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Construction Stakeholders' Perceptions of Occupational Safety and Health Risks in Malaysia

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Abstract: Malaysia's construction industry is known as a hazardous industry, which has been overwhelmed with accidents for a long time. It is perceived that the control of accidents requires the participation of various stakeholders at every stage of the construction process. However, the primary responsibility for site safety has traditionally and commonly been ascribed to general/principal contractors. In practice, it is believed that different stakeholders tend to perceive OSH risks differently due to the diversity of their project interests. This study attempted to understand the similarities and differences of OSH risk perceptions among different construction stakeholder groups. In this study, a survey, which consisted of four different cases, was developed to represent the hazards or risks that can occur in selected activities during the construction process. Each case consists of two different scenarios, in which each scenario presents a combination of different issues that posed different hazards or risks. Survey was distributed to different project stakeholder groups currently working at construction sites, including designers, site management/technical teams, safety personnel, and other relevant individuals, with the purpose of exploring their OSH risk perceptions. The participants were required to determine the magnitude of the risk that each scenario presented, based on 1 (low) to 10 (extremely high) scale. The Intraclass Corellation Coefficient (ICC) and Kruskal-Wallis tests were carried out to test the similarities and differences within and between groups of participants. Findings of the present study revealed a high degree of similarity of OSH risk perception within and among stakeholder groups. The current research made a contribution by providing evidence on the similarities and differences among construction stakeholders' perceptions in Malaysia, particularly those who are site-based.

Keywords: Construction, stakeholders, risk perceptions, OSH risk, risk control

1. Introduction

Construction industry is an economic driver for many countries, including Malaysia. According to Jaselskis (Jaselskis et al., 2006), the construction industry is also perceived as one of the most dangerous sectors, despite its important role in economic growth. This perception is due to the industry's frequent death-related accidents. In

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Malaysia, construction sector has recorded the highest number of deaths compared to other sectors over the years, according to statistics from the Department of Occupational Safety and Health (DOSH) and Social Security Organization (SOCSO). High fatality rate in the construction industry indicates the crucial need to reduce the number of accidents in construction. In this case, the major causes of accidents include the nature of the industry, human behaviour, difficult work-site conditions, and poor safety management and cultures, which tend to result in unsafe work methods, equipment, and procedures (Abdelhamid and Everett, 2000). As suggested by Rahim et al. (2008), current site safety practices require a vast and quick overhaul.

1.1 Accident cases in Malaysian construction industry

Construction industry has been plagued by frequent accidents for a long time. As noted, fatal accidents tend to occur more in the construction industry compared to other industries, even though more accidents occur in other industries (DOSH, 2017). Frequency of accidents in the construction industry is due to long construction periods, job pressures, complicated processes, hazardous machine operation, and hazardous work environments (Zou et al., 2007).

As shown in Table 1, evidence clearly shows that the majority of Malaysia's fatal accidents have occurred in the construction industry. In addition, it can be observed that the manufacturing industry had fewer fatal accidents, despite having the highest amount of accidents overall. This further indicates that the construction industry is the riskiest sector compared to other sectors.

Table 1 - Accidents statistic (based on number of fatalities in the construction industry over total number fatalities reported to DOSH) (Source: DOSH, 2017).

Year	Number of fatalities in the construction industry	Total number of fatalities reported to DOSH for the respective year	Percentage (%)
2007	95	219	43.4
2008	72	230	31.3
2009	62	185	33.5
2010	63	175	36
2011	51	176	29
2012	67	191	35.1
2013	69	185	37.3
2014	70	184	38
2017 (until Oct 2017)	63	206	30.6

According to the DOSH statistical report presented in Fig. 1, between 2002 and 2009, most of the fatalities in the construction industry were caused by "falls of persons," being "caught in or between objects," "stepping on, striking against or [being] struck by objects," being "struck by falling objects," and "electrical shock" (DOSH, 2010; as cited in Abas, 2015). Therefore, scope of the current research aims to cover the hazards or risks related to these types of accidents.

