SAFETY CULTURE IN CONSTRUCTION INDUSTRY

EDWIN TAN AI YANG

FACULTY OF ENGINEERING
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EDWIN TAN AI YANG

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Matric No: S2004444

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[SAFETY CULTURE IN CONSTRUCTION INDUSTRY]

ABSTRACT

The construction industry is top contributor of accidents in workplace in Malaysia. This industry had recorded 143 deaths and 8,191 accidents in 2018 alone. Therefore, change of safety culture in the industry is necessary for improved safety performance. Before any change can take place, assessing the existing safety culture is a must to determine the current situation. This study aimed to assess the safety culture of the local construction industry. A self-administered questionnaire was developed on Google Form and disseminated through SiswaMail and social medias. Targeted respondents are management-level construction personnel. The survey included demographic questions, safety-culture scale, and questions related to safety-culture factors. The safety-culture scale comprised 40 five-points Likert items under various dimensions and was analyzed by descriptive statistics to gauge the current level of safety culture of the industry. The mean value of the safety-culture assessment was "high" ($N = 54$, $\bar{x} = 3.82$) and more agreement than disagreement was generated indicating that respondents were satisfied with safety culture at their organizations. Besides that, relative importance index was performed to rank safety-culture factors by their perceived importance. The top 5 safety-culture factors are: 1) management commitment, 2) site management, 3) communication, 4) supportive environment, and 5) safety alignment. Furthermore, safety-culture assessment also identified two main areas for safety culture improvement: reporting culture and safety behaviour. Based on the literature and survey findings, a framework for improvement was developed to solve those issues.

Keywords: Safety culture, Malaysian construction industry, safety-culture scale, safety culture improvement

[BUDAYA KESELAMATAN DALAM INDUSTRI PEMBINAAN]

ABSTRAK

Industri pembinaan merupakan penyumbang terbesar kemalangan di tempat kerja di Malaysia. Pada tahun 2018, industri pembinaan mencatat sebanyak 143 kes kematian dan 8,191 kes kemalangan. Justeru, penambahbaikan budaya keselamatan amat diperlukan bagi meningkatkan prestasi keselamatan industri tersebut. Sebelum perubahan dapat diimplementasikan, budaya keselamatan semasa perlu dinilaikan bagi mengetahui situasi terkini. Kajian ini dijalankan untuk menaksir budaya keselamatan dalam industri pembinaan tempatan. Borang soal selidik adalah dalam bentuk Google Form dan disebarkan melalui SiswaMail dan media sosial. Responden yang ditargetkan ialah personel binaan pada peringkat pengurusan. Soal selidik ini merangkumi soalan-soalan demografik, skala budaya keselamatan, dan soalan-soalan mengenai faktor-faktor budaya keselamatan. Skala budaya keselamatan terdiri daripada 40 item Likert 5 mata dan dianalisis dengan statistik deskriptif. Skor min daripada skala budaya keselamatan adalah tinggi ($N = 54$, $\bar{x} = 3.82$) dan responden bersetuju dengan item-item dalam skala tersebut. Ini menunjukkan bahawa kebanyakan responden berpuas hati dengan budaya keselamatan dalam organisasi mereka. Selain itu, faktor-faktor yang mempengaruhi budaya keselamatan disusun mengikut indeks kepentingan relatif. 5 faktor terpenting ialah: 1) komitmen pihak pengurusan, 2) pengurusan tapak, 3) komunikasi, 4) persekitaran kerja yang menyokong, 5) keseimbangan antara keselamatan dengan produktiviti. Bukan itu sahaja, penaksiran budaya keselamatan juga mengenalpasti 2 isu utama yang perlu ditangani, iaitu budaya enggan lapor dan tingkahlaku tidak selamat dalam kalangan pekerja-perkerja binaan. Rangka kerja bagi menangani isu-isu tersebut telah dicadangkan bagi meningkatkan budaya keselamatan dalam industri pembinaan.

Keywords: Budaya keselamatan, industri pembinaan Malaysia, skala budaya keselamatan, penambahbaikan budaya keselamatan

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LIST OF SYMBOLS AND ABBREVIATIONS

DOSH	:	Department of Occupational Safety and Health
DOSM	:	Department of Statistics Malaysia
NIOSH	:	National Institute for Occupational Safety and Health
SOCSO	:	Social Security Organization

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In process of undertaking any research, it is necessary to establish the needs for such a study and set out the intentions of the research at first. These provide a reference point to assess against the outcomes of the research. This chapter set the research context and defines the aim and objectives. Besides that, a brief discussion on scope of study, significance of study, and outline of thesis structure are also presented.

1.2 Background of Study

Malaysia is one of the most rapidly growing countries in Southeast Asia region. Over these years, Malaysia has made remarkable progress economically, in which construction sector has been significantly contributing to. This sector has contributed an average of 4.09% to the gross domestic product (GDP) of Malaysia (Khan et al., 2013). Besides that, it is reported that construction work done in third quarter of 2021 was valued at RM 24.8 billion (DOSM, 2021). Civil engineering accounted for the largest proportion (40.7%) followed by non-residential (27.2%) and residential (23.3%) buildings as well as special trade activities (8.8%). This sector also provides substantial job opportunities to more than a million people in Malaysia. As of 2017, this sector has generated employment of over 1.33 million people making up 9.1% of total employment in Malaysia (DOSM, 2019). In short, Malaysian construction sector plays a pivotal role in generating wealth for the country, developing socio-economic infrastructures and buildings, and reducing unemployment and poverty (Khan et al., 2013).

Malaysian construction industry is regulated by Factories and Machinery Act, 1967 (FMA 1967) which is later superimposed by Occupational Safety and Health Act, 1994 (OSHA 1994). The main principles of this OSHA 1994 are self-regulation, tripartite consultation, and collaboration between employers and employees (Auyong, 2014).

Gunningham (2011) defined self-regulation as controlling of a process or an activity by people or organization that involves rather than external organization. Responsibility for managing safety and health lies with those create the risks (employers) and those who work with the risks (employees) (Harun, 2013). Tripartite concept includes government, employers and their organizations, and employees and their unions (DOSH, 2016). Employers and employees are encouraged to cooperate improving health and safety at the workplace.

Despite the great importance in development of economy, construction sector has been plagued by poor safety record. It is even considered as one of the most dangerous sectors globally. The term of '3D' (dirty, dangerous, and difficult) is often used to describe this sector. NIOSH identified construction sector as top contributor of accidents in workplace. Apart from that, SOCSO recorded 143 deaths and 8,191 accidents in 2018 alone. Furthermore, statistics of DOSH indicated that this sector had the highest fatal accident cases among all the sectors throughout the year of 2019. Considering there is high tendency of underreporting in this sector, the actual figure would be even higher. Hamid, et al. (2019) attributed construction fatal accidents to unsafe method, unique nature of the industry, working condition, human factor, managerial factor, safety equipment, and environmental factor. These accidents will have great impact on the people as well as the organization. The major impacts include delay in project completion, rising cost, low productivity, reduced workers' morale, and bad reputation of the construction firm that is involved in the accident (Lee et al., 2018).

There are several characteristics exhibited by construction industry in Malaysia as well as other developing countries posing challenges to health and safety performance. One of them is lacking skilled, educated, and experienced workforce (Boadu et al., 2020). Malaysia is known to be heavily reliant to foreign labors. According to Hamid et al. (2011), 70% to 80% of construction labors are foreigners. The supplying countries

include Indonesia, Bangladesh, Myanmar, India and Vietnam. Most of the labors are low-educated, low-skilled and inexperienced (Wong et al., 2017). Labors of these sorts are hard to persuade on matters relating to health and safety, which in turn can easily cause accidents (Boadu et al., 2020). Apart from that, the industry is complex and fragmented (Ankrah, 2007). The most significant division is separation between design and construction (Mohd Nawi et al., 2014). Addressing risks and hazards in the design stage could help to prevent some site accidents (Donaghy, 2009). However, both parties tend to consider themselves as stand-alone. The design team comprising consultants provides design and details of materials, products, and methods whereas contractor execute the tasks later. Furthermore, construction industry is progress-oriented and hence may compromise occupational safety and health. Two major effects of construction delays are time and cost overruns (Sambasivan & Yau, 2007). Therefore, organization may condone workers' unsafe acts in order to catch up with time schedule.

Based on the available occupational accident statistics, safety record of the construction industry is still considered failing. Many previous studies have recognized the link between safety culture and safety performance. The study of Naji et al. (2021) has confirmed significant relationship between safety culture and safety performance. A higher level of safety culture can improve workers' performance towards safety concerns by reducing their psychosocial hazards. Al-Bayati (2021) considered safety culture fundamental to ideal safety climate, outstanding safety behavior, and satisfactory safety motivation. Moreove, Choudhry et al. (2007) suggested that safety culture can influence attitudes and behavior of employees as regards an organization's safety and health performance. In these recent years, there is shifting from traditional indicators such as accident statistics indices to more proactive indicators, for instance, safety culture in measuring safety and health performance (Arezes & Miguel, 2003).

1.3 Problem Statement

The construction sector has been regarded as one of the most unsafe industries due to high accident rate. Many literature works suggested that promotion of positive safety culture can result in overall reduction of workplace accidents (e.g., Ong, 2014). The concept of safety culture remains vague and varying, although the term has been widely used for many years. There is yet to be consensus on specific leading factors or indicators that comprise or predict positive safety climate which is correspondent of safety culture (CPWR, 2013).

At present, very limited safety culture or climate studies have been undertaken in context of Malaysian construction sector. Therefore, overall level of safety culture in Malaysian construction sector is still a question. Besides that, gauging aspects of the safety culture is a part of the process of measuring safety and health performance (Arezes & Miguel, 2003). By assessing construction personnel's perception of safety culture in their organizations, we may be able to have a glance on how well the local construction sector perform in safety and health. Meanwhile, any deficiency or room for improvement can be identified and recommendations can be made accordingly to ensure a safer and healthier working environment.

1.4 Research Questions

The research questions designed to provide guidance for the research arguments and produce data required to assess the aim and objectives are as follows:

1. What is the current level of safety culture in Malaysian construction sector?
2. What are the important factors influencing development of safety culture in construction sector?
3. How to improve current safety culture of construction industry?

1.5 Research Objectives

This principal aim of this study is to assess safety culture of Malaysian construction industry. The specific objectives of this research are as follows:

1) To measure the level of safety culture of construction industry,
2) To identify important safety-culture factors in construction industry, and
3) To propose a framework to improve the current safety culture.

1.6 Scope of Study

Although safety and health management of an organization requires various inputs in order to be effective, the scope of this study is narrowed to the areas of safety culture only. The reason for limiting the scope to safety culture is owing to impacts that safety culture has had on safety performance. The focus of attention is placed on Malaysian construction sector, which the number of fatalities has marked as the highest among other industries in the released statistics by DOSH. Malaysian construction personnel at all managerial levels make up the targeted population of the research. The respondents were provided questionnaires related to safety culture. Safety culture of Malaysian construction sector was gauged using fifty-items safety culture scale which is based on several established scales from the previous studies. Each item is gauged using a five-points Likert scale.

1.7 Significance of Study

Lack of related research for Malaysian construction sector results in arise of a lot of questions relating to performance of this sector in safety and health. Hence, this study provides insight into current situation of the local construction industry by assessing its existing safety culture. Safety-culture approach also corresponds to the shift of trend in measuring safety and health performance to using more proactive indicators including but

not limited to safety culture. Besides that, paying equal resources to cover every inch is impractical. Hence, this study establishes a ranking of safety-culture factors by their perceived importance in developing safety culture. With such ranking, it is possible for organizations that seek to improve safety performance to make use of their available resources and place their focus on the right areas. Moreover, the findings from safety culture assessment can serve as a basis for recommending and encouraging cultural change in the construction sector.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Chapter 2 provided an in-depth discussion on the concept of safety culture with support of all sorts of literatures. The discussion included definitions of the safety culture and several concepts related to safety culture. Besides that, important aspects regarding the formation of safety culture were also discussed. Moreover, this chapter presented methods of assessing safety culture assessment used in previous study and gave an overview of Malaysian construction sector.

