

**AN INFERENCE-BASED BOOTSTRAP AND MIXED METHODS  
APPROACH TO EXAMINING THE IMPACTS OF BEHAVIOR-BASED  
SAFETY ON JOB SATISFACTION AND STRESS: FROM THE  
CONSTRUCTION WORKERS' PERCEPTION**

*(Pentaabiran Berasaskan Bootstrap dan Kaedah Gabungan untuk Mengkaji Kesan Keselamatan  
Berasaskan Tingkah Laku Terhadap Kepuasan Kerja dan Tekanan:  
Daripada Persepsi Pekerja Binaan)*

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*ABSTRACT*

Behaviour-Based Safety programme requires diligent support, adequate planning, and sufficient resources, in addition to exceptional motivations. This study aimed to identify possible elements that reflect an individual's perception of BBS and its influence on job satisfaction and stress. In order to identify critical factors influencing employees' perceptions of BBS in construction industry, a series of individual semi-structured interviews were conducted with experts (n = 12). Partial Least Squares (PLS-SEM) was used to analyse the effect of BBS perception on employee work stress and job satisfaction at five construction sites utilising BBS in Malaysia. The study identified seven factors that influence employees' perception of BBS. It also indicated that employees' work stress and job satisfaction are directly affected by how they perceive BBS. Therefore, an improved BBS can help employees differentiate between safe and unsafe behaviours, hereby enhancing prevention of accidents, job satisfaction, welfare, and the overall safety culture of the organisation.

*Keywords:* Behaviour-Based Safety; workers' perception; critical factors; job satisfaction; job stress; construction industries

*ABSTRAK*

Program keselamatan berasaskan tingkahlaku (BBS) memerlukan sokongan pihak atasan, perancangan yang mencukupi, dan sumber yang mencukupi, selain motivasi yang tinggi. Kajian ini bertujuan untuk mengenal pasti factor-faktor yang mungkin mencerminkan persepsi individu terhadap BBS dan pengaruhnya terhadap kepuasan kerja dan tekanan. Untuk mengenal pasti faktor kritikal yang mempengaruhi persepsi pekerja terhadap BBS dalam industri pembinaan, satu siri wawancara separa berstruktur individu telah dijalankan dengan pakar (n = 12). Kaedah kuasa dua terkecil separa (PLS-SEM) digunakan untuk menganalisis kesan persepsi BBS terhadap tekanan kerja pekerja dan kepuasan kerja di lima tapak pembinaan yang menggunakan BBS di Malaysia. Kajian ini mengenal pasti tujuh faktor yang mempengaruhi persepsi pekerja terhadap BBS. Ia juga menunjukkan bahawa tekanan kerja dan kepuasan kerja pekerja secara langsung dipengaruhi oleh persepsi mereka terhadap BBS. Oleh itu, pelaksanaan BBS yang lebih baik dapat membantu pekerja membezakan antara tingkah laku yang selamat dan tidak selamat, dengan ini meningkatkan kadar keselamatan, kepuasan kerja, kebajikan, dan budaya keselamatan keseluruhan organisasi.

*Kata kunci:* Keselamatan berasaskan tingkahlaku; persepsi pekerja; faktor kritikal; kepuasan kerja; tekanan kerja; Industri Pembinaan

## 1. Introduction

The Behaviour-Based Safety, referred to as BBS, is exceptionally efficient in mitigating accidents and incidents in Occupational Safety and Health (OSH) (Krause *et al.* 1999; Tuncel *et al.* 2006). BBS is an initiative that involves the integration of employees into a safety committee. This programme employs behaviour-based safety observation to identify the most crucial high-risk activity. The observation method utilises positive and negative reinforcement to effectively modify employee behaviour. Desirable behaviour is reinforced, while unsafe behaviour that puts employee safety at risk is acknowledged. Employee observation is primarily carried out by skilled staff members during work hours. The committee use observational data as a repository to make informed judgements regarding the necessity for training and development or improving employees' awareness, wherever it is deemed necessary (Kabil & Sundararaju 2019).

An initial investigation conducted by H. W. Heinrich on BBS programs revealed that 88% of industrial accidents were caused by human risky behaviour, while 10% were attributed to hazardous physical environments. Interestingly, just 2% of accidents were found to be caused by uncontrollable factors. Accordingly, industrial accidents have also been caused by the incorporation of human aspects (Chen & Tian 2012; Skowron-Grabowska & Sobociński 2018). Therefore, it has become a crucial task to regulate and prevent human behaviours to prevent accidents. The BBS strategy is an effective method for preventing accidents. It involves identifying and addressing the goals of the overall safety performance index, as outlined by Chen and Tian (2012) and Skowron-Grabowska and Sobociński (2018). Experts believe that the BBS concept is potentially being embraced in the construction industries in Malaysia, however it has not been fully implemented as of yet. However, the practical use of BBS in the Malaysian oil and gas industry has demonstrated positive outcomes in terms of quality and safety environment, as shown by Ismail *et al.* (2012). Hence, it is important for the construction organization to identify and manage the elements that contribute to risky conduct in the workplace through the implementation of a suitable (BBS) program. The first step in achieving this is identifying the pre-factors that have a significant impact on each person's perception of having a successful BBS in the field. This study aimed to investigate the elements that may directly influence employees' perceptions of the BBS program and its impact on their job satisfaction and job stress on construction sites. The scarcity of BBS perception studies utilizing a mixed methods approach in Malaysian construction industry has inspired us to undertake this survey.