Risk mitigation and injury interventions can reduce and control fatalities and incidents (Kleiner et al., 2008). In addition, it is worth acknowledging that a considerable amount of research has been conducted in Malaysia on construction safety. The scope and area of research varies widely and includes subjects such as common safety management practices undertaken at construction sites (Yunus and Latiffi, 2017; Amin et al.,2017; Ahmad et al., 2018; Tan and Razak, 2014), identifying the causes of accidents (Rahim et al., 2008; Abas et al., 2017a) and challenges to, and initiatives for, safety improvement (Abas et al., 2016; Abas et al., 2017b; Misnan et al., 2006). In the case of risk mitigation, participation and inputs from all construction stakeholders are deemed necessary (Floyd and Liggett, 2010). Hence, this further explains the importance of a shared understanding of perceived risks among construction stakeholders in ensuring the success of project safety goals. Stakeholders who perceive risks similarly are likely to share similar views on how they can be controlled (Zhang et al., 2015). However, there is a gap in the existing literature about the perceptions of different stakeholders regarding OSH risks in the context of Malaysia's construction industry, particularly in whether they perceive risks similarly or differently.

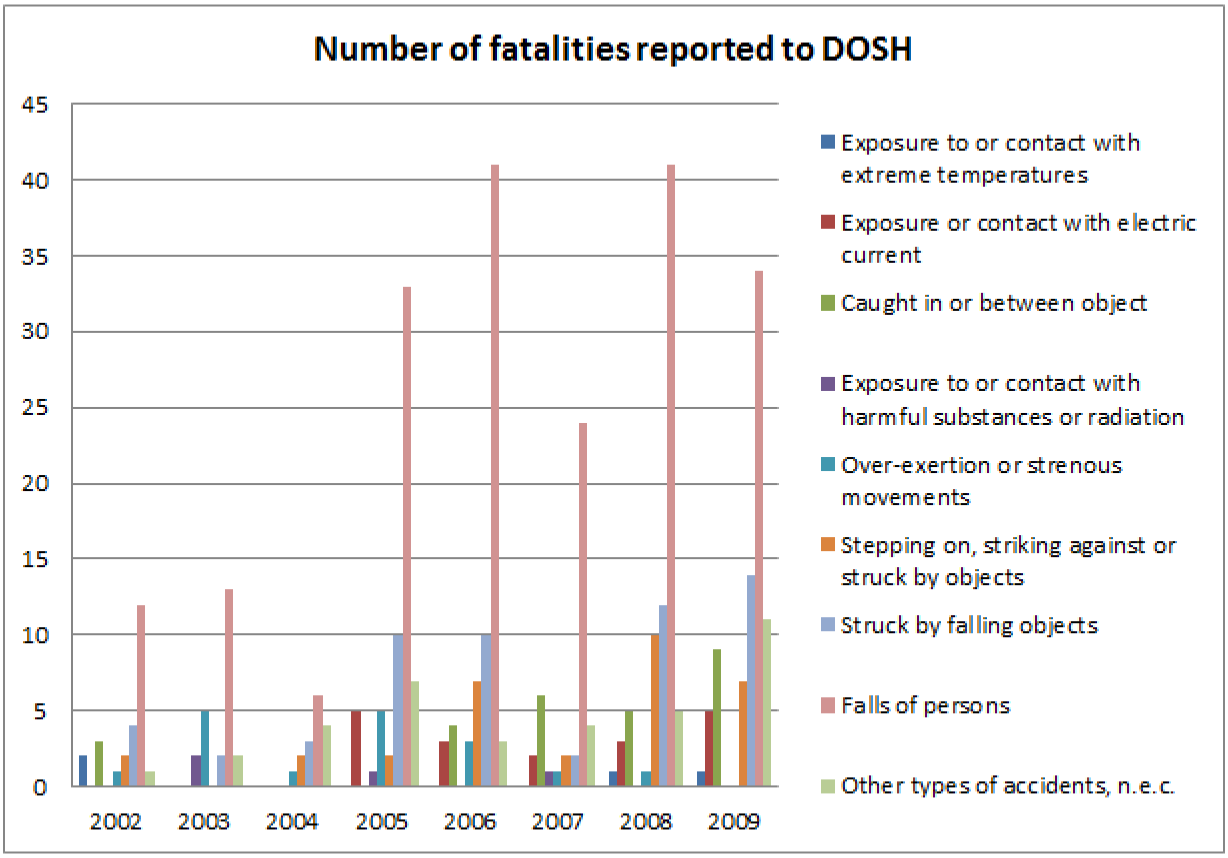

Fig. 1 Accident statistics (based on types of accidents) in construction industry reported to DOSH for the year 2002-2009 – Fatality.

There is an expanding acknowledgment that numerous construction-related occupational safety and health (OSH) hazards emerge as a result of activities in the planning and design stages (Zhao et al., 2016). Hence, the control of accidents requires the participation of various stakeholders at every stage of the construction process. Such activities include assessing risks and taking practical protection measures, ensuring the safety and health of workers, and minimizing risks by means of continuous surveillance as well as by monitoring the places where accidents are most likely to occur (Kadiri et al., 2014). More importantly, the improvement of construction OSH performance does not only positively affect the appointed construction worker but also various construction stakeholder groups (Chan and Theong, 2013). Nevertheless, the construction industry has a poor record of stakeholder management over the past few decades due to the complexity and uncertainty of construction projects (Fang et al., 2013).

It is believed that different stakeholders tend to perceive OSH risks differently, although they normally agree that OSH is the contractor's responsibility. The responsibility is then transferred to safety personnel who is hired by the contractor. For example, Zhao et al. (2016) found a discordance of risk perceptions among stakeholders (i.e., architects, contractors/safety professionals and engineers), particularly in the estimation of risk likelihood. In this case, it should be understood that different perceptions may lead to difficulty in establishing a common strategy to eliminate hazards and/or reduce risks (Lingard, 2010). Therefore, it is essential for stakeholder groups to consider each other's points of view when considering OSH risks (Lingard, 2010) to facilitate the implementation of a strategy and establish cooperation in eliminating hazards and reducing risks.

