A preliminary study of safety management practices on Pan-Borneo highway construction sites in Kuching, Malaysia

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Abstract. Construction site safety is a vital issue in construction safety management. The causes of accidents in the construction industry, among others are due to individual behaviour, complicated work-site surroundings and inadequate safety supervision at the construction site. The case study, namely Pan-Borneo Highway (PBH), was initiated through the Economic Transformation Programme to transform Malaysia into a high-income nation. The PBH is an option travel mode highway alongside Borneo road linking the states of Sarawak and Sabah with Brunei. The iconic project started from Sematan, Sarawak to Tawau, Sabah. This paper aimed to evaluate the current safety management practices on PBH construction sites in Kuching, Sarawak, as well as to emphasise the significance of road construction safety supervision. Questionnaires were distributed to 30 respondents, and the survey responses were analysed using Statistical Package for Social Science (SPSS) software. The result suggested that the most important safety practices are the provision of Personal Protective Equipment (PPE), followed by accident reporting and maintenance report and provision of safety policy. Proper safety management on the construction site can minimise accidents and protect all parties involved in the construction industry.

1. Introduction
Public roads are one of the largest sources of revenue for the development of all national economies, ensuring economic and social benefits [1]. Roads not only have benefits in economic terms, but they also provide access for restricted rural areas, allowing farmers to transport their crops. In addition, it also provides access to the main cities where medical infrastructure is concentrated can improve the life quality of people [2]. However, construction of roadworks has a complex and hazardous environment with many dynamic resources, including staff, equipment and materials [4]. It is categorised as a high-risk work site due to significant numbers of fatality [3].

Therefore, safety issues are vital during road construction. Hence, carrying out of protection, healthiness and ecological management systems can decrease injuries, poor health, and able to offer more secure workplace [5]. In particular, there are issues associated with safety management in the construction of roadworks. Thus, there is a need to investigate safety management practices implemented in the construction of roadworks in Malaysia. This preliminary study seeks to provide systematic site management in the near future.
Road construction is a tidy job which focuses on the duration of the work and safety on-site [6]. A safety management system is a tool that can predict unwanted accidents; however, poor safety report in the construction industry is alarming [7]. Safety management must think about proper management approach in reducing the number of accidents at a construction site even though the construction industry is a complex process. Furthermore, safety is the condition where the hazard to injure people or goods damage is reduced to and maintained at or underneath, a satisfactory level through an ongoing procedure of hazard identification and safety risk management [8]. Generally, a life cycle of the road consists of three phases, namely planning, design, and construction. Road safety management is planned at each phase of the road life cycle. [9]. Road safety can be viewed as a procedure that ends with a managed stage. Alternatively, road safety supervision takes a position in a returning phase repetition, and the organising process ends one management sequence only to commence another [9]

Safety management continues to give various gains in enhancing construction personal protection equipment (PPE) at the site [10]. All the construction workers are required to wear PPE at all times in construction sites. Each employee is mandatory to wear a safety helmet and protection glasses. Reflective safety vests are required when the employees are working on site exposed to the traffic vehicles. In the absences of vehicular traffic, high visibility shirts must be worn at all times. All workers should wear proper attire, including safety shoes or boots when working in construction on site

Furthermore, the growth of institutional road safety management and the engagement of a government organisation to lead the guide the national road safety actions are two other significant measures suggested by the World Health Organisation (WHO) [11]. It shall be the responsibility of the contractors to make sure that their workers and all the subcontractors are adequately trained and proficient to execute the requirements of the safety management based on the contract requirements [12]. Before the contractor set up site work activities, the contractor will organise operation safety training programs essential to prepare all persons performing work on the site and have to adopt a collective commitment to employee and classification safety within their organisations.

The Pan-Borneo Highway (PBH) was initiated throughout the Economic Transformation Programme to transform Malaysia keen on a high-income nation. The PBH is an alternative highway alongside Borneo road between the states of Sarawak, Sabah, including Brunei. The project started from Sematan, Sarawak to Tawau, Sabah. The connectivity will allow businesses to be more dynamic and give entrance to a broader market place. The community will benefit from the toll-free road crossing to 4-lanes compared to existing 2-lanes, and shorter journey time across Sarawak with four lanes facilitate safe overtaking of slower vehicles with twenty-five new interchanges. This highway will be an economic multiplier directly or indirectly by better mobility, release up other areas through access, increase the construction industry, job opportunity, tourism industry, and supporting sectors.

In 2017, Allahyarham Datuk Patinggi Tan Sri Haji Adenan Satem, Former Chief Minister of Sarawak, said that through PBH, the Sarawak economy would build-up, and tourism industry in Sarawak also will grow [13]. YAB Datuk Amar Haji Abang Johari Tun Openg, Chief Minister of Sarawak also said that the PBH not only would give advantage to the rural community but also will provide better conveniences [13]. The route of PBH from Sematan, Sarawak to Tawau, Sabah is shown in Figure 1. This preliminary study aimed to evaluate the current safety management practices on PBH construction sites focussing in areas near to the Kuching city centre, specifically in Sematan, Bau and Serian.
2. Methodology
Preliminary studies can be very informative, not only to the researchers conducting them but also to others doing similar work [14]. It is suggested that 30 representative participants from the population are a reasonable minimum recommendation for a pilot study, where the purpose is for a preliminary survey or scale development [15]. A set of questionnaires was distributed to 30 contractors that participated in the construction of PBH area in Sematan, Bau, and Serian from 15th January 2019 till 15th February 2019. The directory of contractors and professional construction workers were obtained from the Lebuhraya Borneo Utara Sdn Bhd (LBU) which act as the Project Delivery Partner (PDP) for the PBH.