2.2 Definitions of Concepts Related to Safety Culture

Since the term safety culture first emerged in 1986, it has become focus of all the industries and gained a lot of attention. However, safety culture is still an ill-defined concept despite a large amount of research into it over these years. This section presents varying definitions of safety culture and its related concepts found in the literature works.

2.2.1 Culture and Climate

First and foremost, it is important to differentiate between the terms of "culture" and "climate". These two terms are often used interchangeably owing to their similarity. However, they are crucially different.

Triandis (2002) viewed culture as a shared pattern of beliefs, attitudes, norms, role perceptions and values. It is embedded in individual behaviors and thus regarded as personality of an organization (Performance Climate Systems, 2018). Culture points to phenomena that are below the surface (Schein, 2004). What we often see is the behavior that results from the force underneath. Hence, it is very difficult to change the "culture".

Climate, on the other hand, is defined as a summary of molar perception that employees share about their work environments (Zohar, 1980). Climate is more immediate than culture (Ostroff et al., 2013). One can feel or sense climate of an organization through physical layout, emotional state of employees, impression from visitors or new employees upon entering and countless perceivable artifacts (Schein, 1999). Climate is usually measured through evolving workforce attitudes and perception, and therefore can vary from one time to another (Littlejohn et al., 2015). Since climate evolves with culture, it can be taken as a subset or a feature of an organization.

2.2.2 Safety Culture

Safety culture is now regarded as a crucial contributor to improve occupational safety performance in construction. The term safety culture was first presented in a report published by International Nuclear Safety Group following the Chernobyl disaster in 1986. Since then, the concept has been widely used across a wide range of sectors including construction sector. The existing literature contains many definitions of safety culture. Table 2.1 shows examples of the definitions of safety culture.

Table 2.1: Definitions of safety culture

Reference	Definition of Safety Culture
IAEA (2002)	That assembly of characteristics and attitudes in organizations and individuals, which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance
CANSO (2008)	The enduring value, priority, and commitment placed on safety by every individual and every group at every level of the organization.
ACSNI (As cited in HSE, 2008)	The product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management.
OSHA (2000)	Consisting of shared beliefs, practices, and attitudes that exist at an establishment. Culture is the atmosphere created by those beliefs, attitudes, and others, which shape our behavior.

WHSQ (2013)	Organizational culture that places a high level of importance on safety beliefs, values, and attitudes and these are shared by most people within the company.
CPWR (2013)	Deeply held but often unspoken safety-related beliefs, attitudes, and values that interact with an organization's systems, practices, people, and leadership to establish norms about how things are done in the organization. Safety culture is a subset of, and clearly influenced by, organizational culture. Organizations often have multiple cultures or subcultures, and this may be particularly true in construction.
Cooper (2000)	A sub-component of corporate culture, which alludes to individual, job, and organizational features that affect and influence health and safety.
IOSH, 2015	Consisting of share values (what is important) and beliefs (how things work) that interact with an organization's structure and control systems to produce behavioral standards (the way we do things round here)

In sum, these definitions focus on safety belief, value, attitude, and practice that are valued, shared, and normalized within an organization or group. These definitions however lack consistency and do not consider unique nature of construction sector. On the other hand, Choudhry (2007) had contextualized the concept by making it relative to construction industry. He defined "construction safety culture" as "the product of individual and group behaviors, attitudes, norms and values, perceptions, and thoughts that determine the commitment to, and style and proficiency of, an organization's system and how its personnel act and react in terms of the company's on-going safety performance in construction site environments". The author linked safety culture with behaviors, attitudes, and thoughts of work group as well as with safety performance through the organization's safety management system.

2.2.3 Safety Climate

As stated earlier, "safety climate" is often used interchangeably with "safety culture" although many studies suggested that they are dissimilar. Many consider their relationship as "chicken-and-egg" as it is hard to figure out which of them precedes or impacts the other. The term "safety climate" can be dated back at least to 1980 which is much earlier than "safety culture" which was first described in 1986. Some researchers claimed that they have causal relationship where "safety culture" influences safety climate in workplace (Al-Bayati et al., 2019). CPWR (2013) defined safety climate as "the expression of safety culture on a particular jobsite and at a particular time". Similarly, Flin et al. (2000) viewed safety climate as a snapshot of state of safety providing an indicator of underlying safety culture. Since safety climate is just a snapshot at one point in time, it can be varied when measured at any given point in time. According to Fang and Wu (2013), safety climate has been accepted as measurable reflection of safety culture in an organization. Choudhry et al. (2007) postulated that safety climate reflects employees' perceptions about the organization's safety management system, including policies, practices, and procedures that show how safety is implemented within the working environment. Hence, we can say that safety climate is able to assess safety culture.

2.2.4 Organizational Culture

Similarly, a universal consensus is yet to reach on how to define an organizational culture. Researchers use the terms "organizational culture" and "corporate culture" interchangeably. Table 2.2 provides several definitions of organizational culture for more elaborations. In sum, organizational culture is inherent belief and internal norm adopted within an organization. These norms will govern employees' behaviors, for instance how they perform, cooperate with each other, and how they feel towards the company goals

and missions (Morcos, 2018). According to ICSI (2017), organizational culture encompasses:

- Shared and recurring ways of behaving including behavior patterns and rules and procedures, and
- Mutual ways of thinking such as knowledge, beliefs, and attitudes.

Table 2.2: Definitions of organizational culture

Reference	Definition of Organizational Culture
WHSQ (2013), CPWR (2013), Wamuziri (2013), Wu (2010) and Choudhry (2007)	Safety culture is a subset or sub-culture of organizational culture.
Cooper (2000)	A product of multiple goal-directed interactions between people, jobs and the organization.
Performance Climate Systems, (2018)	A system of shared assumptions, values and beliefs that governs how people behave in the organization.
Harvard Business Review (As cited in Triandis, 2002)	Collective effect of collective effect of the common beliefs, behaviors and values of the people within a company.

2.2.5 Safety Management System

In addition to safety culture and safety climate, there has been a related term emerged recently, namely safety management. Application of and adherence to outstanding safety management system (SMS) reflects a positive safety culture in construction site environment (Alrehaili, 2016). Execution of SMS can eradicate work hazards and to lower accidents in the construction sector (Yiu et al., 2019). Hong Kong's Labor Department (2002) defined SMS as "a system which provides safety management in an industrial undertaking". According to Choudhry et al. (2007), a safety system comprises all policies, objectives, roles, responsibilities, accountabilities, codes, standards, communications, processes, procedures, tools, data, and documents for safely managing

site operations. HSE (2008) outlined several key elements of successful safety and health management:

- Setting up policy to provide guidance to an organization,
- Organizing where an effective structure and arrangements are in place to deliver the policy,
- Planning including risk assessment, risk control and development of performance standards,
- Measuring performance against the agreed standards to recognize needs for any improvement, and
- Auditing and reviewing performance so that an organization can learn from experience and apply the lessons.

Figure 2.1 illustrates the main components of a SMS proposed by Choudhry et al. (2007).

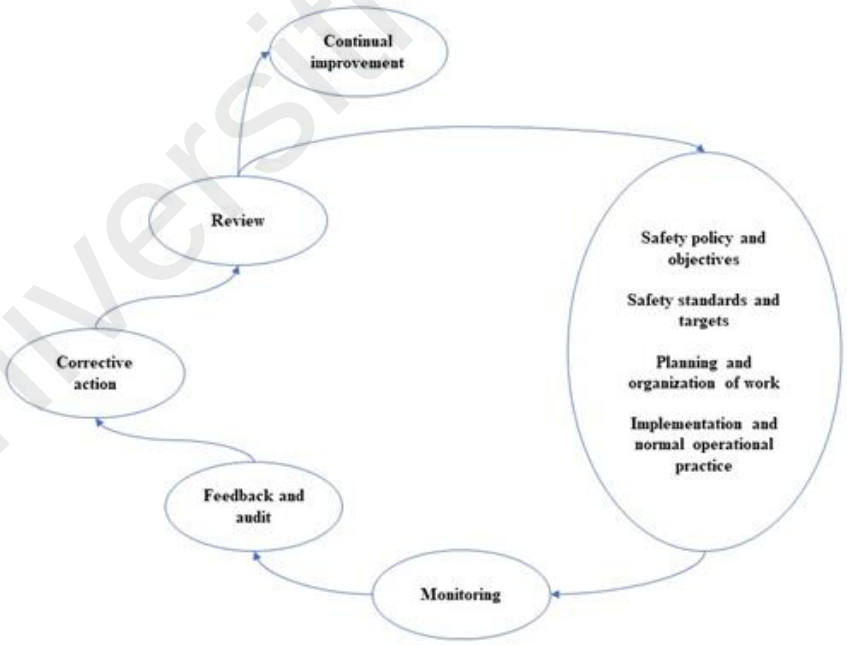

Figure 2.1: A SMS model

2.3 Characteristics of a Positive Safety Culture

A positive safety culture is crucial in the construction sector to reduce workplace accidents that affect workers and properties According to ACSNI (As cited in HSE, 1993), organizations with a positive safety culture are characterized by communications based on reciprocal trust, by shared perceptions of the significance of safety and by assurance in the efficacy of preventive measures. OGP (2013) stated that a strong safety culture is:

- An informed culture - The organization stays informed of its safety performance by collecting and analyzing all important or relevant information to avoid complacency where there is no incident.
- A reporting culture - Employees are persuaded to speak up their safety concerns. A reporting system is made accessible and handy. Value of reporting is visible as well.
- A learning culture - The organization learns from the mistakes. It is sensitive to lessons from both internal and external sources. Most importantly, it implements changes to correct unsafe conditions.
- A flexible culture - Organizational structure moves from hierarchical mode to flatter mode. The organization stresses employees' capabilities or expertise rather than their positions within the organization.
- A just culture - Clear boundary between right and wrong is created, communicated with employees, and constantly employed. Unsafe behaviors are dealt in a just and coherent manner.

As shown in Figure 2.2, ICSI (2017) categorized safety culture into four types based on weight assigned to management and employee in safety for decision-making process:

- A fatalistic safety culture – People are convinced that influencing safety level is impossible and consider accidents normal or unavoidable.

- A shopfloor safety culture – Management do not attach much importance to safety. However, employees develop their own prudent work practices.
- A bureaucratic safety culture – Management becomes accountable for safety. It is heavily reliant on management who is not working at the sharp end to pass down the orders to workers.
- An integrated safety culture – People share strong belief that no single person, but everyone is hold accountable in ensuring good safety performance.

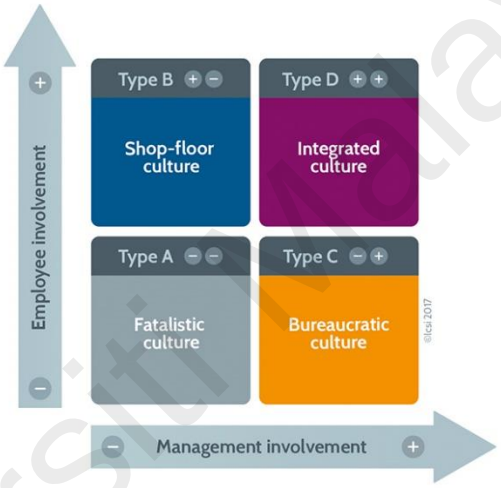

Figure 2.2: Types of safety culture

Apparently, "integrated" safety culture is the most promising among all as it encourages all stakeholders to contribute to safety. In this culture, safety is everyone's responsibility, it is not only for managers but also for sharp-end workers. According to Taylor (2010), the good safety-culture characteristic are as follows:

- Safety is a clearly recognized value,
- Safety leadership is clear,
- Safety accountability is clear,
- Safety is integrated into all activities, and
- Safety is learning-driven.

2.4 Models of Safety Culture

It is traditionally accepted that there is causal relationship between culture on one side and practices and outcomes on the other. Figure 2.3 shows the Antecedent Safety Culture Model. In such model, safety culture acts as antecedent governing safety practices and pushing safety outcomes (Grainger, n.d.). When safety problems persist, the culture will be seen by safety leaders as the cause and fixing the culture will rectify the problems.