On another note, risk perception is an individual's subjective judgement about the frequency and severity of hazards associated with an activity or an event (Baradan and Usmen, 2006; Hallowell, 2010). According to Zhang et al. (2015), risk perception is subjective in nature because it is influenced by a large number of sociotechnical factors that include individuals' personal beliefs, attitudes, occupations, perspectives, and experiences, among others. Hence, it is imperative to investigate how different participant groups perceive risks and seek appropriate opportunities to share risk perspectives. Overall, this is believed to be helpful in promoting "perspective taking" in project decision-making, especially when decisions could lead to a significant impact on OSH at the construction stage (Zhang et al., 2013).

To date, no similar study can be found in the Malaysian context. Hence, in the present study the researcher sought to investigate the similarities and differences on the perceptions of construction OSH risks among stakeholder groups in Malaysia. It is deemed crucial to investigate the risk perceptions among stakeholders in the Malaysian context, considering the different regions and diverse working cultures that may influence the thinking of individuals.

According to Zhang et al. (2015), "the differences in responses between individuals are attributed to individual differences in personal beliefs, attitudes, knowledge, experience, information held, etc." Malaysian working culture is different from the cultures investigated in previous studies (Zhao et al., 2016; Zhang et al., 2013); hence, the above criteria may be different in terms of how participants perceive or respond to risks.

As a stepping stone towards future studies, the participants of the present study were limited to site-based construction stakeholders from different organizations in Johor, Malaysia, including designers, site management and technical team members, safety personnel, and others. All selected participants were site-based and represented their organizations at construction sites.

2. Methods

2.1 Procedure

Researchers distributed a survey as a method of gaining the participants' perceptions on OHS risks for selected cases and scenarios. The method was based on a validated procedure to manipulate risk perceptions on building systems (Abas, 2015; Zhao et al., 2016; and Zhang et al., 2013). Survey consisted of four different cases in which each case was assigned with two different scenarios (see Table 2). The different cases of each case are shown in Table 3, using Case 1 as an example. The features incorporated into the scenarios and cases were obtained from the literature review of relevant OSH guidelines and were combined together for the purpose of providing different OHS risk ratings.

