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PREDICTING SAFETY COMPLIANCE AND BEHAVIOUR: AN EXTENDED THEORY OF PLANNED BEHAVIOUR

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Abstract

The construction industry is considered one of the most dangerous industries due to the complexity and uncertainty associated with construction projects. Safety compliance in the construction industry has attracted significant attention from researchers and practitioners in recent years. Safety compliance is important for minimising accidents in the construction industry. To uphold workplace safety at a construction site, individuals need to actively practise specific and essential behaviours documented through safety compliance measures. Although there is literature on safety compliance in the construction industry, previous studies have overlooked the examination of safety compliance utilisation through the theory of planned behaviour (TPB). The exploration of belief in safety compliance in the construction industry is limited. This research proposes a TPB model to predict the safety compliance intentions of construction workers by investigating salient beliefs, encompassing attitudinal, normative, and control beliefs. Data was collected through an online questionnaire with open-ended questions, which was administered to experts engaged in construction projects in Malaysia. A total of 15 respondents participated in this study and shared their salient beliefs regarding the intention of safety compliance. The beliefs collected from the online survey underwent conceptual content analysis and were categorised into six stable sets of theoretical constructs. Attitudinal Beliefs were decomposed into Perceived Relative Advantages, Normative Beliefs were decomposed into Facilitating Conditions, and Control Beliefs were decomposed into project management teams, local workers, foreign workers, and sub-contractors. A revised conceptual TPB model was formulated to predict safety compliance intention and actual compliance behaviour in the construction industry based on the developed theoretical constructs.

Keywords: Construction industry, Construction projects, Safety compliance, Salient beliefs, Theory of planned behaviour.

1. Introduction

The construction industry not only provides a large number of employment possibilities but also makes a substantial contribution to the economic growth and expansion of the nation [1]. The construction industry in Malaysia propels the economy significantly [2]. To construct long-lasting, distinctive, and complex infrastructure projects, construction sector is in charge of coordinating infrastructure acquisition and integrating existing resources [1], such as properties, reservoirs, highways, trains, and several other necessary constructions.

Construction industry is well considered to be the global' s most hazardous, spanning a range of urgent concerns due to its characteristics of physically taxing work, crowded work locations, and challenging environmental conditions. This highlights that construction workers frequently encounter various potentially serious occupational health dangers.

Construction accident rates continue to raise concerns and accidents continue to loom large over the construction industry [3, 4]. The inherent complexity and unpredictability of construction projects make it one of the most hazardous sectors, with a high risk of fatal accidents and injuries [5, 6]. Notably, the construction industry is a death trap, with workers facing a sixfold higher risk of dying on the job compared to other sectors [4]. Uncontrolled accidents and unavoidable mishaps on construction sites have a negative effect on the construction industry in many ways, including causing fatalities, financial hardships, project delays, and decreased organisational competitiveness [7, 8].

Accidents stem from various causes. The high accident rates of the industry are a result of a lack of strict safety legislation and regulations [6]. Additionally, immaturity of the workers, poor leadership, and inadequate training may also play a role in construction accidents. A significant obstacle to the advancement of safety compliance in the construction sector is the incidence of these uncontrolled accidents at construction sites, which can be largely linked to unsafe human behaviour, which is largely predicted by intentions [9, 10]. Surprisingly, human error is a significant factor in construction accidents, contributing to 88% of incidents [11, 12]. Interventions however are possible, by targeting the understanding of intentions, which leads to the formation of behaviour [13].

Poorly implemented safety measures frequently result in accidents in the construction industry. Accidents might involve professionals and experienced personnel as well as workers with less education. Experts are regularly impacted by 'falls', which include mishaps like 'fall on the same level' and 'dropping objects' [14]. This emphasises that many industrial fatalities and injuries in the construction industry can be predicted because they result from employee negligence and management flaws. As attitude predicts intention [15], it is crucial to improve favourable attitudes towards safety laws and guidelines; however, compliance with safety laws and guidelines in Malaysia is still insufficient [16].

Safety compliance is of the utmost importance to reduce accidents in the construction industry. Safety compliance involves acting in ways that are consistent with organisational safety standards, job responsibilities, and the particular needs of the task at hand [17]. To ensure workplace safety at a construction site, employees must actively engage in several key behaviours that are described in safety compliance measures. Even while safety compliance has helped to lower accidents

and injuries on-site, construction workers still exhibit a low level of health and safety compliance and a moderate level of awareness of health and safety issues [16].