The respondents chosen have vast experience in the construction processes of roadworks and involved in road construction safety management process. Previous research were used as references to develop a set of questionnaires for this preliminary study. The questionnaire is divided into two sections; Sections A was designed to gather demographic information of the respondents and Sections B will evaluate the respondents’ perception of the importance of safety management practices on PBH construction sites.

A total of fifteen (15) factors were identified through a literature review on safety management practices in road construction. In Section B, 5-point Likert scale is used to collect the information as shown in Table 1. Respondents were requested to specify which factors that have critical relative factors on safety management practices. The higher the number, the bigger the weight on the important. The contribution of each of the factors was analysed, and the level of the attributes in provisions of their response was assessed using Relative Importance Index (RII) which was computed using equation (1) and the results of the study are tabulated in Table 3.

$$\text{RII} = \frac{\sum W}{A+N} \quad (0 \leq \text{RII} \leq 1)$$

By: $W$ – weight particular to each reason by the respondents and ranges starting 1 to 5, (where “1” is “Not important” than “5” is “Very important”);
A – is the highest weight and;
N – is the overall number of respondents.
Table 1. Ranking adopted in the questionnaire.

| Ranking | Likert Range       |
|---------|--------------------|
| 1       | Not important (NI) |
| 2       | Fairly important (FI) |
| 3       | Important (I)      |
| 4       | More important (MI) |
| 5       | Very important (VI) |

Preliminary analysis is a consistency analysis studies the properties of capacity scales and the items that make up the scales. One of the most generally used methods is Cronbach’s alpha. The range of the coefficient result is from 0 to 1; a higher rate of Cronbach’s alpha is typically more desirable. In this study, the coefficient is 0.933; therefore, the research data was deemed adequate for further statistical analysis.

3. Results and Findings
Table 2 shows the profile of the respondents. It can be derived that 43.33% of the respondents were from the sub-executive level, 30.00% from the executive level and 10% were from managerial level. Next, in the Construction Industry Development Board (CIDB) Grade category, 46.67% of the construction companies, were from CIDB Grade 7 contractors, 20.00% were from Grade 6 and Grade 5, and 13.33% were from Grade 4 construction companies. A total of 40.00% of the respondents possessed a diploma, and 33.33% have a bachelor degree. Most of the respondents had 11 to 30 years of working experience.

Table 2. Profile of respondents.

| Details in the company                | Frequency | %     | Details in the construction industry | Frequency | %     |
|---------------------------------------|-----------|-------|--------------------------------------|-----------|-------|
| Managerial Level                      | 3         | 10.00 | More than 30 years                   | 2         | 6.67  |
| Executive Level                       | 9         | 30.00 | 21 – 30 years                        | 8         | 26.67 |
| Sub-Executive                         | 13        | 43.33 | 11 – 20 years                        | 10        | 33.33 |
| General Labour                        | 5         | 16.67 | 6 - 10 years                         | 6         | 20.00 |
|                                      | 30        | 100.00|                                      | 30        | 100.00|

| Construction Companies (Grade Category) | Frequency | %     | Site area of on-going Pan Borneo       | Frequency | %     |
|-----------------------------------------|-----------|-------|----------------------------------------|-----------|-------|
| CIDB Grade 7                            | 14        | 46.67 | Semantan                               | 10        | 33.33 |
| CIDB Grade 6                            | 6         | 20.00 | Bau                                    | 10        | 33.33 |
| CIDB Grade 5                            | 6         | 20.00 | Serian                                 | 10        | 33.33 |
| CIDB Grade 4                            | 4         | 13.33 |                                        |           |       |
| Total                                   | 30        | 100.00|                                        | 30        | 100.00|

| Level of education                     | Frequency | %     |
|----------------------------------------|-----------|-------|
| Degree                                 | 10        | 33.33 |
| Diploma                                | 12        | 40.00 |
| Certificate                            | 3         | 10.00 |
| Others                                 | 5         | 16.67 |
| Total                                  | 30        | 100.00|
Table 3 shows that the highest relative important index for safety management practices on PBH is 0.933, specifically the provision of Personal Protective Equipment (PPE). This finding is supported by [16], where Personal Protective Equipment is one of the most important to look after the workers from the accident with selecting job scope is careful planning for the contractor. The Occupational Safety and Health Administration (OSHA) also regulates employers to equip employees with suitable personal protective equipment (PPE). CIDB has also structured many courses for the participant on PPE attire and its functions according to the capacity of work, place and situation. This factor is important because the top management wishes to instil the best practices in safety management in their construction projects.

