DEVELOPMENT OF PREDICTING MODEL FOR SAFETY BEHAVIOUR BASED ON SAFETY PSYCHOLOGY AND WORKING ENVIRONMENT

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ABSTRACT

The increasing trend of occupational accident due to unsafe act and unsafe condition especially in construction site suggests the need for more proactive safety assessment model. Therefore this research aimed to establish a prediction model of safety behaviour based on safety psychology and working environment factors in construction site. Theory of Planned Behaviour (TpB) was adapted to examine on the prediction model of safety behaviour among construction workers using safety psychology representing unsafe act and working environment factors representing unsafe condition. A modified perception questionnaire named Safety Psychometric Model (SPM) was proposed based on TpB questionnaire and safety attitude questionnaire (SQA). Previously, the approach has successfully applied in health care and manufacturing sector. The questionnaire has been validated by three industrial and academic experts. A total of 554 respondents among 92 construction site were selected as the subjects for analysis. Structural Equation Modelling (SEM) and Statistical Package for the Social Science (SPSS) was use for analysis purpose which involve correlation, regression and structural equation analysis. The results demonstrated that safety psychology and work environment factor was related positively with safety behaviour intention. The elements of workers' attitude, subjective norm and perceived control that form the safety psychology context found to be significantly has the ability to predict safety behaviour. The demographics variances of personal and education background, working experiences and training background also determine as the factors of safety behaviour of the construction workers. The research also successfully established a safety behaviour prediction model that named Safety Psychometric Model. The model can be benefited by safety practitioners, organizations and researchers to explore the safety behaviour prediction. It also enhanced the knowledge in the area of employee behaviour prediction and modelling.

ABSTRAK

Trend peningkatan kemalangan pekerjaan akibat tindakan dan keadaan tidak selamat terutamanya di tapak pembinaan menunjukkan keperluan untuk model penilaian keselamatan yang lebih proaktif. Oleh itu, penyelidikan ini berhasrat membina model ramalan tingkah-laku keselamatan berdasarkan psikologi keselamatan dan faktor persekitaran kerja di tapak pembinaan. Teori Tingkahlaku Dirancang diadaptasi untuk mengkaji model ramalan tingkahlaku keselamatan di kalangan pekerja pembinaan menggunakan psikologi keselamatan mewakili tindakan tidak selamat dan faktor persekitaran kerja mewakili keadaan tidak selamat. Soal-selidik persepsi diubahsuai yang dinamakan Model Psikometrik Keselamatan dibina berdasarkan soal selidik TpB dan sikap keselamatan. Pendekatan ini telah berjaya diterapkan dalam sektor hospitaliti dan pembuatan. Soal selidik telah disahkan oleh tiga pakar industri dan akademik. 554 responden dari 92 tapak pembinaan dipilih untuk dianalisis. Pemodelan Persamaan Struktur dan Pakej Statistik untuk Sains Sosial digunakan untuk tujuan analisis yang melibatkan analisis korelasi,, regresi dan analisis persamaan struktur. Hasil menunjukkan kaitan psikologi keselamatan dan faktor persekitaran kerja dengan niat tingkahlaku keselamatan adalah positif. Unsur sikap pekerja, norma subjektif dan kawalan pengamatan yang membentuk konteks psikologi keselamatan didapati signifikan mempunyai kebolehan untuk meramalkan tingkah-laku keselamatan pekerja. Faktor kepelbagaian demografi latarbelakang peribadi dan pendidikan, pengalaman kerja dan latarbelakang latihan juga menentukan tingkah laku keselamatan pekerja pembinaan. Penyelidikan juga berjaya mewujudkan model ramalan tingkahlaku keselamatan. Model ini dapat dimanfaatkan oleh pengamal, organisasi dan penyelidik keselamatan pekerjaan untuk meneroka ramalan perilaku keselamatan. Ia juga meningkatkan pengetahuan dalam kajian peramalan perilaku dan pemodelan perilaku pekerja.