Earlier studies in the construction industry looked into a range of topics, including the causes and consequences of accidents [15], prevention methods [6], and safety compliance. The actions and motivations of employees who disregard safety norms and regulations are not well understood. In an attempt to close these gaps, the TPB was employed to understand compliance intentions.

Elicitation studies can understand underlying beliefs of an individual [9]. When understanding and predicting individual behaviour, these fundamental beliefs are relevant and useful. To test and develop the hypotheses, an elicitation study necessitates that the researchers perform a survey. The most widely used method for adding new constructs to the model is thematic analysis, which is used to find the concepts that come up the most frequently and group them into themes [18].

The TPB model has been widely employed and demonstrated broad relevance in a number of study fields and predicting intentions [19, 20], including evaluating coronavirus disease (COVID-19) vaccination intentions [21], predicting intentions to participate in voluntary activity training [22], and determining intentions of the parents to participate in an online intervention [23]. "Intention" refers to a level of willingness of a person to exert effort and take action to fulfil a specific activity or goal [24].

In the context of this study, the decision to comply with safety rules and regulations is referred to as "compliance intention towards safety." The TPB states that the intention of a person to engage in a certain behaviour is the most accurate predictor of whether they will carry out that behaviour [25]. Attitude, subjective standards, and perceived behavioural control are the three fundamental constructs of TPB [24]. These constructs are supported by control beliefs, behavioural beliefs, and normative beliefs. Despite studies to extend and explain the TPB framework, the fundamental beliefs that underlie attitude, subjective norms, and control beliefs remain poorly understood [3].

2. Theory of Planned Behaviour (TPB)

The TPB is able to anticipate and influence human behaviour. The TPB was introduced by Ajzen in 1991, and this theory has been widely used to identify the human behaviour [24]. TPB is a well-known method for analysing the effects of behaviour on intention of an individual and it also managed to help in identification of the adoption of a behaviour. Moreover, the TPB also can be used to foresee and explain the reasons somebody might desire to engage in a specific behaviour [23, 24].

TPB claims that intention and perceived behavioural control are used to predict human behaviour [24]. Individual intentions indicate the extent of effort or commitment individuals are willing to invest to achieve a specific behaviour [10, 25]. Intention stands as the primary factor that determines behaviour, holding significant influence. Intention holds the power to shape performance to such an extent that individuals gain complete mastery over their actions [20]. The intention of an individual can affect his or her performance to the extent that when he or she has actual control above their behaviour [20]. Intention also refers to the likelihood of an individual participating in a particular behaviour [10]. Attitude, subjective norm, and perceived behavioural control are the three components that affect

intention of an individual [24]. Intention can be represented theoretically, as shown in Eq. (1).

$$I = (w_1)A + (w_2)SN + (w_3)PBC \quad (1)$$

where intention (I) can be expressed as the weighted combination of attitudes (A), subjective norms (SN), and perceived behavioural control (PBC) while W1, W2, and W3 represent empirically determined weights assigned to each factor.

Attitude (A) refers to the favourable or unfavourable evaluations associated with a specific behaviour [10, 24]. Understanding how employees feel about workplace safety is critical for enhancing safety procedures because it might reveal important information about their general attitude. When a person thinks that a conduct will result in favourable outcomes, they are said to have a positive orientation toward that action.

Subjective Norm (SN) is defined as the propensity of a person to encourage or oppose the performance of a particular behaviour. In the context of this study, SN refers to the social pressure that influences the intention of the workers to comply or not to comply with the safety guidelines [24]. The social pressure at the construction site may refer to the project management team, site supervisor, project engineer, contractor, technician, etc. The higher the subjective norm, the higher the individual desire to participate in the behaviour.

Perceived Behavioural Control (PBC) refers to the perception of an individual of his or her capability to successfully carry out a particular behaviour. The level to which a person believes that he or she has complete authority regarding the choices of his or her interests is known as PBC [24].

It is widely agreed that when individuals experience a positive and supportive subjective norm, they feel more empowered to control their actions. Consequently, they are more inclined to perform the behaviour, particularly when they perceive substantial benefits resulting from their attitudes towards that behaviour. Thus, stronger beliefs around following safety rules from colleagues (subjective norms) and the feeling of control over following those rules (perceived behavioural control) act as a buffer, reducing the likelihood of workers engaging in unsafe behaviour.