According to Manjula and De Silva (2014), construction sites are among the most dangerous areas of industrial organisations since they involve high-risk operations. The behaviour of individuals who are managing the construction site may lead to issues within the industry. Therefore, it appears that certain components (e.g. top management, middle management and subcontractor) of the current systems in the construction industry can be re-evaluated to take into account the elements that influence safety behaviour. Therefore, it is crucial not to overlook the BBS argument (Sherratt 2014).

Abdelhamid and Everett (2000) identified three primary causes of accidents in the construction industry: 1) lack of awareness of existing hazardous conditions before or during work activities, 2) failure to stop work despite recognising a hazardous situation, and 3) intentionally acting unsafely regardless of initial work environment requirements. Additionally, they highlighted that common occurrences on construction sites leading to accidents include ineffective managerial decisions, unpredictable behaviour from staff or co-workers, incidents unrelated to human actions, and hazardous work environments. Human mistake is defined as a purposeful decision or action made by a human that reduces or has the potential to reduce the

effectiveness of safety or system performance (Lucy *et al.* 1999; Choi & Lee 2018). This can also be attributed to failures by construction personnel, incorrect judgements, lack of focus at work, lack of interest in safety regulations, and disregard for nearby hazards (Kadiri *et al.* 2014). Research has shown that around 80% of occupational injuries are caused by at-risk behaviour, 15% are caused by unsafe working conditions, and 5% are caused by other unavoidable variables (Sawacha *et al.* 1999; Vredenburg 2002). As a result, the idea of safety behaviour has become an important area of study.

BBS, as a proactive method, can assist personnel in perceiving and trading their behaviours to prevent undesired situations in the workplace (Ibrahim *et al.* 2015; Vinodkumar & Bhasi 2010). Various studies have revealed various aspects that may have an impact on the BBS programme. According to DePasquale and Geller (1999), the following five factors are highly predictive of worker engagement in a BBS procedure: 1) awareness that BBS training used to be effective; 2) self-belief in management's competence; 3) performance assessments for BBS accountability; 4) has anyone got BBS education or not?; and 5) job tenure in the organisation.

A study by Agraz-Boeneker *et al.* (2007) claimed that the main reasons the BBS process couldn't improve safety were the fact that it was too hard to be accurate because of forced observation, the long checklist included important but unrelated factors to the task employees were doing, and managers and supervisors who didn't support its implementation. Indeed, BBS improves safety behaviour and has a direct relationship with the safety climate and culture. According to Spigener *et al.* (2022), the BBS process looks to be a powerful means of culture transformation. The improvements in employees' perceptions of leadership, fairness, and other factors show that the BBS methodology is an effective approach to positive culture building. Spigener *et al.* (2022) also held the opinion that a BBS created for one department or organisation is not applicable to other departments or organisations. Understanding the leadership, procedures, and other features that were set before the program was developed are crucial to the success of BBS programs. As a result, various factors may influence employees' perceptions of the BBS programme in the organisation.

The study was based on the literature and the point of view of experienced professionals.

### **1.1. BBS understanding and job satisfaction**

Employees have a crucial role in the BBS program. Improved involvement and intervention at work enables individuals to access a wider range of safety resources, leading to an inclination to increase the safety of the work environment and allocate resources to prevent accidents for themselves and their colleagues (Yuan *et al.* 2015; Dyreborg *et al.* 2022). As previously stated, numerous aspects contribute to the understanding of the BBS program, and these characteristics may vary across different work settings. The combination of these variables, along with the active participation of employees in the BBS program, will enhance employees' perception of BBS.

Job satisfaction is defined as a person's overall appraisal of his or her work (Alegre *et al.* 2016). As it is presented, job satisfaction or worker satisfaction has been given various explanations. One of the earliest interpretations dates back to Blum and Naylor (1968), who believe that job satisfaction is a combination of several attitudes. These attitudes are related to factors such as salaries, management, employment stability, work conditions, immediate resolution of grievances, social relations on the job, rational behaviour of the employer, and other comparable items (Pestonjee *et al.* 1977; Srivastava 2005; Cabrera & Estacio 2022). These elements will have an impact on employee job satisfaction and safety behaviour. Job satisfaction not only has a significant impact on employees' perceptions of safety, but it also has a strong relationship with safety climate creation (managers and organizations) (Idrees *et*

al. 2017; Dziuba *et al.* 2020). Employees with high job satisfaction appear to have a more optimistic opinion of the company's commitment to enforcing safety measures (Stoilkovska *et al.* 2015). BBS appears to be associated with employee job satisfaction, as suggested by the preceding explanation. According to Kaila (2006), the BBS program promotes a concern for each other's safety in the workplace. It assists employees in improving their overall safety behaviour, which leads to increased job satisfaction.

Therefore, the purpose of this research was to assess the influence of BBS perception on the job satisfaction of construction workers. By doing so, organizations can better preserve and enhance the valuable resources of their workforce, which contributes to higher levels of job satisfaction and safer work performance. Consequently, improved BBS implementation may lead to a reduction in employee anxiety and serve as an indicator of job satisfaction.