Figure 2.3: Antecedent model

Figure 2.4 presents the Cooper's (2001) Reciprocal Safety Culture Model. This model recognizes the interactive relationship between psychological (people), behavioral (job), and situational (organization) factors. A change in any one of these components will exert reciprocal effect on the other two (Cooper, 2002). Since each component can be measured singly or jointly, quantifying safety culture at different organizational levels has become possible (Cooper, 2001).

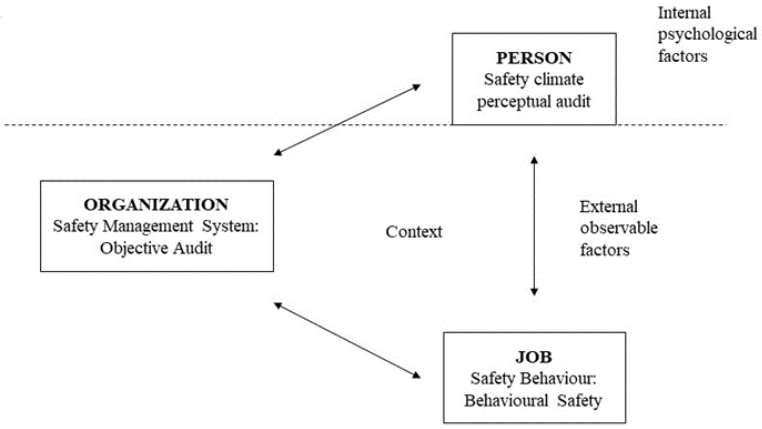

Figure 2.4: Reciprocal model

2.5 Safety-Culture Factors

Developing safety culture is very complex as it may be influenced by numerous factors. However, these factors are yet to be agreed upon. There are inevitable variations across the sources due to complexity of the topic. Therefore, a benchmark of safety-culture factors is required. The common factors can form a benchmark set that is broadly consistent across various sources as discussed later. Table 2.3 presents safety-culture factors found in the existing literature works.

Table 2.3: Safety-culture factors

Reference	Safety-Culture Factors
CPWR (2013)	Employee involvement/empowerment, management commitment, safety valued and aligned with production, owner/client involvement, supervisory leadership, accountability at all levels
Mohamed (2002)	Management commitment, communication, rules and procedures, supportive and supervisory environment, workers' involvement, personal appreciation of risk, appraisal of work environment, work pressure, competence
Misnan et al. (2007)	Organizational structure, top management commitment, employee commitment and involvement, behavior change, communication, safety policy, training, safety and health committee, recognition, motivation, team working, working environment, employee empowerment
Flin et al. (2000)	Management and supervision, safety system, risk, work pressure, competence

2.5.1 Management Commitment and Leadership

Managerial commitment remains the most important safety management practices across sectors and countries (Mashi et al., 2017). Neal and Griffin (2004) defined management commitment as the extent to which management is seen to highly prioritize safety and have effective communication and action on safety issues. Zou (2011) argued that shaping safety culture requires strong commitment at all levels from top management to individual employees over an extended period. Gualardo (2008) listed individuals that are needed for maximizing safety performance within an organization:

- Senior managers who are individuals at the top-of-the-line organization,
- Middle managers who link line managers and top-level management,
- Front-line supervisors who are at the entry level of the management and have the closet contact with the workers, and
- Safety professionals who support the entire organization.

He argued that top managers have power to make changes to the culture. His viewpoint is supported by Cooper (2001) that developing good safety climate requires demonstrated commitment from top managers on a regular basis. When top managers are perceived highly committed to safety matters, the workers are most likely to use positive safety behavior (Mashi et al., 2017). This commitment can be made visible through any announcement and decision made, managerial style, and forms of presence at the sharp end (ICSI, 2017). HSE (2005) stated that it is indicated by the resources, the supports, and the status given to safety and health.

Besides management, leadership is also significant to safety culture (Khasanah et al., 2019). Management and leadership are two very distinct functions but complementary to one another. Managers are not necessarily leaders. Leaders are to create the new changes while managers are to apply them (Wajdi, 2017). Wu et al. (2010) also argued that managers at all levels must function as safety leaders. They found four safety-leadership factors to be significant to safety culture:

- Safety informing – safety monitoring, safety dissemination, safety representing
- Safety caring – including leaders being able to treat subordinates as their own children, to have consensus in working practice, and to respect, trust, and care about them
- Safety coordination – development of safety policy, safety information management, safety communication
- Safety regulation – safety inspection, safety audits, safety incentive system

According to ICSI (2017), leadership can be demonstrated by employers' action (for example, their safety behavior and decisions), communication with employees (such as their presence at sharp end), and resources allocated to safety.

2.5.2 Training

Training is considered by many to be essential in shaping safety culture. Armstrong (2014) defined training as "the use of systematic and planned instruction activities to promote learning". Jafari et al. (2014) affirmed that safety training can improve not only safety climate but also its pertinent factors in construction site. Misnan et al. (2008) ranked training as the second most important factor in developing safety culture. Besides that, it is found that in safety programs having been successful, there was safety training incorporated (Zou, 2011). Furthermore, legislative requirements for employers to give safety training to their employees in OSHA 1994 has underlined significance of safety training in safety. Safety training provide trainees with substantial safety-related knowledge associated with their works. Safety training may be able to influence workers' behaviors or attitudes. Less frequent breach of safety norms was reported by persons who had attended safety training course than person who had not attended such course (Cavazza & Serpe, 2010).

Generally, there are two types of training, namely on-the-job training and off-the-job training. On-the-job training is the job instruction taking place in the work setting and during the work while off-the-job training occurs away from the regular workspaces and is usually to fulfill shared learning needs of a group (Rothwell & Kazanas, 2004; Nik Adik, 2014). Table 2.4 presents the examples of trainings.

Table 2.4: Examples of Trainings

On-the-Job Training	Off-the-Job Training
• Job rotation and transfer • Coaching • Mentoring • Apprenticeship	• Classroom training • Conference • Role playing

The main concern on training is its effectiveness. Only useful training can provoke change in employees. However, the training program is often not tailored to the needs of trainees (Cooper, 2001). It is not underpinned by the real learning environment (Harvey et al., 2001). Besides that, the training received is not constantly reinforced by management or followed up with continuous training and refresher course. Therefore, to instill positive safety-related behaviors or attitudes, the program must be designed with employees' needs in mind and management should show interest in helping or encouraging employees to implement changes from their trainings.

2.5.3 Communication

Communication is one of the key components of safety culture. Communication quality is often associated with safety performance such as workplace accident and safe working practices (Zohar, 1980; Glendon et al., 2016). An effective communication will not only intensify workers' awareness towards risk and hazard as but also their preventive behaviors (WHSQ, 2013). According to WHSQ (2013), in order to be effective, the communication should:

- be lucid and frank,
- be to the point for the receivers,
- not involve blaming, and
- stress the impact of action or decision on the individuals.

Safety communication may take many forms or modes. According to Alsamadani et al. (2013), it can occur either formally (sharing through pre-established safety-specific channel) or informally (ad hoc communication among individuals). Wamuziri (2013) regarded toolbox talks and health and safety tours as important communication tools. Toolbox talks at start of shifts can remind the workers of the need for safety and the presence of hazards at the workplace. According to Vecchio-Sadus (2007), safety communication comes in the following forms:

- Policies and procedures – They serve as the direction of safety process and the reference for safety-related decision making.
- Performance statistics – Performance of an organization is communicable through graphs of lost time, incident rates, workers compensation rates medical treatments and others.
- Hazard or incident report – Management should communicate results of hazard and incident investigation and involve employees in suggesting strategies to prevent recurrence.
- Workplace inductions – Important information such as site rules and requirements, emergency procedures and reporting procedures must be provided to new employees before they are put on the job.
- Risk assessment – Risks are not always perceivable. Hence, risk assessment can help to identify hazards in workplace, assess their magnitudes, apply controls to mitigate risks.
- Training – It aims to close knowledge gap, to target high-risk groups, and to adjust risk perception.
- Others such as safety week and public report.

2.5.4 Employee Engagement

Employee engagement is vital for safety culture. It is very important that employees are involved and engaged, and their inputs are valued. Lockwood (2007) defined employee engagement as "the extent to which employees commit to something or someone in their organization, how hard they work and how long they stay as a result of that commitment. The author also argued that amount of participation given to employees in their work processes determines their engagement. In other words, highly involved workers are more engaged. There is positive link between employee engagement between employee engagement and safety performance. Engaged workers are more committed and responsible to safety (Philips, 2008). Therefore, they are less likely to have safety incidents compared to disengaged workers (Swarnalatha & Prasanna, 2013). Besides that, engaged workers offers advantages including higher productivity and lower safety cost (Vance, 2006). According to Raines (2011), in order to make employees to feel engaged in the safety process, the following factors must present:

- Employee involvement – Taking account their opinions in safety changes to be made and giving their preference priority when feasible.
- Valuing employees' ideas – Encouraging them to provide inputs regarding workplace safety, following up with status as well as crediting and recognizing originators if implemented.
- Communication – Safety-related communication must be free-flowing, clear and concise.
- Positive feedback – Taking place in either formal or informal way as reinforcement of safety behavior, for instance, a simple praise.
- Respect – Treating employees with respect.

2.5.5 Client or Owner Involvement

Clients or owners are one of the stakeholders on a construction project. Their involvement is a deciding factor for safety climate (CPWR, 2013). There is association between owner involvement and safety performance. Huang (2003) claimed that increased owner involvement can reduce the number and severity of accidents on their projects. Low bid is often main criterion for selection of contractor. Such criterion is likely to compromise safety for cost. Therefore, it is important for the owner to put the following safety criterion into consideration during contractor selection (Huang, 2003):

- Injury incident rates,
- Jobsite safety inspection,
- Records of legal citations and fines,
- Injury-related litigations,
- Performance records of key personnel, and so forth.

Besides that, the owner can impact construction safety by encouraging and supporting designers to address safety issues during design phase (Mroszczyk, 2015). Furthermore, the owner, via their project representatives, should involve with the contractors in all safety activities such as new employee orientation, safety meeting, safety audits, and training (Huang, 2003). According to Hislop (1998), in order to establish safe worksite, the owner must:

- See safety as an ongoing process, and thus make timely decision and address problem promptly,
- Make sure safety is addressed throughout project life cycle,
- Provide support to safety program such as adequate financing,
- Specify minimum expectations of project safety and health, and
- Verify that safety program is being carried out in effective manner.

2.5.6 Organizational Learning

Organizational learning is critical to safety culture. There is a link between safety culture and learning culture (Littlejohn et al., 2015). A strong safety culture is a learning culture (OGP, 2013). IOSH (2015) asserted that creating a positive safety culture requires capability to learn from safety incidents and safety performance indicators. Ostrom et al. (1993) also stated organizations with good safety culture collect safety-related information, gauge safety performance, and cause people to learn working in a safer manner. According to Crossan et al. (1999), organizational learning occurs over individual, group, and organization levels through four sub-processes:

- Intuiting – An unconscious process based on filtered experience and pattern recognition
- Interpreting – Explaining in words or actions to oneself and to other
- Integrating – Developing shared understanding and undertaking coordinated actions via mutual adjustment
- Institutionalizing – Coordinated action taking becomes routinized and significant

IAEA (2002) asserted that a learning organization is able to make use of ideas, energy, and concerns of those at all levels in the organization. Bratianu (2015) revealed the two key features of organizational learning: knowledge sharing and organizational memory. A learning organization gathers information from different sources, extracts and makes use of useful lessons, shares knowledges, and brings about improvement (OGP, 2013). Sources of information can be either internal or external to the organization. The organization views disputes as learning opportunities, and hence it is receptive to bad news (Christenson, n.d.). Besides that, losing critical knowledge is avoided in such organization even when key people leave (OGP, 2013). Individuals may come and go but

what they have learnt does not necessarily leave with them (Crossan et al., 1999). Some learning has become embedded into the organization.