TPB has been widely tested and proven to provide comprehensive explanations for behavioural intention [24]. The belief structures within the TPB framework, including attitude, subjective norms, and perceived behavioural control, require further exploration as well as understanding [24, 25]. The belief structures include attitudinal beliefs, normative beliefs, and control beliefs. Hence, expanding the TPB model by incorporating supplementary variables can help overcome its limitations. Through belief elicitation studies, the variables that drive individual behaviour can be discovered. The process of eliciting salient beliefs can provide valuable information that can be utilised in the development of interventions [14].

2.1. Salient beliefs

Due to memory limitations, the human mind can only hold a certain number of beliefs at once, usually between 5 and 9 [25]. These beliefs, referred to as salient beliefs, are critical for comprehending behaviour and can offer insightful information for creating future behaviour interventions [23]. Existing beliefs can be modified, and new beliefs can be introduced to influence behavioural performance through intervention [19]. In

general, behavioural beliefs shape the attitude of an individual towards performing a behaviour, normative beliefs influence subjective norms, and control beliefs play a role in perceived behavioural control [24].

2.2. Research aim

This study aims to elicit salient beliefs about complying with safety rules and regulations.

2.3. Research objective

The objectives are to identify the key factors influencing adherence of individuals to safety rules and regulations and to identify the factors that affect personal attitudes, subjective norms, and perceived control on adherence to safety regulations.

3. Research Methodology

The process of conducting a belief elicitation study can involve various methods, such as interviewing a focus group, conducting interviews, or distributing a mail questionnaire [9]. A critical step in creating future surveys based on the TPB is understanding salient beliefs through belief elicitation. It acts as a requirement since defining these ideas creates a strong foundation for the quantitative measurement of beliefs [25]. Several questions can be asked, like advantages and disadvantages (attitudinal beliefs); approval or disapproval (normative beliefs); mediators or obstacles in performing a particular behaviour (control beliefs). To effectively elicit beliefs, participants were asked to complete an online questionnaire. The questionnaire was structured into three main sections, and the target respondents were identified according to the criteria discussed in the subsequent subsection.

Belief elicitation survey

In this study, beliefs were elicited through an online questionnaire. An open-ended questionnaire method was employed to identify the elicitation of beliefs. The questionnaire comprised three sections: (1) the demographic of respondents; (2) the degree of safety compliance in the construction industry; and (3) the elicitation of salient beliefs.

In Section 1, all the details of the personal information of the respondents and demographics will be asked. Section 2 consists of several questions that use a 5-point Likert scale to measure the level of compliance of the respondents. In Section 3, respondents were instructed to identify and list their salient beliefs based on the questions given.

Sample respondents

The study focuses on construction contractors in Malaysia. The contractors in Malaysia are classified into seven grades based on criteria such as project limit and contractor size. The contractor ranges from G4 to G7 had been chosen. The reason for choosing G4 to G7 is due to the contractor representing medium and large-size contractors. Purposive sampling was adopted in this study.

4. Results and Discussion

4.1. Demographic results

The Belief Elicitation Study involved the creation and distribution of a questionnaire of more than 50 targeted respondents with expertise in safety. However, not all the participants agreed to participate in the survey. The data collected for the survey stopped at 15 respondents due to the data had achieved data saturation. The responses received from the respondents sufficiently met the requirements of a belief elicitation study. 6 Female (40.00%) and 9 Male (60.00%) experts responded to the survey. Most of them are from the G7 organisation, which consists of 9 (60.00%) respondents, while the least number of respondents is from the G4, which has only 1 respondent (6.67%). Most of the projects are in the Selangor area (n = 5, 33.33%), whereas only one project (6.67%) is located in Kuala Lumpur.

4.2. Level of safety compliance

The questions of compliance and safety were rated based on a 5-point Likert scale. Most of the respondents are following the safety rules and regulations, as most of the responses were rated 3 or above. The safety activities include attending the training by the Occupational Safety and Health Administration (OSHA), following construction safety signs and procedures, being aware of the risks associated, and keeping the work area clean and tidy. Other safety activities are shown below. The safety activities include attending the training provided by OSHA, following construction safety signs and procedures, being aware of the risks associated, as well as keeping the work area clean and tidy. Other safety activities are shown below.

4.3. Results of elicited beliefs

In this study, only the beliefs that were mentioned by at least 10% or 20% of the respondents were taken into consideration [10]. The 10% frequency cut-off was employed in this study to select the most common salient beliefs [25]. The elicited beliefs were analysed using thematic analysis, where similar beliefs with common outcomes were grouped, and the frequency of each outcome was determined. The procedure lacks explicit instructions and relies on common sense [15, 25].