The participants were required to determine the magnitude of the risk that each scenario presented and to provide justification on the risk rating they selected. Scale of the risk rating was in the following ranges: 1-2 (low), 3-7 (medium), 8-9 (high), and 10 (extremely high). The scenarios were given to the participants in a consistent pattern, from C1S1 to C4S2.

Table 2 - Description of cases.

Case number	Activity	Types of hazards/risk measured	Case scenario ID
Case 1	Stacking of precast component	Gravitational/ falls of precast panel	C1S1 C1S2
Case 2	Installation of precast component	Gravitational/ falls of precast panel	C2S1 C2S2
Case 3	Cutting the steel rebar using electrical machine	Electrical/ electrocution	C3S1 C3S2
Case 4	Cutting the steel rebar using electrical machine	Noise/ hearing loss	C4S1 C4S2

Table 3 - Different scenario features in Case 1.

Scenario 1 (C1S1)	Scenario 2 (C1S2)
• Components are stacked in a position approved by designer	• Components are stacked based on general advice on suitable stacking.
• The supports for the stacked components has been certified by competent person.	• The supports for the stacked components is not specified.
• Storage area is made of hard, level, clean and well-drained ground.	• Storage area is not made of hard, level, clean and well-drained ground.

2.2 Participants

Survey was distributed to the participants in the form of a self-administered questionnaire on an online platform (Google Forms). The participants of the survey were grouped as follows: design consultants, site management/technical team members, safety personnel, and other relevant individuals who were currently engaged in a project at construction sites in Johor. Total number of participants was 31, and a summary of the participants is depicted in Table 4.

Table 4 - Description of participants.

Stakeholder Group	Number of participants	Description of participants in group
Designer	8	Architect, engineer, quantity surveyor
Site management/ technical team	13	Project/site manager, project/site engineer
Safety personnel	5	Safety and Health Officer (SHO), site safety supervisor (SSS)
Others	5	Factory manager of IBS production company

2.3 Measures for Data Analysis

In order to achieve the aim of the study, non-parametric analysis methods were adopted to reveal the similarities and differences within and among groups regarding risk perceptions related to each case. Analysis was carried out using SPSS 25.0 software and further divided into three tests, namely an instrument reliability test, an intra-group comparison, and an inter-group comparison.

2.3.1 Instrument for reliability test

The purpose of conducting the reliability test was to check the reliability of the results and the overall consistency of a measure for the entire survey. The Cronbach's Alpha statistic was employed to measure the instrument's reliability (i.e., the internal consistency). Generally, an alpha value of greater than 0.6 indicates acceptable reliability, while a value of greater than 0.7 signifies good reliability (Cronbach, 2004).

2.3.2 Intra-group comparison

Intra-group comparison was carried out using the Intraclass Correlation Coefficient (ICC) test in order to assess whether there are similarities or differences within the groups in regard to risk perceptions related to the cases. More specifically, intraclass correlation measures the reliability of ratings or measurements for clusters data collected as groups or sorted into groups. For example, the ICC can be used to measure a wide variety of numerical data from clusters or groups described as follows: (i) how closely relatives resemble each other with respect to a certain characteristic or traits, and (ii) the reproducibility of numerical measurements made by different individuals measuring the same thing. It should be noted that the ICC ranges from 0 to 1, based on the following description:

- a high Intraclass Correlation Coefficient (ICC) close to 1 indicates high similarity among values from the same group, and
- a low ICC close to zero signifies low similarity within the same group (Howell, 2009).

2.3.3 Inter-group comparison

The purpose of inter-group comparison was to check whether there are similarities or differences between and among the groups of stakeholders regarding the risk perceptions related to all of the cases. Kruskal-Wallis test was employed in the present study with the aim of determining whether all of the four stakeholder groups as a whole had any disagreements on risk perceptions. Next, the post-hoc test (Anova 1-way test) was carried out to test the pairwise comparisons between stakeholder groups regarding any significant discordance of risk perception regarding each scenario.