2.5.7 Safety Valued and Aligned with Production

Both safety and productivity are important areas of consideration for a project success. It is very common to observe difference between actual and planned performances in construction sector. Such difference often leads to production pressure. Speed of work or work pace and workload are often associated with pressure at work (Flin et al., 2000). Excessive production pressure is likely to increase job strain, unsafe behaviors, and accident rate, which in turn reduce performance and heighten cost (Cooper, 2001; HSL, 2002; Han et al., 2014). ACSNI identified balance maintained between productivity and safety as one of the key components of safety culture. HSE (2005) revealed that one of the symptoms of poor safety culture is management decision that put production before safety. It is hence important that management treat safety equally with productivity so that neither safety is achieved by sacrificing productivity nor productivity is pursued at the expense of safety. Cooper (2001) stated line managers tend to ignore unsafe practices among workers owing to pressures or competing goals. Senior managers are the ones who have ability to instill such balance as they can permit line managers to focus on safety in the same manner as other priorities such as coast and schedule (Gualardo, 2008). Besides that, management ought to integrate strategies to control pressure at work into their policies that shows commitment to safety (Amponsah-Tawaih & Adu, 2016). Otherwise, workers may perceive such commitment as insincere and become less likely to engage in safe behavior. Furthermore, Enshassi et al. (2009) recognized skillfulness of workers as the most important factor that sustains safety and productivity of a project. Skilled workers are more productive as they perform tasks on time, and more committed to safety

than non-skilled workers. Therefore, management should invest in developing workforce skills, for instance through training.

2.5.8 Rules and Procedures

What makes up organizational culture encompasses rules and procedures (ICSI, 2017). Safety rules refer to actions that employee should do or should not do in order to achieve workplace safety (Leplat, 1998). It is proven that there is association between safety rules and procedures, and safety behavior (Subramaniam et al., 2016; Alfayez et al., 2018). Poor, incomplete, and unenforced safety policies, rules and procedures will lead to the accidents (Abdul Hamid et al., 2008). They ought to be in intelligible and convenient form (IAEA, 2002). Hence, it is vital to review them rigorously for their relevance and practicality (HSE, 1995). Otherwise, violation will begin to happen. How people believe that an organization applies its safety rules and procedures will affect how their daily safety-related behavior (Cooper, 2001). If management themselves show little interest in practicing safety rules and procedures, then the workers could not care less.

2.5.9 Incentives, Rewards, and Recognition

IAEA's (1997) safety culture practices includes rewards and sanctions. Ostrom et al. (1993) asserted that organization with a good safety culture rewards persons who point out safety problems and who innovate how to address workplace hazards. Companies with safety incentives program are found to be safer than those that do not (Goodrum and Gangwar, 2004). Incentives, rewards, and recognition aim to change ideas, values, and practices to accomplish safety behavior (Fernandez et al., 2012). An effective incentives system reinforces risk information among employees, and therefore can lessen their unsafe acts that may cause injuries and encourage their participation in decision-making process (Fernandez et al., 2012). Criterion for awarding incentives can be injury and

illness-based or behavior-based (Goodrum and Gangwar, 2004). Safety incentives can take many forms either financially or non-financially. The examples of financial incentives are one-off prizes, gift vouchers, and safety raffle (HSE, n.d.). Non-financial incentives can be as effective as financial ones, for instance safety feedback including verbal feedback, peer feedback, behavior modeling, and social recognition (Fell-Carlson, 2004). A key features of a successful incentive program is that it must have high visibility within the organization (Ismail et al., 2012). In this way, employees are able to apprehend what the program is designed for and how their performance is being measured. Besides that, it is critical that employees perceive bonus system as fair (Mattson, 2015). Otherwise, it may lead to rise of negative attitudes and conflicts between individuals or groups. Sinclair and Tetrick (2004) described several potential problems with safety incentives. For example, safety incentives may create divisiveness among workers or tempt workers into underreporting of occupational illnesses and injuries.

2.6 Accident Statistics of Malaysian Construction Industry

In Malaysia, DOSH is in charge of humanitarian and environmental protection for all the industrial sectors. Figure 2.5 shows total occupational accident for the whole industries in Malaysia by DOSH. The occupational accident rose sharply from 2017 onwards. The figure increased by about 55% in 2018 and by almost 60% peaking in 2019 (7984 cases). The figure was lower in 2020 compared to previous year due to halt in many industries due to COVID-19 pandemic. In 2019, Selangor was accounted for the highest number of accidents (21.3%) followed by Johor (16.7%) and Perak (12.2%).

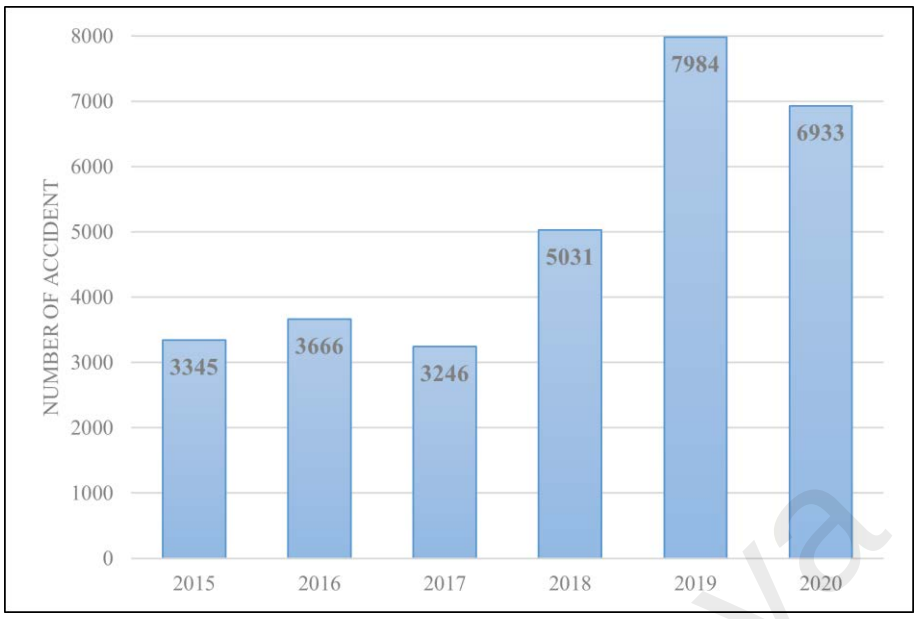

Figure 2.5: Occupation accident in Malaysia from 2015 to 2019

Figure 2.6 presents occupational accident in construction sector in Malaysia. Similarly, the figure rose from 2017 to 2019 and fell in 2020 due to COVID-19 pandemic. Although construction sector only ranked third for number of occupational accident (4.1%), this sector however contributed the highest number of fatalities (32.4%) in the workplace in the country. A total of 510 fatal accident cases have been reported to DOSH from 2015 to 2020. The actual figure may be even worse considering there is high tendency of under-reporting in this sector. Some minor injuries might not be reported to the authority but settled internally instead. Another factor contributing to under-reporting is demographics of construction personnel in which 80% of them are foreigners with and without permits. Under-reporting occurs due to poor reporting culture which is also a key element of safety culture.

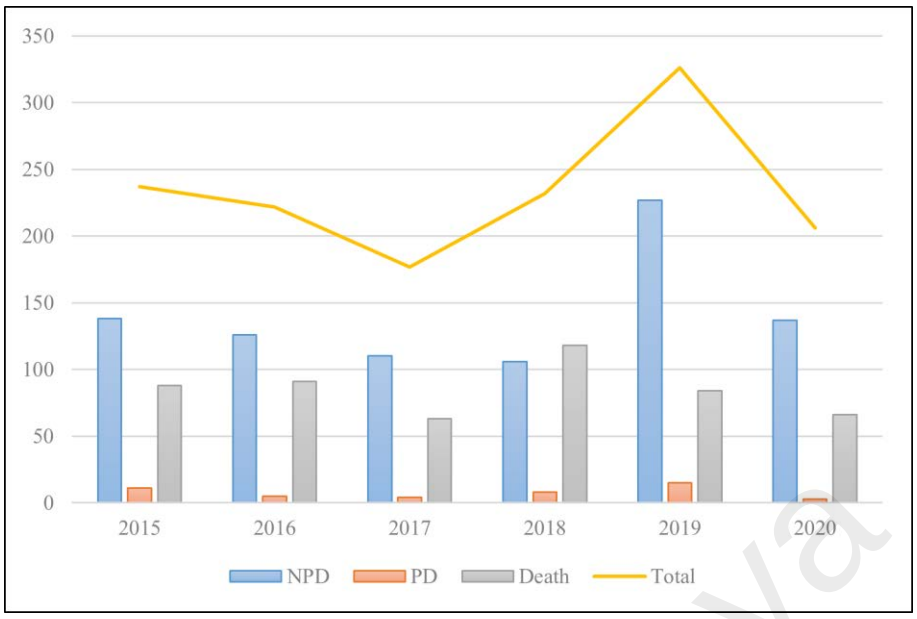

Figure 2.6: Occupational accident in Malaysian construction sector from 2015 to 2020

2.7 Assessing Safety Culture

Before any change of safety culture can take place, assessing the existing safety culture is necessary in order to determine the current situation. However, safety culture is rather hard to gauge for various reasons. One of the reasons is that both cause and effect cannot be identified directly (Littlejohn et al., 2014). Besides that, guidance on how to evaluate and gauge safety culture in an effective way is lacking in the literature.

There are various measurement tools for different aspects of safety culture. For capturing the psychological aspects, the most conventional instrument is safety climate questionnaire (Cooper, 2000). It contains a set of questions which gauge beliefs, values, attitudes, and perceptions over several dimensions of safety viewed to be significant in developing safety culture. As discussed earlier, safety climate can be used to gauge the state of safety culture at a point of time. It has been proven by Teo & Feng (2009) that safety climate assessment is able to predict overall safety culture level of construction organization reliably. Many high-risk industries have been gauging safety climate to assess workers safety perception for a long time. According to Cooper (2002), in order to

measure safety culture, two relatively simple things must occur: measuring "matched" factors and using common metric. There are various dimensions in many existing assessment tools. Table 2.5 presents the designs of safety culture or safety climate questionnaire found in the previous studies.

Table 2.5: Previous safety culture and climate survey questionnaires

Reference	Questionnaire Design	Safety Culture/Climate Dimensions
Zohar (1980)	40 items; each dimension was represented by 7 items (short statements with 5-points scale).	1) Perceived importance of safety training programs; 2) perceived management attitudes toward safety; 3) perceived effects of safety conduct on promotion; 4) perceived level of risk at workplace; 5) perceived effects of required work pace on safety; 6) perceived status of safety officer; 7) perceived effects of safe conduct on social status; and 8) perceived status of safety committee.
Nordic Safety Climate Questionnaire (NOSACQ-50)	50 items over 7 dimensions.	1) Management safety priority, commitment and competency; 2) management safety empowerment; 3) management safety justice; 4) workers' safety commitment; 5) worker's safety priority and risk non-acceptance; 6) safety communication, learning, and trust in co-workers' safety competence; and 7) workers' trust in the efficacy of safety system.
Al-Bayati et al. (2019)	24 items; each construction stakeholder was represented by 6 items.	1) Management safety factor i.e., safety culture: Upper management, safety personnel; and 2) site safety factor i.e., safety climate: Frontline supervisors, workers involvement.
Choudhry at al., (2009)	31 items; modified from HSE questionnaire.	1) Management commitment and employee involvement; and 2) inappropriate safety procedure and work practices.
Ibrahim et al., (2012)	Developed based on recent investigation by many authors; 33 items for safety	1) Work environment and competence; 2) communication; 3) safety involvement and awareness; 4) safety

	climate and 2 items for safety behavior.	beliefs and confidence; 5) supportive environment.
Tehrani et al., (2019)	50 items; the safety culture factors, and questionnaire were provided by Feng (as cited in Tehrani et al., 2019).	1) Management commitment; 2) communication; 3) safety rules and procedures; 4) supportive environment; 5) supervisory environment; 6) workers' involvement; 7) personal appreciation orf risk; 8) appraisal of physical work environment and work hazards; 9) work pressure; 10) level of competence and training.
Béland and Dedobbeleer (1991)	3 dimensions of Brown and Holmes' (As cited in Béland and Dedobbeleer (1991) model measured with 9 variables	1) Employee perception of management concerns with well-being of employee; 2) employee perception of management response to these concerns; 3) employee physical risk perception

Besides that, measuring safety performance remains problematic (Choudhry et al., 2007). Traditional safety performance measure is by lagging indicators or reactive measures, for instance injury rates and workers' compensation. Such indicators are measurements associated with the outcome of an accident (Toellner, as cited in Hinze et al., 2013). They are historical in nature focusing on past performance. They measure system failure rather than success (Wamuziri, 2013). Therefore, they have been considered ineffective in avoiding future accident.