### **1.2. BBS perception and job stress in construction company**

The construction business is widely recognized as a significant sector in nearly every country. Given its large workforce, it is crucial to examine the impact of job stress on employees' risky conduct. Research conducted by Wu *et al.* (2018) has demonstrated that effective management of job stress can enhance the safety performance in the construction industry. Job stress has been found to have a negative impact on personnel's safety behaviour, as demonstrated by Wang *et al.* (2018). As per a report by the Centers for Disease Control and Prevention (CDC) of the US National Institute for Occupational Safety and Health (NIOSH), job stress refers to the harmful physical and emotional reactions that occur when the demands of a job are not aligned with the abilities, resources, or requirements of the workers. It has the potential to result in severe physical harm and negative effects on health (CDC 1999).

The presence of job-related stress has a substantial impact on workers' work behaviour (Azila-Gbettor *et al.* 2022). This impact becomes even more severe when employees become aware that they receive insufficient assistance from their managers and supervisors, which negatively affects their conduct inside the organization (Aftab & Javeed 2012). According to Wu *et al.* (2018), job stress is considered a significant component in the dangerous conduct of construction workers and is negatively associated with safety behaviour. Job stress is, in fact, an extension of general stress. However, it is important to note that the nature of job stress differs from general stress. Job stress mostly arises from the conditions and environment in which work is performed. A variety of factors in a work environment can contribute to stress, including job tasks, the work environment itself, job characteristics, conflicts in roles, the talents of workers, and *etc.* (Jou *et al.* 2013; Vallasamy *et al.* 2023). Under these conditions, it appears that implementing a BBS program could potentially impact employees' occupational stress levels and enhance their adherence to safety protocols. Thus, this study aimed to examine the influence of employees' perception of Behaviour-Based Safety (BBS) on job stress within the construction work environment.

In general, a review of the relevant literature indicates that despite extensive research reports and the implementation of the BBS model, the BBS method has encountered numerous difficulties in achieving its goals of sustainability and satisfactory results (Ismail *et al.* 2012; Galis *et al.* 2018; Tong *et al.* 2018). This study aimed to evaluate the employees' perception in the Malaysian construction workplace in order to uncover crucial elements that may have a bigger impact in the sustainability and performance of the BBS program. Furthermore, the absence of research exploring the direct impact of BBS perception on employees' job satisfaction and workplace stress has motivated us to investigate the relationship involved. The discovery will primarily address this knowledge gap and enhance theories in organizational and

occupational health safety. Figure 1 displays the theoretical frameworks used in the investigation.

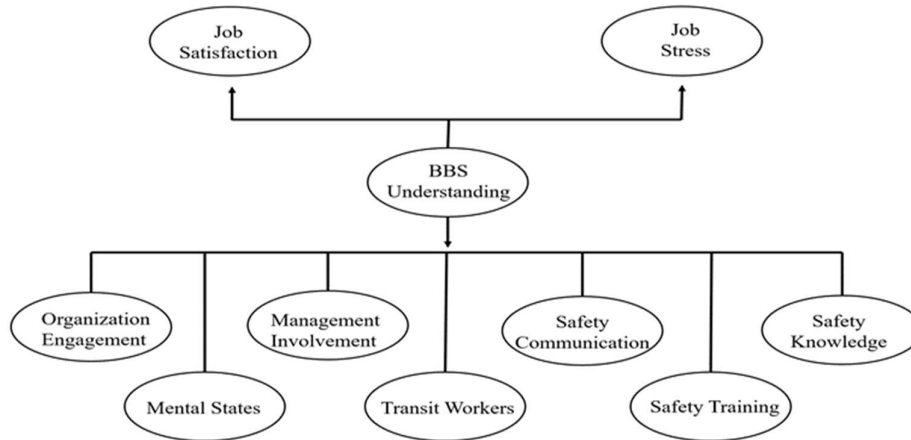


Figure 1: Research model

The following was carried out to evaluate the objectives of the study:

- The critical success factors examined in this study may indicate the outcomes of the perception of BBS (Behaviour-Based Safety)
- Employee job satisfaction and stress levels on construction sites under study are directly impacted by BBS perception.

## 2. Materials and Methods

### 2.1. Instruments

In conducting this study, both qualitative and quantitative research methodologies were employed. The instruments adopted in qualitative and quantitative research were questionnaires and interview questions. In order to align with the research objectives, most of the content for these instruments was adapted and improved from the works of Mearns *et al.* (2010), Carlson *et al.* (2000), Cox and Cheyne (2000), Vinodkumar and Bhasi (2009), Singh and Jain (2013), Amankwah *et al.* (2015), Wu *et al.* (2018), and Lyu *et al.* (2018).

### 2.2. Qualitative study

Individual semi-structured interviews were used as an approach for conducting qualitative research in the current study. Separate interviews were conducted with a total of 12 project specialists (6 managers, 4 safety trainers, and 2 site supervisors). An online interview was conducted using judgmental sampling (purposive sampling) to select interviewees based on their expertise and BBS knowledge in the construction industry. Attendance at the interview was entirely voluntary, and this study tried to balance responds from all categories (safety managers, supervisors, and safety trainers) in order to cover every angle. The goal of these interviews (qualitative study) was to gather more information on the BBS programme from

expert perspectives with the objective to investigate the key factors that could lead to employees having a negative perception of the BBS programme and failure in the construction sector. The findings of the interviews are incorporated into the questionnaire for the study. To ensure the questions in semi-structured interviews were valid, a panel consisting of two senior lecturers in management studies was consulted to refine those questions so that they could effectively assess the study's context.