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LIST OF SYMBOLS AND ABBREVIATIONS

AIC	-	Akaike information Criterion
AMOS	-	Analysis of a moment structures
ANOVA	-	Analysis of Variance
ATID	-	Implicit safety attitude
ATM	-	Explicit safety attitude
BCC	-	Browne-Cudeck criterion
BIC	-	Bayesian Information Criterion
CAIC	-	Constant Akaike information Criterion
CFI	-	Comparative fit index
CFA	-	Confirmatory factor analysis
CIDB	-	Construction Industry Development Board
CMIN	-	chi-square goodness of fit
DOSH	-	Department of Occupational Safety and Health
ECVI	-	Constant multiple of AIC
FMA	-	Factory and Machinery Act
GC	-	Green Card
GFI	-	Goodness fit index
HBM	-	Health Belief Model
IFI	-	Incremental fit index
ISO	-	International Standard Organization
JS	-	Job satisfaction
MECVI	-	Constant multiple of BCC
ML	-	Maximum Likelihood Estimation
MoHR	-	Ministry of Human Resources
MPC	-	Malaysia Productivity Corporation
MPRC	-	Malaysia Petroleum Resources Corporation

NFI	-	Normed fit index
NIOSH	-	National Institute of Occupational Safety and Health
OSHA	-	Occupational Safety and Health Act
OSHMP	-	Occupational Safety and Health Master Plan
PCFI	-	parsimony adjustment to the CFI
PCID	-	Implicit perceive control
PCM	-	Explicit perceive control
PM	-	Perception of management
PNFI	-	Parsimony adjustment to the NFI
PPE	-	Personal protective equipment
QLASSIC	-	Quality Assessment System In Construction
RFI	-	Relative fit index
RMSEA	-	Root mean square error of approximation
SAQ	-	Safety Attitude Questionnaire
SC	-	Safety climate
SCM	-	Safety Climate Model
SEM	-	Structural equation modelling
SHASSIC	-	Safety and Health Assessment System in Construction
SICW	-	Safety Induction for Construction Workers
SNID	-	Implicit Subjective norm
SNM	-	Explicit Subjective Norm
SPM	-	Safety psychometric model
SPSS	-	Statistical Package for the Social Sciences
SR	-	Stress recognition
TpB	-	Theory of Planned Behaviour
TLI	-	Tucker Lewis index
TRA	-	Theory of Reason Action
TW	-	Teamwork
UTHM	-	Universiti Tun Hussein Onn Malaysia
WE	-	Work environment
α	-	Cronbach's Alpha

GLOSSARY

Safety Psychometric Model	-	A model as a representative of safety behaviour prediction of construction workers designed to tackle the issue of unsafe act and unsafe behaviour in construction site.
Safety Behaviour Intention	-	The readiness of a person to performed a behaviour, and it is considered as the immediate antecedent of behaviour
Safety Psychology Factor	-	Psychological components represent the unsafe act of the employees in construction site.
Working Environment:	-	The surrounding conditions in which an employee operates. It represent unsafe condition at the working area.
Workers Personality	-	The demographic element of the workers such as company background, employment background and training background.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The construction sector remains to be the highest contributor in an occupational accident statistic in the developing country (Sorensen and Dennerlein, 2014). In the developing country, the fatality risk level in construction sector is five times more acceptable than in a manufacturing based industry, whereas three to six times higher in term of the major injury risk (Gürcanli and Müngen, 2013). In Malaysia for the period of 2011 until 2014, construction sector is the highest fatality in occupational accident involving 136 cases (Department of Occupational Safety and Health, 2015). The number of accidents signifies the safety and health level of the particular workplace and correspondingly the safety performance of the site. In spite of vast initiatives taken by the government and industry for the improvement of safety performance, the result is still far from achieving the target (Contruction Industry Development Board, 2014). Therefore, these facts indicate that more initiatives need to be carried out in ensuring better result of safety performance in the future, particularly in construction sector.

Regulators, practitioners, and researchers have investigated many possibilities for designing the safety performance assessment tools, which can support complex organization such as construction sites (Matt Gillen, 2013). Various construction companies have also tried to improve their safety performance through behaviour improvement together with system improvement such as behaviour base system (BBS) and ISO18001 system (Dollard, et al., 2012).