In recent times, there has been a trend of using leading indicators or proactive measures to gauge performance in construction industry. Leading indicators are rather predictive in nature and serve as 'feedforward' control. Toellner (as cited in Hinze et al., 2013) characterized them as measurements associated with action taken to prevent accidents. Hinze et al. (2013) suggested leading indicators measure building blocks of safety culture of a project or an organization.

CHAPTER 3: METHODOLOGY

3.1 Introduction

Chapter 3 outlines the research design and the method adopted to achieve the research objectives. The flowchart methodology of this research is available in the Figure 3.1.

This study focused on assessing safety culture among construction personnel who work in the management level in Malaysia. Construction personnel targeted in this research were managers such as engineers and supervisors as well as safety professionals, for example safety officers. This research explored which leading indicators are perceived to be significant in developing safety culture in construction industry. Furthermore, this study aimed to find out the level of overall safety culture level of Malaysian construction industry.

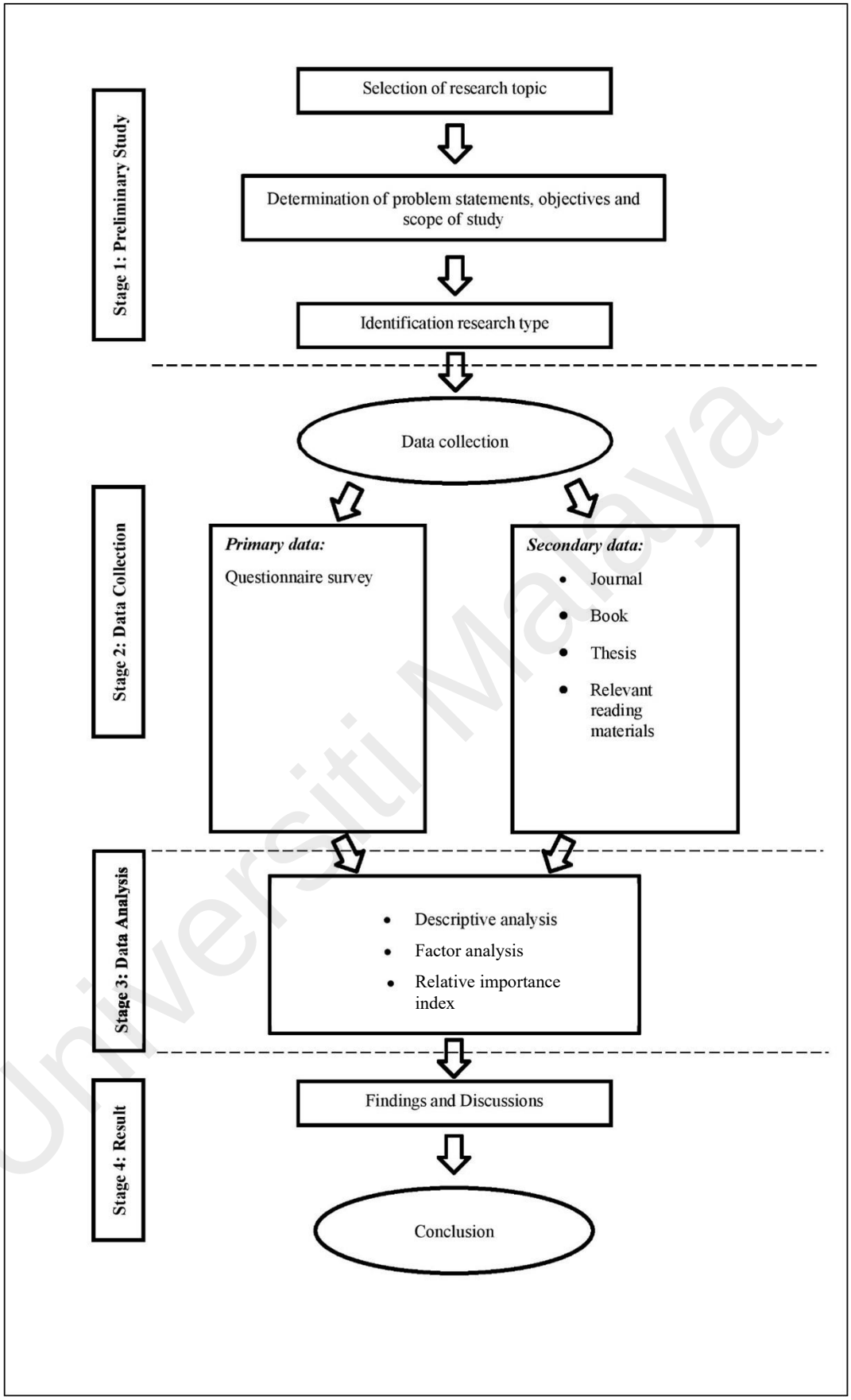

Figure 3.1: Flow chart of research

3.2 Data

There are two types of data in this study: primary data and secondary data. Primary data was obtained from questionnaire survey involving working personnel at managerial level in construction industry in Malaysia. Secondary data, on the other hand, was extracted from a wide range of publications relative to safety culture or safety climate, including but not limited to, newspapers, online materials, journals and conference papers and others. These materials had provided substantial support during the preparation of this research.

3.3 Participant

Participants involved in the research were local construction personnel at all managerial levels including low managers, middle managers and top managers. Statistical formula used to calculate required sample size, n was as follows (Taherdoost, 2017):

$$n = \frac{p\ (100 - p)z^2}{E^2}$$

P is the percentage occurrence of a state or condition.

E is the margin error.

z is the value corresponding to level of confidence required.

It is suggested to use 50%, 5%, and 95% (0.05; Z = 1.96) for P, E, and confidence level, respectively. Therefore, n for this study was:

$$n = \frac{50\ (100 - 50)(1.96^2)}{5^2} = 384$$

However, sample size of 384 was considered inviable due to several constraints. Time allocated for the whole research was only 1 semester and 1 special semester. The study was also funded by the author solely. Furthermore, the decision was also influenced by type of analysis. There are minimum sample sizes recommended in previous literatures to perform certain analyses. According to Hair et al. (2009), factor analysis requires at

least 50 observations. Therefore, the minimum sample size was reduced to 50 respondents.

3.4 Sampling

The research adopted convenience sampling which is a non-probability sampling method involving samples from population that is close to hand. The author simply recruited fellow students, friends, relatives and whoever was "convenient" to the author for the research through SiswaMail and social medias including WhatsApp and Facebook. Considering difficulties arisen due to Covid-19 as well as limited time and budget, convenience sample was a viable option as it is much simple, prompt, and economical.

3.5 Instrument

The instrument used in the study was a self-administered questionnaire developed on Google Form. The questionnaire was developed based upon questionnaires from the literatures (Ibrahim et al., 2012; Choudhry et al., 2009; Al-Bayati et al., 2019; Tehrani et al., 2019). The 5-points Likert scale was applied so that respondents could express their level of agreement on a symmetrical scale ranging from 'strongly disagree' to 'strongly agree' or 'very unimportant' to 'very important' regarding a series of the statements given.

As shown in Table 3.1, the questionnaire comprised of 4 sections with varied attributes. Section 1 measured perceived importance of 15 proposed leading indicators of safety culture by respondents; Section 2 measured perceived safety culture of respondents' current organizations and this section was open to respondents who are working on site; Section 3 presented demography of respondent; Section 4 collected feedback and suggestion from respondents.

Table 3.1: Sections of questionnaire

Section	Questions
Section 1: Safety-culture factors	Perceived importance of 12 safety-culture factors
Section 2: Safety culture of current organization	Safety-culture scale containing 40 five-points Likert items
Section 3: Demographic information of respondents	This section included respondent's gender, age, job position, field of work, employer, working experience and working location
Section 4: Recommendations	This section was made optional for the respondents

3.6 Data Analysis

The collected data was analyzed by Microsoft Excel and Statistical Package for the Social Sciences (SPSS). The analysis results were then illustrated clearly in several forms including table, graph, and chart. Type of analyses used in this study are as follows:

3.6.1 Descriptive Analysis

Descriptive statistics are the numerical and graphical techniques used to organize, present, and analyze data (Fisher & Marshall, 2009). They comprise of two main categories of measures:

- Measures of central tendency – Indicating approximate center of a distribution including the mean, median, and mode.
- Measures of dispersion – Measures describing the spread of a data, such as standard deviation

When deciding on which statistical technique to use, level of measurement must be determined. There are three levels of measurement broadly: nominal, ordinal, and continuous. Whether Likert scale is ordinal or interval has always been a debate. Some consider that Likert scale is not equivalent or equidistant between points and thus is ordinal (e.g., Marshall & Jonker, 2010) while others think otherwise. In fact, statistical

treatment for Likert data depends on the design of research instrument (Joshi et al., 2015). In this study, the safety-culture scale was to generate a composite score and therefore the data was analyzed at interval measurement scale. Interval measurements are measurements with consistent distance between values (Matthews, 2017). Suggestions to describe the scale include mean for central tendency, and frequency distribution and standard deviation for variability (Boone & Boone, 2012; Fisher & Marshall, 2009)

According to Dean (2010), a relative frequency is the fraction of times an answer occurs. It can be written in forms of fractions, percent, or decimals. The formula of relative frequency is:

$$Relative\ frequency = \frac{Frequency}{Sum\ of\ all\ frequencies}$$

In this research study, the author mainly used mean to describe central tendency. The mean is an average value of data set and is computed using the following formula:

$$\bar{x} = \frac{\sum a_i X_i}{X_i}, i = 1,2,3,4, \ldots$$

$\bar{x}$ is mean.

a_i is coding or constant expressing weight of each response of i.

X_i is frequency of each response of i in percentage.

Each response was assigned with a coding. The coding started at '1' for 'strongly disagree' increasing by one for each level of response and ended at '5' for 'strongly agree'. The resulting weighted mean is interpreted using Table 3.2 which shows the interval with its corresponding interpretation. The interval is suggested by Pimentel (2019) which every difference is similar.

Table 3.2: Likert scale range

Likert Scale	Interval
Strongly Disagree (SD)	1.00 – 1.79
Disagree (D)	1.80 – 2.59
Neutral (N)	2.60 – 3.39
Agree (A)	3.40 – 4.19
Strongly Agree (SA)	4.20 – 5.00

The level of agreement from respondents was assessed using score interpretation as shown in Table 3.3 (Ahmad et al., 2017). The scores relative to each other point out the "weak" components of safety culture. Attention needs to be given to those components and corrective actions should be taken for improvement.

Table 3.3: Interpretations of mean score

Mean Score	Interpretation
1.00 – 2.33	Low
2.34 – 3.67	Average
3.68 – 5.00	High

Standard deviation (SD) is the average difference of each score to the mean (Fisher & Marshall, 2009). The lower the SD, the closer the value to the mean of the set, and vice versa. The formula for calculating SD is as follows:

$$\sigma = \sqrt{\frac{\sum(X - \bar{x})^2}{n - 1}}$$

σ is SD.

X is a set of numbers.

$\bar{x}$ is the mean (or average).

n is the size of the set.

3.6.2 Relative Importance Index

It is impossible to give all the leading factors the same attention, time, effort and cost. Relative Importance Index (RII) approach was used to describe the relative importance of every factor. The higher the RII, the more critical the factor in improving safety culture of the industry. According to Kassem et al. (2020), RII is determined by the equation:

$$RII = \frac{\sum W}{A \times N}$$

W is the weight assigned to each factor by respondents from 1 to 5.