3. Results and Discussions

3.1 Analysis of the survey

In the present study, the mean of the participants' risk perceptions was assessed prior to analyzing the intra- and inter-group similarities and differences. In particular, cases C1S1, C2S1, C3S1, and C4S1consisted of scenarios that were mostly controllable and expected to provide a low to medium OSH risk level. Meanwhile, cases C1S2, C2S2, C3S2, and C4S2 were expected to provide scenarios that could potentially produce medium to extreme risk.

4.1.1 Case 1: Stacking of precast component

This case describes the gravitational hazard that may occur during the stacking of precast components. In this case, the risk refers to the possibility of a precast panel falling during the stacking process. The different scenarios in Case 1 had been shown in Table 3 previously.

Features in the case were different for both scenarios in terms of the way the components were stacked, the supports for the stacked components, and the storage area for the components. In this case, all the participants rated scenario 1 between 1 and 5. The highest risk rating was 5, which was recorded by two respondents. One of the participants (SP3) stated that the reason for choosing that rating was due to the 5S's (Sort, Set in Order, Standardize, Sweep Daily, Sustain the Discipline) that are necessary to apply in the work process. Meanwhile, most of the participants rated scenario 2 as medium to extreme risk (5 to 10). Specifically, the highest rating given was 10, while the lowest was 5. The mean rating for C1S1 was 2.3, while for C1S2 it was 8.45. Summary of the risks rated by the participants according to their groups is presented in Table 8.

4.1.2 Case 2: Propping of precast wall panel

This case refers to the gravitational hazard that may happen during the installation of a precast component. In this case, the risk refers to the falling of a precast panel during installation. Table 5 presents the different scenario features that formed Case 2.

Table 5 - Different design features in Case 2.

Scenario 1 (C2S1)	Scenario 2 (C2S2)
• There is sufficient clear space for the safe propping that assessed and verified by designer. • Number of propping to be installed is adequate engineered and marked. • Before releasing the hoisting cable, the stability of erected props has been assessed and verified by designer.	• Sufficient clear space for the safe propping is not assessed. • Number of propping to be installed is adequate is not specified, site staff to determine themselves. • Before releasing the hoisting cable, the stability of erected props has been not specified.

Most of the participants rated Scenario 1 (C2S1) between 1 and 5. However, one respondent rated the risk at 6, which seemed to be a response to the conditions in that respondent's particular site. Meanwhile, most of the respondents rated Scenario 2 as having medium to extreme risk (5 to 10). The highest rating given was 10, while the lowest was 5. The mean rating for C2S1 was 2.61, while C2S2 was 8.81. Summary of the risks rated by the participants according to their groups is presented in Table 8.

4.1.3 Case 3: Electrical hazard

Case 3 refers to the electrical hazard involving the cutting of a steel bar. Table 6 presents the different scenario features that formed Case 3.

Table 6 - Different design features in Case 3.

Scenario 1 (C3S1)	Scenario 2 (C3S2)
• The maintenance of equipment is done accordingly assessed and verified by designer. • The working area where the work is done and the equipment is used is dry. • Weather condition during work is good. • Visibility during cutting the bar will be good. • The PPE supplied for workers is checked for the record and verified safe by designer.	• The maintenance of equipment is done accordingly is unknown and no record. • The working area where the work is done and the equipment is used is, wet area is separated by means of dry insulated floor. • Weather condition during work is fair, and determined safe to do work. • Visibility during cutting the bar will be fair. • The PPE supplied for workers is general advised that PPE is adequate.

All of the respondents rated C3S1 in the range of 1 to 5. Only one respondent rated the risk at 5. On the other hand, most of the respondents rated scenario 2 as having medium to extreme risk (5 to 10). However, one respondent (SM7) rated Scenario 2 a 4. The highest rating given was 10, and the lowest was 4. The total mean for C3S1 by all groups was 2.25, while a total mean of 8.07 was recorded for C3S2. The summary of the risks rated by participants according to their group is presented in Table 8.