Thematic analysis approaches were employed to analyse the qualitative data and identify key aspects that can impact employees' understanding and execution of BBS in the construction industry. The subsequent sections illustrate the stages of data analysis using the methodological framework of the Miles and Huberman (1994) thematic analysis model in this study.

- Data reduction: involves the process of choosing, simplifying, and transforming data.
- The reliability and validity of themes: This test aims to determine whether the topics identified by researchers accurately correspond to the overall text. Results should be assessed by an impartial reviewer to obtain their input.
- Data description: is the concise collection and organized presentation of information. The purpose is to make sense of the obtained data.
- Data visualisation and inference: refers to the use of specific data points to facilitate researchers in deriving conclusions by presenting data in various formats.

### **2.3. Quantitative study**

#### *2.3.1. Explanation of questionnaire*

A total of 40 questions spread over 9 categories on the survey. As independent variables, 7 criteria were used to describe the level of perception of BBS among employees. The qualitative research findings of this study indicated that these certain elements influence employees' perceptions of BBS. Additionally, this study's dependent variables included levels of job satisfaction and stress. The survey used a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Pilot study and pre-test were conducted to insure questionnaire's face and content validity. Additionally, factor analysis was employed to assess the appropriateness of the questions for data analysis.

#### *2.3.2. Data collection, small sample size and PLS-SEM*

Data was collected using online and indirect survey approaches. The questionnaire is mostly created using popular online survey tools such as Google Forms and distributed to respondents by email and other indirect means on various days. During indirect distribution, site supervisors assist researchers in the dissemination and retrieval of questionnaires. In all methods, questionnaires were received from each responder within a maximum of one month from the date they were sent. The data gathering process, consisting of three separate survey efforts, took around six months in total. A total of 94 participants, consisting of 33 supervisors and 61 general workers, were involved in the study. These participants were selected from 5 infrastructure and commercial construction sites in Malaysia that implement BBS practices. It constituted 15% of the overall population of sites.

All respondents voluntarily participated in this study, and the data gathered was analysed as a group. Importantly, information from the responses is strictly confidential and used solely for this study. In fact, this study received ethical approval from the National University of Malaysia's Research Ethics Committee, with the approval number (UKM PPI/111/8/JEP-2019-816).

The sample size of this study is relatively small due to limited construction companies that practicing BBS program and the COVID-19 outbreak.

Partial Least Squares (PLS-SEM) was used to examine the impact of BBS perception on job satisfaction and job stress. The methodological decision for this study using Partial Least Squares Structural Equation Modelling (PLS-SEM) has been significantly influenced. The fundamental qualities of PLS-SEM, such as its focus on prediction-oriented analysis and its ability to handle latent constructs with a limited number of indicators, make it particularly suitable for scenarios when it is not feasible to gather a large sample size. Multiple research has confirmed the efficacy of PLS-SEM when used with reduced sample sizes, highlighting its capacity to produce precise estimates of parameters and preserve statistical power (Franke & Sarstedt 2019).

Furthermore, this research integrated bootstrapping methods into the PLS-SEM framework, enhancing the dependability of our results. Bootstrapping entails the process of resampling from the dataset, which serves as a potent technique for estimating standard errors and confidence intervals. The rigorous methodology of PLS-SEM, together with the application of bootstrapping techniques, enhances the credibility and reliability of our study's findings, even when working with a limited sample size (Barclay *et al.* 1995; Chin 1998).

### **3. Results**

The descriptive outcomes of the quantitative study indicate that 76.6% of the respondents were under the age of 35. Additionally, 81.9% had less than 10 years of work experience. Furthermore, 13.8% had a degree, 17% had a diploma, 7.4% possessed a working skill certificate, and 61.7% had completed schooling up to the school level.

#### **3.1. Interview findings**

Table 1 shows the main suggestions from the interviews with safety trainers and managers, which can be broken down into seven major themes. Below are the explanations for the mentioned thematic concepts:

- *Organization engagement: representing company-wide transparency in following safety procedures from owners, safety officers, and other high-ranking officials. Organizational engagement and support to the pre-BBS activities and BBS policy are the basic factors ensuring that a policy is lived and taken serious by everyone within the company.*
- *Management involvement: is key in reflecting employees' safety behaviours. They play a vital role in bridging the gap between the company's top management and lower-level safety managers, as well as front-line workers. By actively demonstrating involvement to safety, workers will realise the management's seriousness about safeguarding their safety and workplace wellbeing.*
- *Transit workers: are individuals employed for a specific duration, encompassing project- or task-based contracts, as well as seasonal or casual employment, including day labor. In a construction project, numerous subcontractors participate, each bringing temporary workers for various tasks. Consequently, these temporary workers play a vital role in the safety programs, particularly behavioral safety, at every construction site.*