A is the highest weight (5 in this study).

N is the total number of respondents.

3.6.3 Cronbach's Alpha

In this study, 40 items were used to form safety-culture scale. Hence, internal consistency is important to these items. All of them should measure the same thing. Cronbach's alpha (α) is useful in assessing internal consistency (Bland & Altman, 1997). The α ranges between 0 and 1. The higher the α, the better the scale is. However, overly high α may indicate redundancy and thus test length should be reduced (Tavakol & Dennick, 2011). The interpretation of Cronbach's α is presented on Table 3.4 (Mat Nawi et al., 2020). In general, lower limit for Cronbach's α is .70. However, the value may decrease to .60 for exploratory studies.

Table 3.4: Interpretation of Cronbach's α

α Coefficient Range	Interpretation
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Very good
$0.8 > \alpha \geq 0.7$	Good
$0.7 > \alpha \geq 0.6$	Moderate
$\alpha > 0.6$	Poor

3.6.4 Factor Analysis

Factor analysis (FA) condenses many variables down to a smaller and more manageable number of factors (Pallant, 2007). This technique is to find out underlying structure among the variables. There are two types of FA: exploratory factor analysis (EFA) and confirmatory factor analysis. EFA serves the purpose of describing a multidimensional data set using fewer variables. This can be accomplished in two steps: factor extraction and factor rotation. One of the approaches to factor extraction is principal factor analysis (PCA). PCA assumes that all the variance is common variance (communality, h^2=1). A specific guideline in selecting rotational technique is yet to be developed. The most widely used method is orthogonal rotation (varimax) which rotates factors while keeping them independent of each other. Besides that, adequate sample size is important to ensure reliability of FA and therefore measure of sampling adequacy (MSA) must be assessed prior to the analysis. In SPSS, Kaiser-Meyer-Olkin (KMO) is available on SPSS. Table 3.5 shows interpretation of KMO value (Kaiser, 1974). Values of 0.5 and higher indicate appropriateness.

Table 3.5: Interpretation of KMO value

KMO	Interpretation
in the .90s	Marvelous
in the .80s	Meritorious
in the .70s	Middling
in the .60s	Mediocre
in the .50s	Miserable
below .50	Unacceptable

Furthermore, factor loadings are also important in FA. Factor loading shows the effect of a given factor on a given surface attributes (or items) (Tucker & MacCallum, 1997). These loadings are normally arranged in matrix form. High loading represents strong influence by the factor on the surface attribute, and vice versa. In general, factor loading

of ±.30 to ±.40 is minimally acceptable. Nevertheless, the significance of a loading will have to depend on the sample size (Field, 2009). Table 3.6 presents the relationship between factor loading and sample sizes (Hair et al., 2009). The lower the factor loading to be considered significant, the bigger the required sample size. By referring to Table 3.6, value of .73 was obtained using interpolation given that the sample size is 54. Therefore, loading of .73 and above was considered significant.

Table 3.6: Significant factor loadings based on sample size

Factor Loading	Sample Size Needed for Significance
.30	350
.35	250
.40	200
.45	150
.50	120
.55	100
.60	85
.65	70
.70	60
.75	50

CHAPTER 4: RESULT AND DISCUSSION

4.1 Introduction

This Chapter discusses the findings of this research. By referring to Chapter 3, although the sample size required had to be at least 384, the minimum however was reduced to 50 due to the time constraint. 100 feedbacks were received over 3 months. Finally, 85 feedbacks were selected for the following analyses. All the feedbacks were from local construction personnel at all managerial levels.

4.2 Demographic Profile of Respondents

Among 85 respondents, there were 54 males (63.5%) and 31 females (36.5%). Besides that, 54 (63.53%) out of 85 respondents were based at construction site. All site-based respondents completed safety climate survey. With respect to age, majority of the respondents (60.0%) were aged between 20 to less than 30 followed by respondents aged between 30 and 40 (29.4%). Respondents aged more than 40 accounted for only 10.6% of the respondents. Furthermore, most of the respondents surveyed (63.5%) were residing or working in Wilayah Persekutuan Kuala Lumpur and Selangor followed by Johor (16.5%).

Table 4.1 demonstrates profile of the respondents. There was no top manager participating in this survey. As for middle-level manager category, 7.1% and 4.7% of the respondents were project managers and site/construction managers respectively. 21.2%, 11.8% and 8.2% of the respondents worked as civil engineers, site engineers and project engineers respectively. Safety personnel including S&H executives, safety managers and safety and health officers, on the other hand, accounted for 16.5% of the respondents. At low-level management, 8.2% of the respondents were frontline supervisors. Most of the respondents (78.8%) had experience of less than 10 years at the construction industry.

12.9% of the respondents had experience of 10 to less than 15 years. The rest (8.2%) had experience of 15 years and above. It is apparent that distribution of respondents in term of working experience was imbalanced. Last but not least, personnel working in buildings made up the largest portion of respondents with 62.4% followed by those working in road with 10.6% and water and sewage with 5.9%.

Table 4.1: Professional background of the respondents

No	Variable	Option	Percentage (%)
1	Job position	Civil Engineer	21.18
		Site Engineer	11.76
		Safety and Health Officer (SHO)	9.41
		Project Engineer	8.24
		Frontline Supervisor	8.24
		Project Manager	7.06
		Safety Personnel other than SHO	7.06
		Site/Construction Manager	4.71
		Others	22.34
2	Experience at the construction industry (years)	Less than 3	45.88
		3 to less than 10	32.94
		10 to less than 15	12.94
		15 to 20	5.88
		More than 20	2.35
3	Current employer	Contractor	41.18
		Consultant	29.41
		Subcontractor	11.76
		Developer	9.41
		Government/GLC	4.71
		Client	3.53
4	Current field of work	Buildings	62.35
		Road	10.59
		Water and sewage	5.88

4.3 Present Level of Safety Culture

Before any culture change can take place, assessing the status quo has to be done. Table 4.2 and Figure 4.1 show the important statistics for safety culture assessment. All items in the questionnaire were positively worded statements. A higher mean score reflects a more positive perception from the respondents. The resulting mean from safety culture assessment was 3.82. It was "high" referring to Table 3.3. Besides that, respondents agreed to components of safety culture. These were considered positively promising for "safety culture".

The top 3 items with the highest mean scores were recorded by Item 37 ($\bar{x}$ = 4.43, σ = .944), Item 36 ($\bar{x}$ = 4.31, σ = .987), Item 29 ($\bar{x}$ = 4.20, σ = .1.016), and Item 33 ($\bar{x}$ = 4.20, σ = 1.053). Respondents had the strongest agreement towards clear and all-levels accountability in safety at their organizations. Besides that, they were also positive about their involvement in safety as well as availability of safety rules and procedures in their workplaces. In contrast, there were some items which showed at average levels as shown in Table 4.2. Item 6 recorded the lowest mean ($\bar{x}$ = 2.54, σ = 1.224. It is likely that workers did not actively report their safety concerns, including but not limited to workplace hazards, near misses and actual incidents. This is supported by Moore et al. (2013) and Shariff et al. (2016) that asserted that under-reporting is prevalent in construction industry. It was followed by Item 31 ($\bar{x}$ = 2.80, σ = 1.351). Respondents seemed to adopt neutral sort of attitude towards workers' risk-taking behavior; thus, they might be tolerant to such act in their workplace. The third lowest mean score was seen in Item 30 ($\bar{x}$ = 2.96, σ = 1.148) suggesting the issue of non-compliance to safety rules and procedures among workers.

Table 4.2: Percentage, RII, mean and SD for safety culture

Item	Relative Frequency (%)					Mean, μ	SD, σ	Level	Rank
	SD	D	N	A	SA				
1	7.4%	11.1%	11.1%	27.8%	42.6%	3.87	1.289	High	21
2	3.7%	11.1%	14.8%	25.9%	44.4%	3.96	1.181	High	14
3	5.6%	9.3%	20.4%	25.9%	38.9%	3.83	1.209	High	24
4	7.4%	7.4%	18.5%	27.8%	38.9%	3.83	1.240	High	24
5	5.6%	1.9%	9.3%	40.7%	42.6%	4.13	1.047	High	5
6	16.7%	46.3%	14.8%	11.1%	11.1%	2.54	1.224	Average	40
7	7.4%	13.0%	14.8%	33.3%	31.5%	3.69	1.256	High	32
8	5.6%	1.9%	16.7%	33.3%	42.6%	4.06	1.089	High	7
9	5.6%	7.4%	14.8%	42.6%	29.6%	3.83	1.112	High	24
10	7.4%	5.6%	20.4%	31.5%	35.2%	3.81	1.199	High	28
11	0.0%	5.6%	18.5%	37.0%	38.9%	4.04	1.045	High	8
12	5.6%	7.4%	9.3%	38.9%	38.9%	3.98	1.141	High	12
13	3.7%	9.3%	16.7%	33.3%	37.0%	3.91	1.120	High	17
14	1.9%	13.0%	16.7%	35.2%	33.3%	3.85	1.089	High	23
15	3.7%	11.1%	16.7%	35.2%	33.3%	3.83	1.129	High	24
16	5.6%	11.1%	14.8%	42.6%	25.9%	3.72	1.140	High	32
17	3.7%	11.1%	20.4%	24.1%	40.7%	3.87	1.182	High	21
18	1.9%	9.3%	14.8%	33.3%	40.7%	4.02	1.055	High	10
19	3.7%	9.3%	25.9%	29.6%	31.5%	3.76	1.115	High	30
20	3.7%	7.4%	22.2%	29.6%	37.0%	3.89	1.110	High	18
21	5.6%	3.7%	14.8%	42.6%	33.3%	3.94	1.071	High	15
22	14.8%	3.7%	9.3%	29.6%	42.6%	3.81	1.415	High	28
23	7.4%	20.4%	25.9%	13.0%	33.3%	3.44	1.341	Average	35
24	3.7%	11.1%	24.1%	33.3%	27.8%	3.65	1.110	Average	33
25	5.6%	3.7%	13.0%	31.5%	46.3%	4.09	1.120	High	6
26	16.7%	20.4%	22.2%	24.1%	16.7%	3.04	1.345	Average	37
27	7.4%	5.6%	13.0%	38.9%	35.2%	3.89	1.176	High	18
28	3.7%	7.4%	14.8%	38.9%	35.2%	3.94	1.071	High	15
29	3.7%	3.7%	9.3%	35.2%	48.1%	4.20	1.016	High	3
30	7.4%	20.4%	25.9%	33.3%	13.0%	2.96	1.148	Average	38
31	20.4%	25.9%	22.2%	16.7%	14.8%	2.80	1.351	Average	39
32	14.8%	13.0%	18.5%	22.2%	31.5%	3.43	1.435	Average	36
33	3.7%	5.6%	7.4%	33.3%	50.0%	4.20	1.053	High	3
34	3.7%	13.0%	14.8%	27.8%	40.7%	3.89	1.192	High	18
35	5.6%	16.7%	31.5%	18.5%	27.8%	3.46	1.224	Average	34
36	3.7%	3.7%	3.7%	35.2%	53.7%	4.31	0.987	High	2
37	3.7%	1.9%	3.7%	29.6%	61.1%	4.43	0.944	High	1
38	1.9%	11.1%	13.0%	33.3%	40.7%	4.00	1.082	High	11
39	3.7%	7.4%	16.7%	31.5%	40.7%	3.98	1.107	High	12
40	1.9%	13.0%	11.1%	27.8%	46.3%	4.04	1.132	High	8
Average	6.0%	10.3%	16.1%	30.7%	36.8%	3.82	1.157	N/A	N/A

