providing a comprehensive overview of the research findings.

Chapter 5: Conclusions and Recommendations

In chapter five, the research conclusions regarding its objectives and questions are elaborated upon. Finally, this chapter provides recommendations for future research directions.