Unfortunately, they still lack of comprehensive guidelines and framework that emphasis on working environment and psychological factor available, which has force them to perform the evaluation separately. Neither the industry nor the scientific literature have to provide cohesive framework and guidelines at the stage where the items could be conceptually understood (Yoon et al., 2013). They need to provide the ideas related to define the parameter, measurement method, or factors that are important and crucial for the evaluation, which will lead to the best possible information needed.

In Malaysian construction scenario, it is determine that the two major contributors of accident are, work environment and work practice (Asari and Leman, 2016). These facts are also supported by prior research, indicating safety culture and safety climate as significant in reducing the injuries, illnesses and fatalities on construction site (Matt Gillen, 2013). In another research, Cooper (2013) suggested that safety standards, goals, and safety management, which include employee commitment, communications, workplace hazards and physical work environment determines the safety performance of a construction site. Furthermore, Ibrahim (2012) asserted that safety culture of an organization is the main contributor of safety performance and it reflects through safety climate and safety attitude of the organizations. Moreover, it defines that one of the way to comprehensively measure the safety performance is by evaluating the two elements mentioned above that are safety attitude and safety climate of the organizations.

Construction safety has always been a complex matter because it requires the cooperation of many parties and their employers in complicated organizational structures such as client, main contractor, subcontractors and scenario that changes from day to day (Huay et. al, 2015). The situation is much more unpredictable and dynamic (Spear, 2013). They are facing issues and problem including workforce considerations, safety, time constraints and the changing nature of the work (Spillane and Oyedele, 2013). Despite that, construction companies nowadays operate in a situation with increasing the level of regulation ranging from health and safety to sustainability, labour law and completion schedule, beside facing aggressive global competition (Sousa et al., 2014). Malaysian construction firms are also facing the same situation or might be worse. The main issues facing by them are unsafe act and unsafe condition, lack of awareness of safety regulations,

worker turnover and false acts, lack of proper safety training, human and physical factor and poor safety awareness (Huay et al., 2015). It clearly indicates that working condition, workers behaviour, safety training and safety management system contribute directly on safety performance in construction site.

According to research (Cooper, 2013), 80% of work-related accidents are caused by workers unsafe behaviour. Due to this fact, organization and authority has shifted their focus from system safety to behavioural safety (Leitão and Greiner, 2017). As of recently, Ministry of Human Resources (MoHR) through their government body the Department of Occupational Safety and Health (DOSH), has introduced Occupational Safety and Health Master Plan (2016-2020) which focuses on preventive culture embedded into each worker in the construction sector (MoHR, 2016). The master plan is adapting the principle of accountability and self-regulation towards strengthening the establishment of Safe Work Culture among employers and employees. This strategy confirms that there is a need of the organization to implement safety management throughout safety behaviour improvement as highlighted by the government. Thus, the organization needs to understand and be aware of the level of their current safety behaviour and how to evaluate it. However, traditionally there is a lack of guideline and framework that may be used by the organization for this implementation (Pinto et al., 2011). Therefore, the industries need a tool and instrument for evaluating their employee's safety behaviour to understand and to be aware of their safety behaviour level.

In the context of this research, past literature shows that the success of safety performance is based on workers involvement and employer commitment (J. Zhang, 2011). It was also known that unsafe behaviour estimated that 85% of workers accidents can be attributed to unsafe acts (Choudhry, 2014) such as using a wrong tools and neglecting the safety sign. Therefore, it is a great advantage for the safety practitioner to know the safety behaviour of the company's employees for substantial safety strategy and implementation. Moreover, it will be beneficial if they can predict it. From this research view point, safety performance needs to be measured using leading indicator rather than a normal traditional way by using accident rate, number of fatality and injuries cases.

The traditional ways of measure only promote reactive action rather than proactive action, is necessary for safety management. Therefore, the aim this

research is to establish a theoretical framework as tools, allowing understanding and predicting safety behaviour of construction workers in a systematic way. The establish framework will intend to assist the safety practitioners, scholars and safety professionals to improve their knowledge and practice on safety.