4.1.4 Case 4: Exposure to noise

Case 4 describes the exposure to noise hazards during the cutting of a steel bar, which could cause temporary or permanent hearing loss. Table 7 presents the different scenario features that formed Case 4.

Table 7 - Different design features in Case 4.

Scenario 1 (C4S1)	Scenario 2 (C4S2)
• The maximum noise output from the equipment will be less than 40 decibel (dB).	• The maximum noise output from the equipment will be more than 85dB.
• The type of noise from machine will be intermittent.	• The type of noise from machine will be continuous.
• The noise generated from surrounding is less than 40dB.	• The noise generated from surrounding is more than 85dB.
• The type of noise from surrounding is intermittent.	• The type of noise from surrounding is continuous.

Features in the case were different for both scenarios, particularly in terms of the maximum noise output from the equipment, the type of noise from the machine, and the volume of noise generated from the surroundings. In Scenario 1, the rating provided by most of the respondents was in the range of 1 to 5. However, one respondent (D5) rated the risk at 7, which was the highest rating provided by for this case. On the other hand, most of the respondents rated Scenario 2 as medium to extreme risk (5 to 10). However, one respondent (SM7) rated it at 4. The highest rating given was 10, and the lowest was 4. For Scenario 1, the total mean for all groups was 2.57, whereas the total mean for all groups for Scenario 2 was 8.03.

Table 8 depicts the summary of the perceived risk level for every case scenario for each group. Findings suggested that designers tend to perceive risk levels the highest compared to other groups, followed by safety personnel. Moreover, the mean of designers that perceive OSH risk was greater than the mean of all participants for all cases, while the perceived risk of the site management/technical team members was lower than the mean. Furthermore, it is interesting to note that the designers did not perceive the risk as the lowest for every case, while the site management/technical team members also did not perceive the risk level for any case as the highest.

Table 8 - Summary of the mean perceived risk level for all stakeholder groups.

Case ID	Designers	Site management/ technical team	Safety personnel	Others	Mean (all participants)
C1S1	2.57*	2.07	3*	1.5	2.29
C1S2	9*	8.30	8	8.5*	8.45
C2S1	2.57	2.15	3.2*	2.5	2.61
C2S2	9.14*	8.38	8.2	9.5*	8.81
C3S1	2.71*	2.07	2.8*	1.5	2.27
C3S2	9.28*	8	8	8.5*	8.45
C4S1	3.85*	1.84	3.2*	2.5	2.85
C4S2	8.71*	8.30*	8	8.05	8.25

Legend

(green)	*Indicates highest rank of risk perception for each case*
(blue)	*Indicates lowest rank of risk perception for each case*
*	*Indicates higher perceived risk than mean*

4.1 Reliability test

Reliability test was conducted based on the Cronbach's Alpha value with the aim of determining the reliability of the result and overall consistency of a measure. The purpose of the Cronbach's Alpha statistic is to measure the instrument's reliability (i.e., the internal consistency). Generally, an Alpha value of greater than 0.6 indicates acceptable reliability, whereas a value of greater than 0.7 signifies good reliability (Cronbach, 2004).

Table 9 - Results of the Cronbach's Alpha test of reliability.

Group	Number of participants	Cronbach's Alpha
Designers	8	0.989
Site Management/ Technical Team	13	0.992
Safety Personnel	5	0.947
Others	2	0.981

As can be observed in Table 9, the group of site management/technical team members produced the highest Cronbach's Alpha value compared to the other groups. All of the Cronbach's Alpha values for each group were above 0.7, which indicates very good reliability and internal consistency. Apart from that, the results from the Cronbach's Alpha test indicate high reliability of the experiment setting.

4.2 Within-group comparison (Intra-group comparison)

In the present study, the Intraclass Correlation Coefficient (ICC) was employed for a within-group comparison. Intraclass correlation measures the reliability of ratings or measurements for clusters data that are collected as groups or sorted into groups. The ICC ranges from 0 to 1.