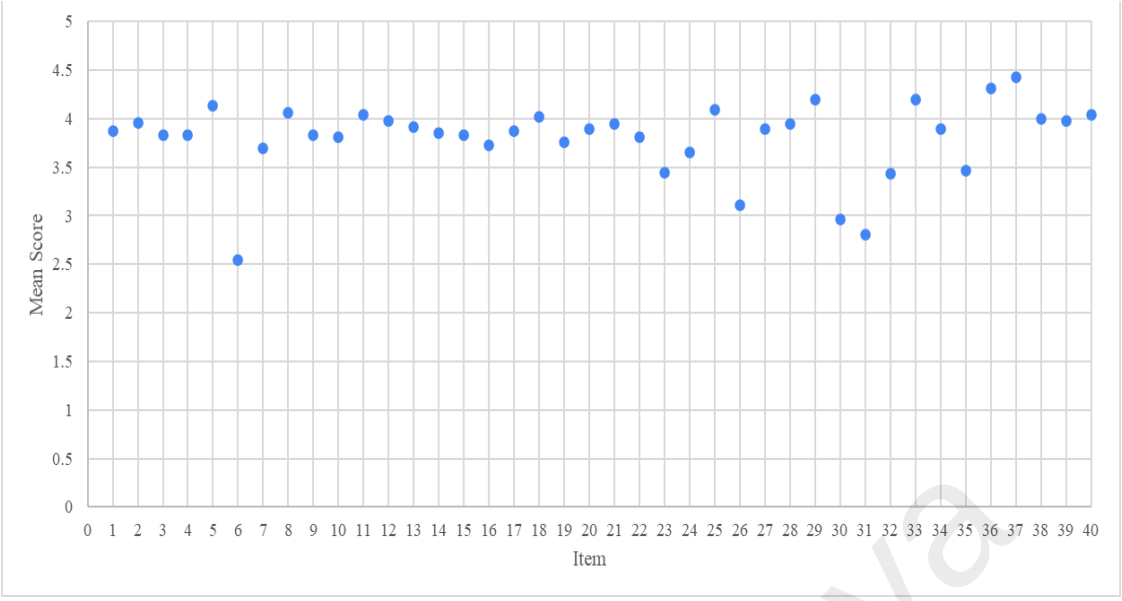

Figure 4.1: Safety culture assessment

4.4 Safety-Culture Factors

Table 4.3 shows the ranking of these factors based on RII. Here RII functions as an indicator of how important the factors are relative to the other; in this respect, the higher the RII, the higher the importance given by respondents. Paying equal resources to all the factors is impossible but by the table below the organization will be able to plan appropriate strategies accordingly. Almost all the factors had RII of above .80 and difference between each RII was small. The most influential factor was site management (RII = .882) followed by management commitment (RII = .873). Both factors are management related. These findings, in the same line as the previous studies (e.g., Zohar, 1980; Mohamed, 2002; Misnan et al., 2008), showed paramount importance of management and their concern to safety issues in shaping organizations' safety culture. Communication, supportive environment, and safety alignment come in third with RII = .854. Surprisingly, training and employee involvement were only ranked sixth and eighth respectively although they occur frequently in the published papers. The least important factor was owner/client involvement (RII = .795).

Table 4.3: Ranking of safety-culture factors

No	Safety-Culture Factors	RII	Rank
1	Management commitment	.873	2
2	Site management/supervisory leadership	.882	1
3	Training	.842	6
4	Worker involvement	.838	8
5	Communication	.854	3
6	Owner/client involvement	.795	12
7	Organizational learning	.807	11
8	Safety rules and procedures	.840	7
9	Accountability at all levels	.835	9
10	Supportive environment	.854	3
11	Safety as value/safety alignment	.854	3
12	Recognition/incentive system	.824	10

Besides RII analysis, FA was also conducted to reduce a large number of variables into fewer numbers of factors. With an N = 54 on a 40-items survey, first step of the analysis was to check suitability of the data set for FA. It was performed by way of KMO and Bartlett's Test. Initially, overall KMO value was .738 and significance level was <.001. The diagonal of anti-image correlation matrix contains MSA of each variable (Hair et al., 2009). Items with KMO values of less than .50 and hence were removed. After the removal, overall KMO value increased to .780 which is "middling" according to Table 3.5. Bartlett's test of sphericity χ^2 (54) = 2859.641, p<.001 indicated that there are sufficient correlations exist among the items. Results of the tests are presented in Table 4.4. Besides that, every individual KMO value was larger than .50, and extraction communalities were higher than .30.

Table 4.4: Adequacy testing

Test	Value	P-value
Bartlett's Test of Sphericity	2859.641 (Chi-square)	<.001
KMO Test	Overall MSA = .780	N/A

Factor extraction was based on Kaiser's criterion i.e., Eigenvalue greater than 1.0 and scree plot. Both suggested that there were six 'meaningful' factors. However, the six-factor model showed considerable cross-loading on the variables. A simpler model might be appropriate. Also, a significant loading is .73 and higher. The variables with cross-loading or insignificant loading were eliminated from future iterations of model fitting. After exclusion, the remaining ten variables loaded cleanly on the three factors. Table 4.5 shows the pattern matrix. The higher the factor loading, the greater the influence on the item by the factor. Each factor was named based on theme shared by the items that cluster on a particular factor. The labels are entirely subjective. Then, Cronbach's α was used to test their reliability. All the factors had α larger than .80 indicating satisfactory internal consistency.

Table 4.5: Pattern matrix

Item		Factor		
		1	2	3
1	Management places safety before production.	.848		
2	Management always gets involved in safety.	.842		
3	Management allocates sufficient resources for safety.	.926		
4	Management is approachable and receptive to workers.	.908		
7	Management follows up all safety reports.	.770		
25	Every new worker receives orientation.		.783	
34	Workers involve in developing and reviewing safety policies and procedures.			.813
35	Workers participate safety-related decision making.			.891
36	I am clear about my responsibility for safety.		.864	
37	Everyone is accountable for safety in workplace.		.923	
	Eigenvalue	4.057	2.740	1.884
	% Of Variance	40.574	27.403	18.840
	Cronbach's α	.970	.917	.820

Since all items loaded on Factor 1 explicitly involve management, Factor 1 can be interpreted as 'Management Commitment'. This factor accounted for the largest variance with 40.574% of total variance. Item 1 had the highest loading among all. It is necessary for management to provide adequate resources as well as supports so that safety activities can take place effectively. It was followed by Item 4, Item 1, Item 2, and Item 7. Committed management should be approachable and receptive to workers' ideas. As a result, workers feel able to contribute ideas and do not sit on or cover up problems. Apart from that, they should give safety a high status by balancing them with other competing priorities such as production. Furthermore, it is important that management must actively participate in safety, for instance, holding regular safety meetings. Moreover, they must ensure prompt follow-up on all safety reports from workers.

Factor 2, on the other hand, can be thought of as 'Safety Accountability'. This factor accounted for 27.403% of total variance and had high loadings on three items. Item 37 had the highest loading following by Item 36 and Item 25. Accountability throughout an organization is critical for establishing a positive safety culture. Everyone involved in a construction project must be held accountable for safety, including owners, management, and workers. Responsibilities for implementing safety should be clearly defined, communicated, and reinforced at all levels within an organization regularly. One of the methods to instill safety accountability in the workplace is by providing orientation to new workers.

Finally, Factor 3 accounted for 18.840% of total variance and strongly influenced Item 34 and Item 35 which are relating to workers participation in safety of the organization. Therefore, Factor 3 can be interpreted as 'Worker Involvement'. Such involvement can create ownership of safety among workers and make use of knowledge that they have of their own works.

4.5 Recommendations to Improve Safety Culture

4.5.1 Rationale

Although respondents considered safety culture at their organizations satisfactory, there were several items that score only 'average' calling for interventions. This study and the reviewed papers provided the information required to recommend how to improve existing safety culture of local construction industry.

4.5.2 Framework and Recommendations

Due to limited time and space, this section focused on items with top three lowest mean in safety-culture assessment. Figure 4.2 presents the proposed framework for safety culture improvement.

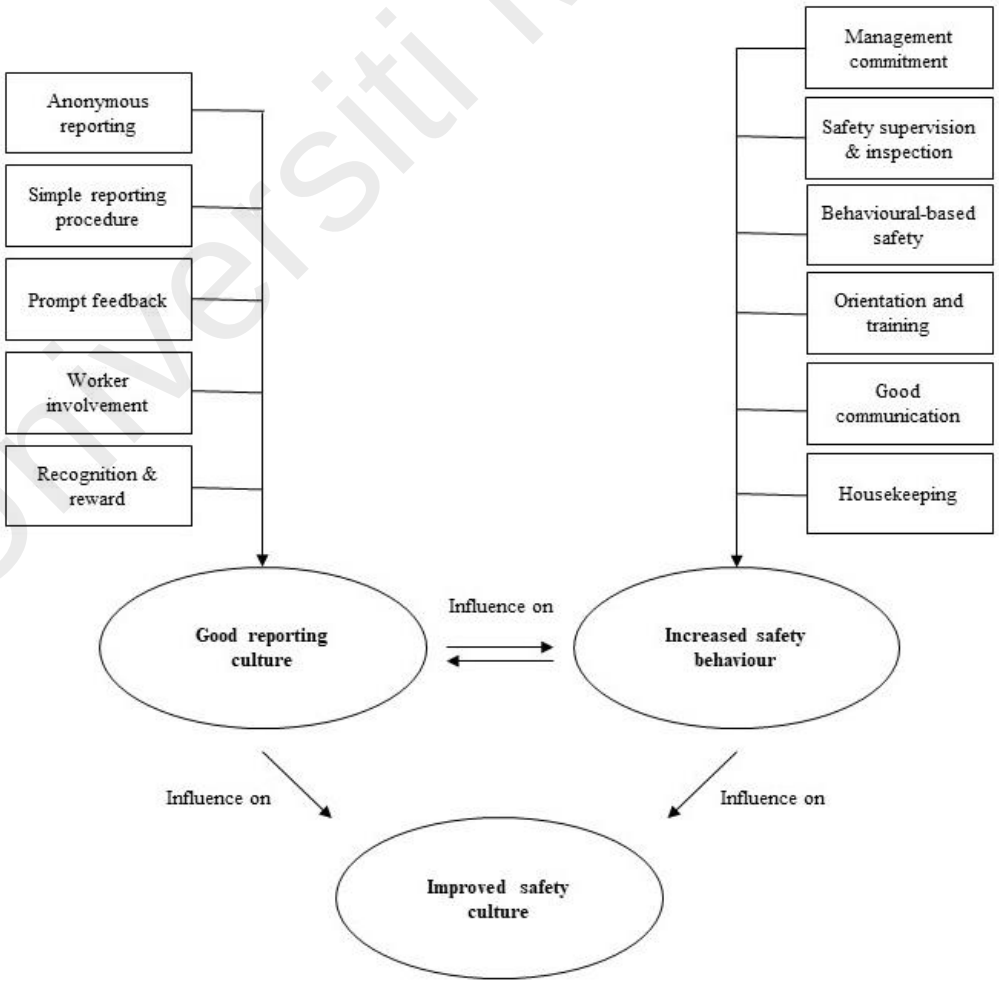

Figure 4.2: A framework of safety culture improvement

4.5.2.1 Under-reporting

Item reporting safety concern recorded the lowest mean (2.54) suggesting likelihood of under-reporting among workers. If workers do not report close-call or actual incidents, the root causes will remain unaddressed and unfixed likely to recur in future affecting more workers. Contributory factors of reluctance in reporting among workers include accepting injuries as "part of the job", fear of negative consequences following the reporting, and sense of powerlessness to bring about improvements (Moore et al., 2013; Tucker and Turner, 2013). The following are the recommended practices to encourage reporting among workers:

- Establish a simple procedure for workers to report their safety concerns.
- Introduce anonymous reporting to reduce fear of reprisal. Emphasize that reported information will be used by management to improve safety in workplace solely.
- Follow up promptly on all reports from the workers. Actions taken must be reported back to the workers so that will feel that their opinions are valued and taken seriously.
- Involve workers in finding solutions to reported issues. The workers are well-positioned to say how the work might be improved as they are the person who carry out the work.
- May introduce employee recognition or reward to show appreciation for their contribution. This can be accomplished by formal or informal methods. It is evident that respondents perceived their organizations lack such system (Item 23).