Previous research Guo et al. (2015) confirmed that the cause of the accident is due to unsafe act and unsafe condition. Both of these two element in safety prediction in vital since it work improve the level of the comprehensiveness and efficacy of the model (Nkem et al., 2015). Studies on the safety performance usually only focused on the either one of the elements (Shin et al., 2014). Base on the literature studies, The Theory of Planned Baheviour (TpB) has been widely used in other industry such as hospital safety by Lopez-Mosquera (2016) studied occupational safety and healt conditions at work, and driving behaviour by Castanier et al. (2013) studied truck driving behaviour towards compliance with regulations. However, this in this study the researcher attempt to use psychological constructs from TpB to analyse factors that affect the safety behaviour with the addition of working environment components in construction sector. The result of the research will provide theoretical model that can be used to predict safety behaviour intention in construction site.

1.2 Problem Statement

In comparing to others sector such as manufacturing and service sector, construction job is among the dangerous job in the world (Franco-Duran and Mejia A, 2016). In most developing countries, it is identified as the highest contributor for occupational accident and fatal injuries. According to International Labour Organization (ILO), construction sites in developing countries are 10 times more dangerous than in industrialized countries (International Labour Organization, 2016). In Malaysia from 2011 until 2014, construction sector showed highest fatalities in occupational accident involving 35% of total fatality occupational accident cases (Asari and Leman, 2016). This statistic demonstrates the severity of the issue and result the focus on the level of workplace accidents in the construction sector is unacceptably high and requires attention. Therefore, this research choose constructions site as the most relevant place for adapting the study.

Occupational safety and health risk in construction industry has risen a growing awareness by various interested party for the last decades (Lu et al., 2016). In spite of the massive improvement and initiatives is being done, the rate of accident is still higher than the other industry (Choudhry, 2014). Alarcón et. al. (2016) asserted that the majority of the failure in safety implementation is due to the lack of preventive action implemented in a strategy, the lower the accident rate. Givehchi et. al. (2017) also suggests predictive and preventive role of leading indicators that can act as a monitoring tool for detection and identification of hidden failures. These situations suggest that by applying preventive action, it will help to improve safety performance in construction site. However, it is found that there is much less literature that provides the preventive model in construction industry (Shin et al., 2014). This strongly indicates that there is a need of tool that could provide measurement on leading indicator of safety performance that should be able to assist in accident prevention planning and implementation. Due to lack of safety performance leading indicator, this research plan to develop an alternative tools and model that can be used to performed the task.

Prior research conducted by Hecker et al. (2014) confirmed that the majority of accident in the workplace was due to two main factors; unsafe act such as using inappropriate tools while working and unsafe condition such as working at height. For the last decades safety practitioners and scholars have focused in eliminating unsafe conditions through development of safety administration such as policies, legislation and training (Mary, 2013). The initiatives had helped in the reduction of accident rate and fatalities. However, it only reflects on certain type of industries, such as manufacturing and service industry while it is not successfully and completely reflecting construction industry (Man et al., 2017). These results strongly suggest that aside from the removal of unsafe conditions such as high rise construction site, effort needs to be made in other areas as well as improving unsafe behaviour such as not following safety sign. Thus, it is crucial for organization to focus on understanding the unsafe behaviours of construction in order to reducing or eliminating accident is construction site. Therefore, this research aimed to provide a comprehensive safety prediction model that will cover unsafe act and unsafe condition that surely will benefit the industry.

Measuring safety behaviour prediction was very sensitive towards the emotional state of the respondents (Kays et al., 2012). Theoretically, behaviour