- *Safety knowledge: is a term that should be ingrained throughout an organization, from the highest level to the lowest. This doesn't imply that everyone must be a safety expert, but rather that a fundamental understanding of safety principles is advantageous across all areas. Achieving this can foster a strong safety culture within the company, enhancing vigilance and fostering a sense of being valued by the organization.*
- *Safety communication: creating a feedback-rich environment where employees can openly express their concerns and management consistently consider the issues and conducts awareness programs. Effective communication is a key component in achieving an injury-free workplace. Many injuries are partially due to risky behaviours, yet employees frequently hesitate to give safety-related feedback to the company.*
- *Safety training: aims to minimize the risk of hazardous behaviours by improving hands-on and practical exercises on workplace. Providing employees with information, skills, and the motivation to work more safely ensures the maximization of their learning and its application in real-world scenarios. This type of training is instrumental in maintaining and improving safety systems through psychological interventions.*
- *Workers mental states: represent a significant yet often overlooked issue, as mental health affects employees at every level within the construction industry. In fact, the most hazardous aspect of a building site may be the psychological risks. Whether due to human error or intentional actions, employees are at the core of these risks, and mental health issues can intensify them.*

Table 1: Qualitative thematic analysis with expert's frequency and percentage point of view (n=12)

No;	Theme	Theme description	Frequency	%
1	Organization engagement	Understanding of BBS from top management and providing all needs and support for implementing BBS	11	91.6
		Provide Master trainer program based on BBS needs	3	25
		Support idea of making safety passport profile for each and every employee that it will help to control them	6	50
		Companies more attention to safety (safety culture) and less focus only on profit	5	41.6
		Commitment of top management on applying BBS automatically give motivation and encourage middle management / workers to implement BBS accordingly	7	58.3
2	Management involvement	Create a good culture (mindset) by updating latest issue and implement it better in the site	7	58.3
		No blaming system, on the other hand increasing positive reinforcement and reducing employee's lack of engagement	6	50
		Close observation on the entire process by middle management and foreman is recommended.	9	75
		Emphasize on factor that trigger non safety behaviour: not just root cause of the accident	4	33.3
		Focus on education not punishment and be a perfect mentor	6	50



*Table 1 (Continued)*

3	Transit workers	Knowing workers background and details of experience	6	50
		Provide training for those sub-contractor's workers to be familiar with the site working condition and atmosphere before entering to site	10	83.3
		Company should provide specific task training to improve and verify their (workers) competency	4	33.3
		Closely monitoring by site supervisor, foremen or reliable permanent workers is required	8	66.6
4	Safety knowledge/ awareness	Middle managers and site supervisors should be good on BBS program and deliver it in an appropriate way to the workers.	11	91.6
		Managers should always remember workers on safety issues and keep them update on the risk of their work environment	5	41.6
		Workers have to understand the BBS system and apply it accordingly	6	50
		Workers safety action and behaviour should evaluate frequently to find out the deficiency and should improve	8	66.6
		The success of implementation of BBS very much depends on the ability to change the worker behaviour. It takes 5-10 years to change behaviour	5	41.6
5	Safety communication	Managers/ supervisors should understand workers working condition	8	66.6
		Site supervisor frequently should be in the site and workers has right to directly share any safety problem with them and the site supervisor deliver the problem to middle management immediately	6	50
		Site managers have to downgrade their level of communication skills, get to know workers culture (soft skill)	10	83.3
		Rewards for those workers that have highest submission for monitoring and reporting safe/unsafe condition on their work place	9	75
		Providing notice boards as many as possible in the site and using online platform to remind workers on their behavioural safety, safe /unsafe action and possible hazard for each and specific task in the site maybe by using their mother tong language too	6	50
6	Safety training	Assessment of safety mostly focus on physical aspects (Machine and technical) less emphasize on behavioural aspects (no balance)	5	41.6
		Workers can have on the job training means positive reinforcement	8	66.6
		Workers should have contribution on time to time learning (refresher class), attention to the results of evaluation bay mangers and personally improve themself after each assessment in real-life working environment	6	50

*Table 1 (Continued)*

		Organization should find out suitable safety training method based on needs, proper observation and justification (customize training program)	10	83.3
7	Workers mental states	Controlling workers operation time, attention to their welfare specifically at work with providing shelter	7	58.3
		Company shouldn't blame workers at the first place if accident / incident happens	9	75
		Manager should emotionally touch workers and always remind them about the reason of working and loved one to encourage them to take safety seriously	10	83.3
		Workers mentally should accept that BBS is not an extra job for them doesn't burden them and taking their time away for unnecessary work and is an extra job	4	33.3

Meeting all the requirements will strengthen the related factor, which can then affect how the BBS programme is used overall and how workers feel about it in the construction industry.

### 3.2. PLS-SEM analysis findings

The quantitative results show that the important factors that were looked into in the qualitative study were shown to have an effect on how well workers understood BBS in the construction sites that were studied. After looking at the important factors that affect BBS, the results also showed how workers' views of BBS affected their job satisfaction and stress.

The data that was collected fitted the assumption (Measurement (outer) model) so that the objective could be assessed by path analysis (Structural (inner) model). To do this, convergent and discriminant tests were used to see how well the theoretically described constructs (Construct validity) were loaded onto the questions (indexes). Results that show the measurement model is valid and consistent with itself are enough to say that the validity of convergence has been achieved (Table 2).