The attitudinal beliefs, normative and control beliefs from the participants were analysed and shown in Table 1. The attitudinal, normative, and control beliefs of the participants were analysed and shown in Table 1. For instance, concerning inquiries within the domain of attitudinal beliefs, such as "What are the advantages or disadvantages that you think of when complying with the safety rules and regulations?" responses like "make work sufficient and efficient", "slow down work progress", "project run smoothly", and "project flow goes smooth" were categorised as productive (mentioned by respondents n = 5, 33.33%).

4.3.1. Model in predicting safety compliance

As shown in Fig. 1, the model has been developed based on the classification and grouping of the obtained sets of beliefs. In the first phase, attitudinal, normative, and control beliefs serve as the cognitive and affective basis for forming attitudes. Salient attitudinal beliefs encompass evaluations regarding the outcomes of

compliance safety, like improved productivity, reduced time consumption, reduced accidents, fostered exemplary leadership, as well as to save cost and improve financial performance.

Table 1. Frequency of elicited belief.

	Frequency	Percentage
Attitudinal Beliefs		
Improve Productivity	5	33.33
Reduce Time Consumption	4	26.67
Reduce Accident	14	93.33
Foster Exemplary Leadership	4	26.67
Save Cost and Improve Financial Performance	3	20.00
Normative Beliefs		
Project Management Team	8	53.33
General Workers	5	33.33
Foreign Workers	2	13.33
Sub-Contractor	2	13.33
Control Beliefs		
Adequate Safety Equipment	4	26.67
Formalised Safety Policies	7	46.67
Reward Incentives	5	33.33
Reinforced by Good Safety Culture	3	20.00

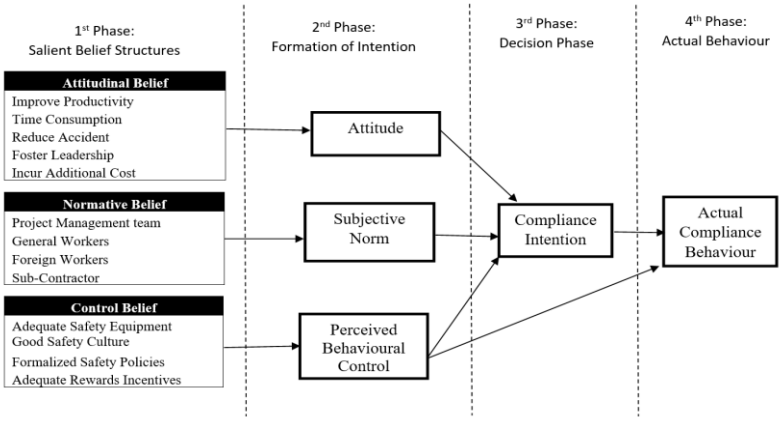

Fig. 1. Theory of planned behaviour model in predicting compliance intention.

Next, salient normative beliefs comprise beliefs about the perspectives of other significant parties, such as the project management team, general workers, foreign workers, and sub-contractors. Lastly, salient control beliefs encompass beliefs regarding the factors that can either facilitate or hinder the utilisation of compliance safety. The control beliefs are adequate safety equipment, formalised safety policies, rewards incentives, and a good safety culture.

In the 1st Phase, the structured beliefs contribute to the development of intention in the 2nd Phase. Salient attitudinal beliefs shape attitude, salient normative beliefs influence subjective norms, and salient control beliefs impact perceived behavioural control. The integration of attitude, subjective norms, and

perceived behavioural control culminates in the formation of compliance intention. A higher compliance intention in the 3rd Phase is influenced by a more positive attitude towards compliance intention, favourable subjective norms, and greater perceived behavioural control over the compliance intention. In this phase, decision-makers are motivated by their strongest compliance intentions towards a method that aligns with their intentions. Once decision-makers have a sufficient degree of control over the compliance intention, they are more likely to realise and act upon it when the opportunity arises. This realisation of intention ultimately leads to the actual compliance intention in the 4th Phase.

4.3.2. New model in predicting safety compliance

The set of beliefs obtained (as shown in Fig. 1) can be further reclassified based on theoretical foundations, existing literature, and empirical validation in practical settings [25]. Taylor and Todd [13] demonstrated that the original TPB model could be broken down into multidimensional constructs, thereby enhancing the explanatory power of behavioural intention. Hence, this section expands and reclassifies the resulting sets of beliefs that underlie attitudinal, normative, and control beliefs into five theoretical constructs, which can be further explored in future empirical studies. The reclassification of sets of beliefs into theoretical constructs is presented in Fig. 2.