Table 10 - Results of Intraclass Correlation Coefficient (ICC)

Group	ICC	Significance value
Designers	0.973	<0.001
Site Management/ Technical Team	0.989	<0.001
Safety Personnel	0.949	<0.001
Others	0.983	<0.001

Overall, all of the four stakeholder groups are shown to have an overall intragroup concordance with a 99% confidence level ($p < 0.001$). Meanwhile, site management/technical team members have the greatest concordance when perceiving risk levels for each scenario (ICC = 0.989, $p < 0.001$), whilst safety personnel produces the least concordance (ICC = 0.949, $p < 0.001$). In addition, all the ICC values are close to 1, which seems to suggest that there is a high degree of similarity within groups (which tend to be homogenous), based on professional characteristics.

4.4 Between-group comparison (Intergroup comparison)

Kruskal-Wallis test was adopted to measure the intergroup discordance for comparison between groups. This test is able to determine the degree of disagreement in risk perceptions for all stakeholder groups. Table 11 presents the result of the Kruskal-Wallis test.

Table 11 - Results of Kruskal-Wallis test

Null hypothesis	Test	Sig.	Decision
The distribution of C1S1 is the same across categories A1**	Independent-Samples Kruskal-Wallis Test	0.520	Retain the null hypothesis
The distribution of C1S2 is the same across categories A1**		0.071	Retain the null hypothesis
The distribution of C2S1 is the same across categories A1**		0.408	Retain the null hypothesis
The distribution of C2S2 is the same across categories A1**		0.784	Retain the null hypothesis
The distribution of C3S1 is the same across categories A1**		0.504	Retain the null hypothesis
The distribution of C3S2 is the same across categories A1**		0.725	Retain the null hypothesis
The distribution of C4S1 is the same across categories A1**		0.021	Reject the null hypothesis
The distribution of C4S2 is the same across categories A1**		0.756	Retain the null hypothesis

****A1 :** Type of construction stakeholder (design consultant, site management/technical team, safety personnel, others)*
***Null hypothesis:** Null hypothesis assumes that the distribution of rating given for each case is the same across categories of construction stakeholder.*

As Table 11 shows, the null hypothesis for each case manages to be retained except for C4S1 (*sig. value* = 0.021). Hence, this suggests that OSH risks in this particular scenario were judged differently by the four stakeholder groups. Meanwhile, the value of the significance level for C4S1 is low because there is a huge difference in the individuals' ratings. Post-hoc test (Anova 1-way test) was employed to assess the pairwise comparisons between stakeholder groups in regard to significant discordance of risk perceptions on case C4S1, as shown in Table 12. The aim of the post-hoc test was to confirm where the differences occurred between groups.

Table 12 - Results of post-hoc Anova 1-way test.

Sample1-Sample2	Test statistic	Std. error	Std. test statistic	Sig.	Adj.Sig.
Site management/Technical team-Designers	0.536	4.872	0.110	0.912	1.000
Site management/Technical team-Safety personnel	-6.786	3.737	-1.816	0.069	0.416
Site management/Technical team-Others	-11.336	3.990	-2.841	0.004	0.027
Designers-Safety personnel	-6.250	5.415	-1.154	0.248	1.000
Designers-Others	-10.8	5.593	0.-1.931	0.053	0.321
Safety personnel-Others	-4.55	4.637	-0.981	0.327	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is 0.05.
Significance values have been adjusted by the Bonferroni correction for multiple tests.

The values of the adjusted significance level for all pairs of stakeholders are above the significance level of 0.05, except for the pair of site management/technical team members with others (*adj. sig. value* = 0.027). This further indicates the existence of intergroup discordance of risk perceptions for case C4S1 between the site management/technical team members group and the 'others' group.