Table 2: The Convergent Validity result of overall measurement model

Variables	Question	Loading Factor	AVE	CR	rho-A	Cronbach's Alpha
Management Involvement	MI1	0.728	0.669	0.890	0.840	0.834
	MI2	0.843				
	MI3	0.849				
	MI4	0.845				
Safety Communication	SCO1	0.868	0.675	0.925	0.908	0.902
	SCO2	0.867				
	SCO3	0.863				
	SCO4	0.806				
	SCO5	0.791				
	SCO6	0.723				
Safety Training	ST1	0.825	0.692	0.918	0.897	0.888
	ST2	0.816				
	ST3	0.864				
	ST6	0.758				
	ST7	0.891				

*Table 2 (Continued)*

Organization	OE1	0.904	0.736	0.917	0.879	0.878
Engagement	OE2	0.849				
	OE3	0.914				
	OE4	0.757				
Transit Workers	TW3	0.946	0.871	0.931	0.876	0.853
	TW6	0.920				
Mental States	MS1	0.887	0.808	0.927	0.902	0.882
	MS3	0.933				
	MS4	0.876				
Safety Knowledge	SK1	0.901	0.701	0.921	0.903	0.892
	SK2	0.880				
	SK3	0.886				
	SK5	0.715				
	SK6	0.790				
Job satisfaction	JSA1	0.822	0.703	0.904	0.884	0.859
	JSA3	0.756				
	JSA4	0.914				
	JSA5	0.854				
Job Stress	JST1	0.892	0.709	0.924	0.921	0.898
	JST2	0.894				
	JST3	0.857				
	JST4	0.805				
	JST5	0.752				

Given that all the square root values (bolded in Table 3) of the Average Variance Extracted (AVE) are larger than the other correlations under them, the test of discriminant validity has been fulfilled (Fornell & Larcker 1981).

Table 3: The discriminant validities of the latent constructs

	<sup>a</sup> JSA	<sup>b</sup> JST	<sup>c</sup> MI	<sup>d</sup> MS	<sup>e</sup> OE	<sup>f</sup> SCO	<sup>g</sup> SK	<sup>h</sup> ST	<sup>i</sup> TW
Job Satisfaction	<b>0.839</b>								
Job Stress	-0.550	<b>0.842</b>							
Management Involvement	0.600	-0.509	<b>0.818</b>						
Mental States	0.369	-0.820	0.436	<b>0.899</b>					
Organization Engagement	0.393	-0.376	0.761	0.338	<b>0.858</b>				
Safety Communication	0.809	-0.582	0.732	0.511	0.607	<b>0.821</b>			
Safety Knowledge	0.699	-0.500	0.751	0.447	0.683	0.704	<b>0.837</b>		
Safety Training	0.649	-0.586	0.788	0.538	0.504	0.685	0.688	<b>0.832</b>	
Transit Workers	0.334	-0.465	0.522	0.486	0.395	0.476	0.291	0.481	<b>0.933</b>

<sup>a</sup>Job Satisfaction, <sup>b</sup>Job Stress, <sup>c</sup>Management Involvement, <sup>d</sup>Mental States, <sup>e</sup>Organization Engagement, <sup>f</sup>Safety Communication, <sup>g</sup>Safety Knowledge, <sup>h</sup>Safety Training, <sup>i</sup>Transit Workers.

Information about the relationships between the variables can be found in the structural path model. Figure 2 depicts the correlation between the investigated variables and the given data.

Organizational engagement, management involvement, safety communication, safety knowledge, transit workers, mental states, and safety training were all reflected in employees' BBS perceptions of the organization's BBS performance, as shown by the coefficient of determination ( $R^2$ ). The results show employees perceived that safety communication ( $R^2: 0.775 = 77.5\%$ ) and management participation ( $R^2: 0.825 = 82.5\%$ ) had the most impact on BBS understanding in the construction industry. Mental states and transit (temporary) workers, on the other hand, had the least impact on employees' understanding of BBS ( $R^2: 0.400 = 40.0\%$  and  $R^2: 0.336 = 33.6\%$ , respectively). Due to suitable BBS implementation on targeted

construction sectors, mental states and temporary workers played a low role and should not be ignored by authorities.