cannot be measure but only can be predicted (Wright et al., 2014). Greaves et al. (2013) suggest that intention is considered as precursor and best predictor of behaviour. There are many theories regarding behaviour prediction. TpB (Ajzen, 2010) has been selected as the underpinning theory of this research due to the ability to measure individual motivational factors as determinants of the likelihood of performing specific behaviour (D Kasprzyk et al., 2015). This theory is the most widely used in prediction individual behaviour intention towards curtained behavioural interest (Ruffing, 2013). Previously, this theory has been successfully apply in many disciplines, domains and settings, such as food intake psychology (Riebl et al., 2015), patient perception towards safety (Omura et al., 2015), organizational environment individual differences (Kilian et al., 2017) and driving behaviour among young driver (Leandro, 2012), there is only little evidence that shows the adoption and testing of this theory has been conducted into construction site. Even there were some evidence that this theory has been tested in construction site such as in safety climate (Fogarty and Shaw, 2010), proactive behaviour (Li et al, 2015), environmental management (Sánchez-Medina et al., 2014), community based (Marin et al, 2015) and technology adoption (H. Guo et al., 2017), these studies only focused on dedicated interest areas that did not provide holistic framework or guideline that can be generalized into other settings in construction site. Therefore, this study will attempt to provide a theoretical structure that can support and assist safety behaviour prediction assessment.

Malaysia as a developing county has initiate Economic Transformation Programme which involve the government agencies with the affiliation of PETRONAS and Dialog Group Berhad has initiated RM 60 billion Refinery and Petrochemical Integrated Development Project and RM 5 billion Pengerang Independent Deep water Petroleum Terminal in which both project are located in the state of Johor (Malaysia Petroleum Resources Corporation, 2016). This rapid development of infrastructure and facilities will make the state of Johor as one of the highest numbers of construction site and investment. This high demand of foreign manpower urgently will create competency and psycho social issues which may result in potentially increasing number of accident cases (Chen et al., 2017). Therefore, it clearly shows that Johor is the most fitted place to conduct the research in term of this research context. The project that involve the construction

of high rise building, road traffic and housing development has made Johor is the most suitable population for the study and directly will help the industry itself.

1.3 Research Questions

In this research, the emphasis is on how this research could be utilized to support the development of safety behaviour prediction model. Therefore, the questions dwell on how to verify the validity of each component and dimension on the studied relationship towards the issues. Specifically, the research sought to answer these questions:

(i) What is the relationship between measures of working environment factors, and behavioural intention in terms of performing safe work practice.

(ii) What is the relationship between worker's demographic variables, and the constructs of safety behaviour intention in construction site.

(iii) What is the influence of working environment towards each construct in the safety psychology factor (attitude, subjective norm and perceived behavioural control).

(iv) Can the three constructs in the safety psychology factors (attitude, subjective norm and perceived behavioural control) be used to predict safety behavioural intentions in construction site.

1.4 Research Objectives

The purpose of this research is to develop and establish a behaviour safety performance evaluation model that can be used to predict safety behaviour intention based on the psychological factors. The model is name as Safety Psychometric Model (SPM). Previous research finding shows that working environment has also high contribution to accident, so therefore intervention of safety culture need to be involved in this research.

In order to answer the research question, the research has identified three main objectives for the research as stated below:

(i) To determine the relationship between working environment factors, and safety psychology factors in terms of performing safe work practice.

(ii) To rank the relationship among construction worker's characteristics dimensions with the safety behaviour intention of performing safe work practice.

(iii) To examine the efficacy of working environment and safety psychology factors to determine safety behaviour intention in construction site.

(iv) To develop a worker's safety behaviour prediction theoretical framework in construction site.

1.5 Scope of Research

This research has its own strength since it is a theory-based research supported by sufficient sample population size to detect substantial variance with acceptable power. It also adapted cross-cultural instruments which showed good reliability in its relationship. Nevertheless, several limitations have been identified in this research as follows.

1.5.1 Focus of research

This research examines factors that relate to behavioural intention in which no evaluation of actual behaviour is attempted. This is due to the objective of the research that is just to understand the intention level of the employees. The use of a cross-sectional correlation design limits the testing for the causal direction between intention and actual behaviour which the TpB initially suggested. Moreover, it is not appropriate to perform assessment on the actual behaviour since it involves simulating the dangerous act and sensitive issues of etiquette. No evaluation of the intensity of the personal factor (i.e. safety culture, training and competency, work relationship and language barrier, safety committee and safety organization, safety and health promotion) is attempted. Its intensity is the actual safety related program which relates to their effectiveness will not be measured since it involves confidential data and massive documentation compilation.

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