| S/No | Safety Management Practices on Pan-Borneo Highway Construction Sites | VI | MI | I | FI | NI | A * N | RII | RANK |
|------|-------------------------------------------------|----|----|---|----|----|------|-----|------|
| 1    | Provision of Personal Protective Equipment (PPE) | 22 | 6  | 2 | -  | -  | 140  | 0.933| 1    |
| 2    | Accident reporting and maintenance report       | 20 | 8  | 2 | -  | -  | 138  | 0.920| 2    |
| 3    | Provision of safety policy                      | 20 | 8  | 2 | -  | -  | 138  | 0.920| 2    |
| 4    | Provision of adequate welfare facilities on site| 19 | 8  | 3 | -  | -  | 136  | 0.907| 3    |
| 5    | Provision of health and safety clothing and equipment | 18 | 9  | 3 | -  | -  | 135  | 0.900| 4    |
| 6    | Provision of healthy and safe working environment | 17 | 6  | 7 | -  | -  | 130  | 0.867| 5    |
| 7    | Provision of health and safety signs            | 12 | 9  | 9 | -  | -  | 123  | 0.820| 6    |
| 8    | Control of hazardous activities on site         | 12 | 9  | 9 | -  | -  | 123  | 0.820| 6    |
| 9    | Site meetings specially for safety purposes     | 9  | 15 | 6 | -  | -  | 123  | 0.820| 6    |
| 10   | Ensuring health and safety education            | 5  | 18 | 7 | -  | -  | 118  | 0.787| 7    |
| 11   | Designated health and safety person             | 2  | 16 | 12| -  | -  | 110  | 0.733| 8    |
| 12   | Communicating health and safety                 | 2  | 14 | 14| -  | -  | 108  | 0.720| 9    |
| 13   | Provision of first aid box                      | 2  | 12 | 16| -  | -  | 106  | 0.707| 10   |
| 14   | Workers participation in hazard identification on sites | 3  | 9  | 18| -  | -  | 105  | 0.700| 11   |
| 15   | Using outside health and safety consultants     | 2  | 7  | 21| -  | -  | 101  | 0.673| 12   |

From Table 3 it indicates that the accident and maintenance reporting and provision of safety policy are 0.920 the second highest relative important index. This finding also supported by [17]. In the Health and Safety at Work Act 1974, the employers must include a healthiness and protection procedure. If a contractor hired more than five persons of employees, the policy of safety management, then have to be presented to the employees. The results in Table 3 also shows that the provision of adequate welfare facilities on-site with an aggregated relative important index of 0.907 and was ranked third highest.
relative important indexes for safety management practices on PBH. This result as mentioned in the Construction Health, Safety and Welfare Regulations 1996 act, the responsibility of any individual in control of a construction site to guarantee, so far as is realistically practicable, that the requirements of welfare facilities have complied on-site [18].

The provision of health and safety clothing and equipment with an aggregated (RII = 0.900) and provision of the healthy and safe working environment (RI=0.867) was ranked 4 and 5. The Personal Protective Equipment at Work Regulations 1992, in section 10(1) of the HSE Act states that employers should offer, make available to, and make sure the use by the employees of, appropriate clothing and equipment to protect them from any injury that might result from being exposed to the critical hazard [19]. The 6th ranked with RII = 0.820, three safety management practices on PBH construction sites which are the provision of health and safety signs; control of hazardous activities on-site and site meetings, especially for safety purposes. This finding also supported by [20]. The road site construction must understand all communication signals used between equipment operators and workers on foot [20], and according to [21] the appropriate safety warning and indication arrangement should be utilised to ensure safety to be optimised.

The research however revealed that six (6) safety management practices for PBH construction had minimal influence RII, and they include; Ranked 7 with RII = 0.787, ranked 8th with RII = 0.733 and ranked 9th with RII = 0.720 was ensuring healthiness and protection education, designated health and safety personnel and communicating healthiness and protection. Provision of first aid box (RII=0.707) at ranked 10th. Workers participation in hazard identification on sites (RII=0.700) and using outside health and safety consultants were at ranked 15 with RII = 0.673. However, no factors were identified as Not Important (NI) and Fairly Important (FI) in safety management practices on PBH.

4. Conclusions
Safety management is very significant in road construction. Based on the results, the highest relative important index for safety management practices on PBH construction sites is the provision of proper Personal Protective Equipment (PPE) to all the employees on the site by the employer. In general, safety is always regarded as an independent function in the management system. Safety is wrongly assumed by the management to be a specialist function that is separate from their normal management activities.

Given that safety is an integral part of the management’s function, the safety management system will properly advise everyone in the organisation on their responsibilities and provides guidelines to develop a safer workplace. In order to achieve this, a change of mentality is needed, starting from the top management. Positive attitudes also can be encouraged by the organisational policy to safety, the behaviour of management and supervision, and equipment management in stimulating good practice. Proper preparation on safety management will avoid a disaster on road construction sites. Therefore, safety management resources must be applied to minimise accidents and protect all parties involved in the construction industry.

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