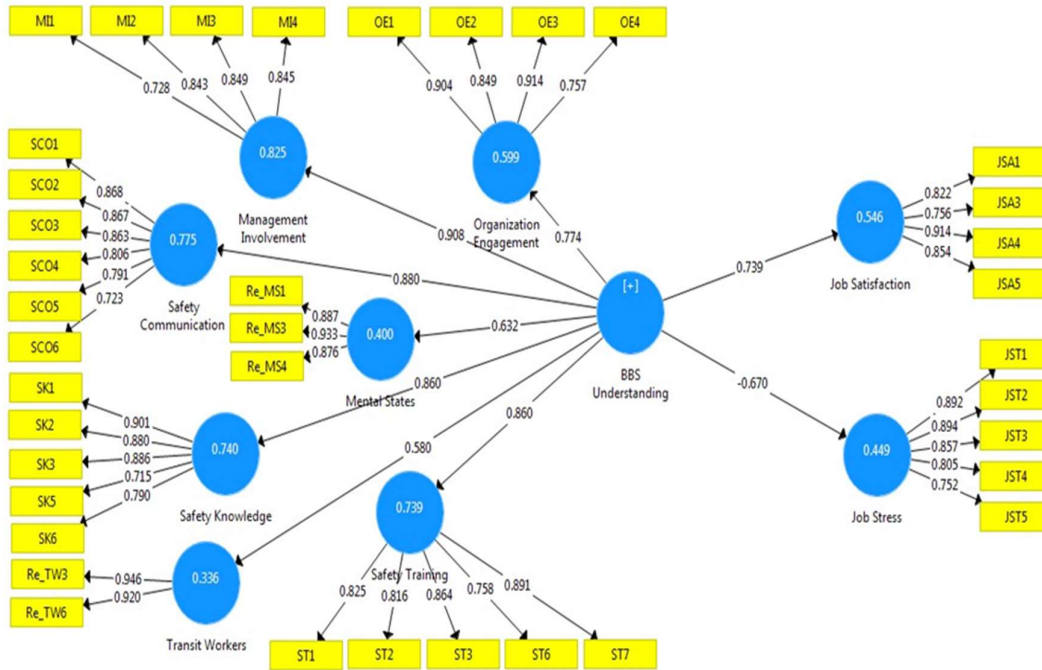


Figure 2: Study path model

Employee job satisfaction and stress had  $R^2$  coefficients of 0.546 and 0.449, respectively. In construction sites under study, BBS explained 54.6% of job satisfaction variability and 44.9% of job stress variability (Figure 2). According to Table 4, good BBS perception increased employee job satisfaction but decreased job stress. Therefore, improving employees' BBS knowledge will reduce job-related stress and boost job satisfaction.

Table 4: Test of BBS effects on employee's job satisfaction and job stress

PATH	B	B (bootstrapping)	SE	T- VALUE	P- VALUE
BBS Understanding → Job Satisfaction	0.739	0.745	0.037	20.172	0.000
BBS Understanding → Job Stress	-0.670	-0.673	0.072	9.301	0.000

#### 4. Discussions

##### 4.1. Critical factors and BBS understanding

According to expert's point of view, the most significant items (themes description) emphasized were.

- (*Understanding of BBS from top management and providing all needs and support for implementing BBS*) under the theme of management involvement;
- (*Middle managers and site supervisors should be good on BBS program and deliver it in an appropriate way to the workers*) under safety awareness /knowledge (theme) with 91.6% of respond for both items
- (*Provide training for those sub-contractor's workers to be familiar with the site working condition and atmosphere before entering to site*) under transit workers (theme);
- (*Site managers have to downgrade their level of communication skills, get to know workers culture (soft skill)*) under safety communication (theme);
- (*Organization should find out suitable safety training method based on needs, proper observation and justification (customize training program)*) under safety training (theme);
- (*Manager should emotionally touch workers and always remind them about the reason of working and loved one to encourage them to take safety seriously*) under mental condition and psychological safety (theme) at 83.3% for all mentioned items (themes descriptions).

The study indicated that top management, middle management, and workers are three key groups equally responsible for reinforcing the seven identified factors crucial to the successful deployment of a robust BBS program. It is vital for top safety management to be current with the latest safety standards and regulations. They must maintain open communication with the internal safety supervisor and workers, while also ensuring a satisfactory work environment and allocating a suitable budget for the BBS program. Mid-level safety managers should diligently prioritize the implementation of regular work meetings that encompass safe work protocols and routine workplace and staff inspections. It is imperative to thoroughly examine all safety reports in a timely manner, promptly implement measures to prevent potential accidents, and ensure that new staff are familiarized with the most up-to-date safety protocols and regulations of the facility. Intermediate safety managers must possess a comprehensive understanding of the working conditions of employees and serve as a crucial intermediary between frontline workers and senior safety management. Workers must adapt themselves to behavioural safety training and be willing to contribute to safe work practices. To ensure safety on a daily basis, it is imperative for individuals to provide support to one another and maintain strong relationships with their supervisor based on mutual understanding and trust.

This result is supported by Hopkins' (2006) claim that the BBS program fails when there is a lack of trust between employees and management. Hopkins also says that the safety program is just another way to make sure that employees are responsible. It can be said that business activities, organizational policies, safety standards, and people's awareness of safety in all areas are the main things that affect how safe their employees are (DePasquale & Geller 1999).

The findings of the qualitative study align with the research conducted by Galis *et al.* (2018), which highlights the significance of organizational commitment, management level, training, and workers' knowledge in achieving effective BBS implementation. The findings of Harsini *et al.* (2020) align with the notion that various factors contribute to hazardous work behaviours. These factors include the absence of effective safety management and supervision, inadequate safety systems and observations, unsafe working conditions both physically and psychologically, workers' lack of skills to address safety concerns resulting in active errors, and broader organizational factors such as an unsafe management culture and its impact on workers' safety.

The results indicate that both individual responsibility and management responsibility are essential for achieving a strong understanding and performance in BBS (Behaviour-Based Safety). Individual responsibility plays a critical role in reducing or eliminating risk factors

associated with unsafe behaviours, while management responsibility is important for providing resources to enhance workers' commitment to safety in the most effective manner possible. Choudhry *et al.* (2007) found that when management is committed to safety, considers the well-being of workers, establishes trust and reliability with them, empowers employees, continuously monitors, takes corrective and preventive actions, revises systems, and continually improves safety, it strengthens the safety culture. This, in turn, has a positive impact on the behavioural safety of workers in the organization. Organizational climate is directly associated with particular procedures, practices, and regulations. Consequently, employees' perception of the organizational climate can serve as a guide, making them aware of the expected safe conduct that should be demonstrated. Thus, safety climate could enhance the impact of employees' anticipation of safety behaviour by providing employees with contextual cues (Schneider *et al.* 2013). Furthermore, it posited that the presence of a suitable safety climate and culture in the workplace will lead to employees exhibiting responsible safety behaviour (Rafique *et al.* 2021; Saedi *et al.* 2023).