5 Discussion and Conclusion

Current research presents an experimental study that investigated the risk perceptions of stakeholders (i.e., designers, site management/technical team members, safety personnel, and others) regarding construction work. A total of eight scenarios were adopted for this study in order to measure the risk perceptions of different stakeholder groups. Results of the mean score for each stakeholder group indicated that designers have enhanced their knowledge in building construction safety and demonstrated awareness of OSH risks. This is in agreement with the findings of Zhao et al. (2016), findings which contradict Mill's claims that "designers are lack an awareness of hazards during the construction phase and unfamiliar with OSH control measures" (Mills, 2009).

On another note, the findings demonstrated that all participants perceived OSH risks homogeneously within their groups. Additionally, when comparing the degree of similarities or differences between pairs of stakeholder groups, all participants demonstrated a high degree of similarity in their risk perceptions for all cases, except for case C4S1. Findings of the present study contradict those of a previous study conducted by Zhao et al. (2016) that found strong evidence of discrepancies among stakeholder perceptions. Furthermore, detailed analysis on the discrepancies revealed a significant difference in risk perception between site management/technical team members and other groups (IBS manufacturers).

Findings of this study provide evidence on the extent of alignment and heterogeneity among stakeholders in their understanding of OSH risks. In this study, all stakeholders seemed to possess accurate shared understandings of OSH risks, regardless of their professional characteristics. A possible explanation for this might be that the participants selected for the survey were working at construction sites and acting as site representatives for their organizations. In particular, constant exposure to site activities and frequent meetings to discuss project matters may have affected the way they were thinking. This finding is in line with Zhang et al. who stated that "risk perceptions change with personal attitudes, knowledge, and experience, as well as the social groups to which a person belongs due to specific values, norms, and practices associated with that group" (Zhang et al., 2015).

Furthermore, findings also revealed that designers perceived OSH risks as higher compared to other groups. This in agreement with previous study in "they are obligated to ensure satisfactory building performance in their design and calculation and hence prone to be sensitive to uncertainties" (Zhao et al., 2016). Meanwhile, safety personnel had a lower perception of OSH risks compared to other groups for several scenarios (see Table 8), despite the difference in mean rating score for each case scenario. More importantly, the discrepancies in the mean rating of perceived OSH risks (though very low) may be due to the different responsibilities and working styles of each group related to OSH [Zhao et al., 2016; Lingard et al., 2015), despite the fact that these groups are commonly site-based. They are also based on the assumption that they thoroughly understood the construction means and methods.

According to Krallis and Csontos (n.d.), the contributing factors that shape risk perception include experience, knowledge, work stress, and exposure to and control of risks. Commonly, OSH responsibility is placed solely on safety personnel, who are hired by the contractors. Hence, this motivated them to rate the risk based on their knowledge and experience. As can be seen in Table 8, safety personnel rated the high-level type of risk scenario cases as the lowest compared to other participants for all scenarios. In addition, safety personnel are regarded as individuals who have a great understanding and knowledge about the risks involved, considering their role in managing risks based on risk assessment. This finding is in agreement with Johnson (1993) who stated that those who know more tend to judge risks to be smaller. In contrast, safety personnel rated low-level type of risk scenarios (C1S1, C2S1, C3S1) as the highest compared to other stakeholders. In this case, it is believed that safety personnel understand the risks involved in the workplace, which explains their ability to manage the risk control and understand the extent of the risk posed. This is in line with Krallis and Csontos (n.d.), who stated that control over the work environment greatly influences the perception of existing risk.

Present study contributes to the current body of knowledge on this subject by providing evidence on the similarities and differences among stakeholders' perceptions, particularly those who are site-based. The method employed in this study, which refers to scenario-based cases, provided a new approach to investigate attitudes and judgements regarding risks.

Future research should investigate the detailed reasons why stakeholders choose certain risk ratings for each case. The author agreed with Zhao et al. (2016) who stated that the justification of perceived risks should be noted to understand why risks are perceived differently. Further, it is recommended that organization-based stakeholders, such as architect, engineers, contractor, and owners be included as key stakeholders in order to expand the investigation of similarities and differences among all groups of stakeholders. Finally, it is suggested that future works increase the number of total respondents for each stakeholder group by covering all regions in Malaysia.

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