Attitudinal beliefs can be grouped into perceived relative advantages. Normative beliefs had been decomposed into a project management team, local workers, foreign workers, and a contractor. Lastly, the control beliefs can be grouped as facilitating conditions.

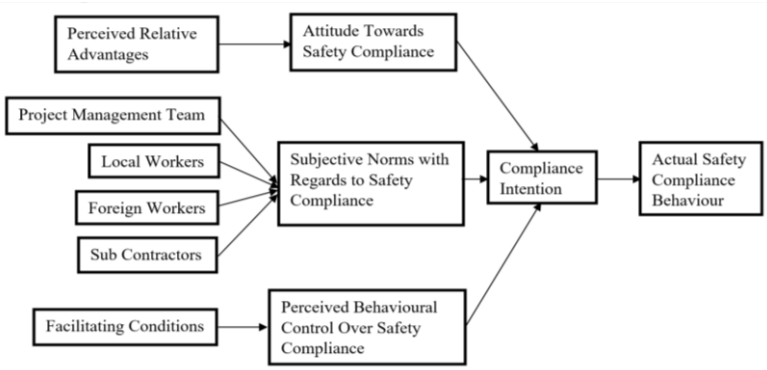

Fig. 2. Revised TPB model in predicting compliance intention.

4.3.2.1. Decompositions of attitudinal beliefs

The structures of attitudinal beliefs can be reclassified into perceived relative advantages. Perceived relative advantages, proposed by Shamout et al. [8], is a theory that is frequently linked to the diffusion of innovation theory. Relative advantage refers to the degree to which potential adopters perceive a technological innovation as superior to available alternatives [8]. The perceived relative advantages play a critical role in shaping decision-making processes of the individuals when it comes to either adopting or rejecting the innovation. It can be said that, when workers think that they have more advantages when complying with the rules, they are more likely to comply.

4.3.2.2. Decompositions of normative beliefs

In this study, the normative beliefs were decomposed into Project Management teams, local workers, foreign workers and sub-contractors. Normative beliefs refer to individuals or groups that possess the authority or influence on express agreement or disagreement with a particular matter [24]. However, diverse groups of individuals hold distinct perspectives and viewpoints. In this study, the Project teams and sub-contractors may hold varying perspectives on compliance and safety. Different organisational levels may exhibit varying degrees of support, with some being receptive while others may not even consider implementation. Hence, decomposing normative beliefs becomes essential to gain deeper insights into behavioural intentions.

4.3.2.3. Decomposition of control beliefs

The control beliefs in this study have been decomposed into facilitating conditions. Facilitating conditions are defined as the level of accessibility individuals have to the necessary resources and tools to accomplish a specific task. Moreover, facilitating conditions are an external factor associated with the concept of providing resources and support to enable smoother progress and control over a given task. It can be inferred that a scarcity of resources and limited compatibility of technologies tend to reduce the behavioural intention towards adoption and usage.

5. Conclusions

The primary aim of this study was to introduce an enhanced TPB framework for predicting compliance and safety in construction sites. This was accomplished by eliciting and examining the significant attitudinal, normative, and control beliefs of the safety experts. An open-ended questionnaire was completed by a group of 15 professionals who specialise in construction projects and are experienced in safety. The salient beliefs of the respondents towards compliance and safety were collected. All the salient beliefs were grouped into five attitudinal themes, four control themes and four normative themes.

After the belief elicitation process, the collected beliefs were analysed and organised into six separate theoretical constructs, which were derived from a combination of existing literature and practical empirical evidence. The attitudinal beliefs had decomposed into perceived relative advantages The normative belief structures were decomposed into four dimensions: the project management team, local workers, foreign workers and the sub-contractors. Lastly, control beliefs were decomposed into facilitating conditions.

This study proposed a conceptualised revised TPB model for predicting compliance safety intention and actual compliance behaviour in the construction industry based on the developed theoretical constructs. While the model demonstrated comprehensiveness and theoretical advancement, the study acknowledges the necessity for further research to validate and refine the model. The proposed revised TPB model holds the potential to provide a comprehensive assessment of various types of safety compliance and improve our understanding of the importance of safety compliance within the construction industry.

It is important to acknowledge the limitations of this study. While the inclusion of 15 respondents met the minimum requirement for a belief elicitation study, future research should elicit beliefs from the developers or consultants. By

incorporating a broader range of participants, the extended TPB model can be further strengthened, and its robustness will be enhanced. This would contribute to a more comprehensive understanding of safety compliance within the context of different stakeholders in the construction industry.

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