4.5.2.2 Unsafe Behavior

Both Item 34 and Item 32 were concerning safety compliance. Safety compliance is encompassed into safety behavior (Neal and Griffin, 2002). Low mean scores (2.80 and 2.96 respectively) indicated that workers may perform unsafe behaviors to some extent. Famous Bird's pyramid from 1966 proposed 600:300:10:1 theory suggesting that unsafe acts can cause minor injuries and over time to major injuries. Safety behavior is considered a subset of safety culture (Mohammad & Hadikusumo, 2019). Safety behavior involves only one level whereas safety culture involves all levels within an organization. If an organization is unable to keep unsafe behavior in control, major incident may be unavoidable. HSE (2002) found that most accidents are attributed to human behavior. Therefore, only by focusing upon unsafe behavior in construction sites, safety performance may be likely be improved.

Literature suggested various causes of such behavior among workers. Low et al. (2019) revealed that attitude toward risk has the greatest influence on risk-taking behavior. People with positive attitude toward risk have propensity for risk-taking and vice versa. Apart from that, time pressure is often regarded influential to behavioral responses of individual (Oswald et al., 2013; Aulin et al., 2019). Construction sector is progress-oriented and thus safety is always compromised to catch up with the progress. As a result, workers may be pressured to perform their job faster and thus engaging in unsafe acts only to meet employer's demand. Utami (2020) also highlighted significance of leadership on positively affecting safety behavior of workers. with emphasis on transformational leadership style. Other factors include, but are not limited to, risk perception, workplace condition, social influence, and management commitment.

All practices that can be adopted to reduce unsafe behavior in construction sites are described here.

(a) ***Management Commitment***

Managerial commitment plays a pivotal role in influencing workers' safety behaviors (Cooper, 2006). Hence, management must manifest their commitment to safety on a regular basis. According to HSE (2005), their commitment is indicated by proportion of resources and support provided. The resources are vital to promote safe work among workers. They can take many forms such as money, workforce, and material. However, it is difficult to tell if the resources allocated are adequate or not. The study of Shohet et al. (2018) suggested that the optimal level of safety investment is at 1.0% of project scope. They further claimed that increase in safety investment will not only reduce overall safety cost but also quantity of accidents. The resources also include time for safety works (Zahiri Harsini, et al., 2020). For instance, time slot for safety procedures. Apart from that, the status given to H&S by management is also crucial. Although there are conflicting priorities such as productivity, quality, cost, and safety in most organizations, management must give safety a priority by treating all of them as related parts of the project. As an example, manager never compromise on safety of workers to meet project deadlines. When management is seen to be doing so, supervisors and workers will be keen to take part in daily safety practices (Aulin et al., 2019). Finally, it is essential that managers at all levels of the organizations are seen to be physically engaging in structured activities such as safety tour, safety stand-down and safety meeting.

(b) ***Safety Supervision and Inspection***

HSE (1995) argued that a strong discouragement of rule violation is high likelihood of being detected. McKeon (2007) also asserted that an organization with good supervision has strong ability to influence behavior of its workers. Therefore, adequate safety supervision and inspection are required when workers are performing construction works (Low et al., 2018). By "adequate", it means frequent, broad and deep enough. Supervisors

must closely watch workers, especially those with high level of attitude towards risk (Low et al., 2019). If necessary, additional human resources must be employed as well. In addition, it is critical to train supervisors for improved supervisory skills (Wong et al., 2021). Moreover, every supervisor ought to be relationship oriented because workers are more comfortable working with supervisors who care for their safety (Choudhry & Fang, 2008). Quality relationship between supervisors and workers will positively affect individuals' safety behaviors (Su et al., 2019).

Besides the hired supervisors, workforce themselves are the most effective supervisors (HSE, 1995). Individual workers' decisions to violate safety rules are often encouraged by their co-workers who are doing the same (Liang et al., 2018). Safety violations are "contagious". Hence, it is necessary to create a working environment where a member of the workforce would feel uncomfortable if breaking safety rules and expect other members to follow those rules.

(c) ***Behavioral-Based Safety***

Unlike traditional interventions, behavioral-based safety (BBS) emphasizes on two features: concentrate upon observable safety behavior and encourage safe behavior (Choudhry, 2014). It is revealed that safety performance has improved with adoption of BBS (Oostakhan et al., 2012). BBS is a very flexible approach and different across organizations. In general, BBS approach is as follows.

- Planning – Deciding scope of the interventions such as department involved and necessary resources, as well as appointing a coordinator (Cooper, 1994).
- Measuring current safety culture/climate (HSA, 2013) – The result of the measure will provide a baseline for BBS intervention. One of the ways to assess safety culture/climate is survey approach.

- Studying company documents (Salem et al., 2007) – For example, past accident records, near miss reports and safety audit reports. This will help to target critical safety behaviors.
- Goal-setting meeting (Choudhry, 2014) – It is important to reach a consensus among workers regarding the goals in order to establish ownership of the improvement process.
- Behavioral observation – There are 2 ways of observation: 1) Appointing and training safety observers among the workers to observe their colleagues at work (Salem et al. 2007; Choudhry, 2014); 2) Involving all workers in the observation process by encouraging them to observe each other (HSA, 2013). It may involve checklist and rating system.
- Feedback session – Feedback is one of the key components of BBS approach (McSween, 2003). Feedbacks in relation to the goals must be delivered to workers on a periodic basis. For instance, an award or punishment (Liao et al., 2017), and a feedback chart (Choudhry, 2014)
- Continuing to monitor safety performance (Reber et al., 1993) – To detect any performance change timely allowing for more responsive adjustments to be done.

*(d) **Orientation and Training***

Previous study attributed unsafe work behaviors to inadequate safety knowledge and skills (Haslam, et al., 2005; Choudhry & Fang, 2008). The most widely used approach to tackle this problem is by provision of orientation and training. New hires are usually unfamiliar with their new jobs and may become unaware of the associated hazards. Hence, their training begins with orientation in order to prepare them for their new jobs. Well-oriented workers are unlikely to work unsafely (Zahiri Harsini et al., 2020). High

score of Item 25 showed that orientation is sufficient in the industry. Nevertheless, orientation alone may not suffice. Safety training is equally important as it equips workers with skills and knowledge required to work in a safe and efficient manner. Safety training is proven to have desirable effect on workers' attitude towards risk and risk perception (Man et al., 2021). In turn, safety training may improve personal compliance (Kumarasamy et al., 2018). Employing qualified safety trainers is crucial to training quality as they are more aware of workers' problems and able to align the training content with workers' needs (Demirkesen & Arditi, 2015). Keçeci (2019) recommended use of proactive learning process by instructing the workers how their risky behaviour might affect themselves as well as their colleagues.

However, one of the problems with this approach is that it does not often represent the actual working environment (Choudhry & Fang, 2008). Our findings also pointed to possibility of deficient job-specific training for workers in the industry (Item 26). Hence, assessing training needs is very crucial to ensure the course content is relevant (Hassan et al., n.d.; Ashtiani, 2015). Training needs analysis (TNA) should be conducted at organizational level, operational level and individual level to be accurate. Besides that, Cooper (2001) suggested examining organization's safety information systems to identify these needs. Apart from that, it is found that perceived learning decreases over time (Akdere & Schmidt, 2008). What is learnt during orientation and training may not all stay with the workers when they are on the job. Hence, refresher training is brought into play to keep all important knowledge and skills fresh and updated.

According to OSHA Alliance Program (2016), safety orientation should at least cover the following information:

- H&S responsibilities of employers and workers,
- Company's H&S program/policies,
- Applicable H&S regulatory requirements,

- Site-specific information such as identified workplace hazards,
- Hazard identification, assessment, and control,
- Personal protective equipment,
- Reporting procedures, and
- Emergency procedures.

(e) ***Communication***

Fernandez et al. (2012) revealed that what governs safety behavior is safety-related communication and transmission of information to the workers. There must be open communication and frequent interaction between managers and employees. Managers play an important role in promoting that communication (Fernandez et al., 2012). They need to embody commitment towards safety. Olanrewaju et al. (2017) also suggested attitude of superiors towards site workers has effect on communication and in turn affects safety performance. According to IAEA (2002), good communication involves three elements: transmission, reception, and verification. It is crucial to make certain that messages have been transmitted, received, and apprehended. Face-to-face communication is the most effective due to managers and supervisors being highly visible at workplace (IAEA, 2002). When addressing workers who engage in unsafe work, aggressive actions on the workers must be avoided, such as threatening for discipline, because it will only lead to worker disengagement (Raines, 2011). Instead, one can have a proper discussion with them to understand the reasons for perpetrating unsafe acts and communicate possible consequences for doing so.

(f) ***Housekeeping***

Construction sector is known as "3D" sector, meaning dangerous, dirty, and difficult. Work condition is often associated with risk-taking tendency and occupational

injuries (e.g., Ghosh et al., 2004). Study of Sawacha et al. (1999) also highlighted importance of a clean and tidy site in improving safety performance. Poor work conditions, on the other hand, are likely to promote unsafe behavior (Mohammad & Hadikusumo, 2019). In other words, when good work conditions are provided to workers, they are less prone to risk-taking (Low et al., 2019). Low et al. (2018) defined workplace condition as the housekeeping of a construction site. Therefore, it is important for organization to establish a good housekeeping procedure and allocate sufficient time to workers for housekeeping. Housekeeping can reduce site hazards and make construction site less dangerous, less dirty, and less difficult.

4.6 Limitations of Study

Several limitations of these results were recognized. One of the limitations is observed in term of size of respondent population. The size of population was small with imbalance of demography of respondents. For instance, majority of the respondents (60%) were aged 30 and below. Hence, there is a need to cover bigger population, preferable higher number of respondents and more diversity, to produce a more representative and generalizable outcome. In order to achieve that, more time and resources are required. Besides that, all data used in this study were self-reported. Social desirability (SD) bias has been detected in many questionnaire-based studies (van de Mortel, 2008). SD bias seemed to enhance safety-culture measure as respondents tend to increase the degree of their agreement affecting the validity of self-reported data. Therefore, future researcher must consider SD bias when developing the instrument and analyzing data. Furthermore, the response rate was very low. A proportion of survey invitations went unanswered. It is most likely due to single survey mode (i.e., online survey) in this study.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Introduction

Chapter 5 summarizes all the outcomes of this study in relation to the pre-set objectives. Besides that, limitations of this study are also presented in this Chapter as well as the recommendations for future research to overcome the shortcomings recognized in this study.

5.2 Conclusion

From the study, regarding the Objective 1, it is denoted that there is positive outlook for safety culture among organizations. Safety culture was gauged using safety-culture scale that comprises 40 items under various dimensions. Referring to Section 4.2.2, the mean value of safety culture assessment was 3.82 indicating "high", and more agreement was generated than disagreement. However, this perception does not extend to the whole construction industry. The result of the assessment should be treated with caution due to lack of representation of the population.

With regard to Objective 2, a ranking of safety-culture factors by their perceived importance was established based on RII. Top 5 factors were site management, management commitment, communication, supportive environment, and safety alignment. Besides that, through FA performed, some potential factors were identified, namely management commitment, safety accountability, and worker involvement. These results recognized that management is of utmost importance in promoting safety culture corresponding to many previous studies. Their commitment to safety is shown through resources allocated to safety, attitudes towards workers, status or priority given to safety, and participation in safety activities.

As for Objective 3, a framework of safety culture improvement was proposed based on the findings for Objectives 1 and 2 in this study as well as from previous studies. This study has identified two main areas for safety culture improvement: reporting culture and safety behavior.

5.3 Recommendations for Future Research

This study has several limitations which affect the results. Hence, suggestions made to enhance the quality of work in future research are as follows:

1. Survey period may be extended to at least an academic semester to achieve a larger sample size. A minimum sample size of 384 is required (referring to Section 3.3).
2. Using multiple survey modes may help to boost response rate (Nulty, 2008). Talking to people to draw out facts, experiences, and opinions is important (Arezes and Miguel, 2003). Hence, future study may incorporate face-to-face interview.
3. A questionnaire should minimize SD (Roopa and Rani, 2012). A SD scale helps to control SD bias for improved validity of questionnaire-based research (van de Mortel, 2008). The most widely used SD scale is the Marlowe-Crowne Social Desirability Scale.
4. Safety-culture change involves both management and operatives. Therefore, the operatives should be part of the safety-culture assessment.

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