Safety climate aims to enhance the overall safety culture inside a business, which in turn influences employees' commitment to safety success. By maintaining an adequate safety level, firms can prioritize positive reinforcement in their Behaviour-Based Safety (BBS) program to enhance employees' behaviour. Therefore, certain elements that assess the safety climate inside a company (such as management accountability and safety expertise) can also serve as additional factors that impact employees' perception and enhance the successful implementation of the Behaviour-Based Safety (BBS) program in the workplace. There is a reciprocal relationship between the safety climate within an organization and an individual's impression of Behaviour-Based Safety (BBS). Failure to address the above factors will jeopardize the implementation of the BBS program, diminish employees' safety behaviour, and result in significant mental and physical harm to the organization's workforce.

#### **4.2. BBS perception, job satisfaction and job stress**

Quantitative results have indicated direct effects on employees' job satisfaction and job stress in examined construction sites due to a proper understanding and implementation of BBS program. Details revealed that staff were pleased with their jobs and eager to execute them well. Their supervisors were friendly, and they understood each other. Workers were given special attention in their organization to meet their needs, and they were seen as a vital part of the organizational system. Employees were not assigned to many positions at the same time or to work overtime. Workers were not stressed as a result of conflict or displeasure with co-workers, and there was a shared understanding and teamwork among them. Employee feedback demonstrates apparent job satisfaction as a result of a thorough understanding and implementation of the BBS program at specific construction sites.

As previously said, this study found seven critical characteristics that contribute to a more effective BBS program and improve employee perception of BBS. Employee job satisfaction in the investigated construction work environment can be attained by keeping these elements at an appropriate level. Several studies have found elements that may influence employee job satisfaction. Inadequate supervision, unstable employment, bad working conditions, demanding jobs, small income, a lack of growth chances, and limited workplace autonomy all have a negative impact on job satisfaction (Guest 2004; Silla *et al.* 2005; Anin *et al.* 2015). The study's argument was supported further by the findings of Marzuki *et al.* (2012), who found that job characteristics, reward systems, hierarchical relationships, teamwork, job security, and employee welfare all have a significant impact on job satisfaction among construction workers. According to the data, different levels of job satisfaction among different employee categories

can be linked to the fact that employees' perceptions of the condition of job components change depending on their managerial position and occupational group. Behaviour-based performance (BBS) is widely acknowledged as a set of critical success factors associated with health and safety initiatives and activities (French & Geller 2008). Employee perceptions of BBS in connection to job satisfaction can have a substantial impact on BBS effectiveness. Kaila (2006) backs up the aforementioned claim that behaviour-based safety practices boost job satisfaction.

In addition, effectively managing job-related stress is a crucial aspect of maintaining a healthy work environment in the construction industry. Workplace stress can undermine employees' motivation, leading to a decline in innovation and job satisfaction. If a person experiences job stress, it can lead to not just low job satisfaction but also violations, ultimately resulting in risky behaviour. The findings of this study indicate that employees expressed satisfaction with their responsibilities and working environment, resulting in reduced levels of stress. The study of construction sites has demonstrated that employees' job stress is significantly influenced by their impression of BBS (Behaviour-Based Safety), highlighting the need of promoting sustainable behavioural safety among employees. This sustainability can be explained by the theory of resource conservation. This idea posits that the inherent nature of a human is to acquire, retain, safeguard, and enhance important resources (Hobfoll 1989). It is crucial for both employees and organizations to consider BBS as a significant resource for enhancing job satisfaction and alleviating job stress. Risking this resource (BBS perception) can lead to a decrease in safety behaviour (Niciejewska & Obrecht 2020). Addressing this issue requires additional allocation of budget, time, and manpower, which in turn leads to a depletion of redundant resources available for monitoring, strengthening, and regulating safety practices. Premkumar and Rajkumar (2015) asserted that the primary stressors for workers in the construction industry include excessive workload, harsh site conditions, inadequate feedback, sudden changes in job requirements, interpersonal conflicts, and low wages. Examining the indicated factors related to job stress and job satisfaction reveals that the perception of BBS can substantially mitigate employees' job stress and enhance satisfaction with safety measures. Enhancing employee satisfaction has a significant and evident impact on the sharing of safety knowledge and dedication to work (Ni *et al.* 2020). It confirms the importance for construction companies to increase employees' BBS perception and performance to make them more willing to share safety knowledge and operate at a high safety level.

The above argument combines critical success factors of BBS, BBS understanding, job stress, and job satisfaction. Based on the identified parameters, excellent BBS perception should lead to higher job satisfaction and lower job stress in construction. BBS is a supportive program in OHS management that supports personnel and organization behavioural safety. This study aimed to encourage managers, contractors, and workers of construction companies that are not practicing BBS and companies that are practicing but having trouble with BBS sustainability to improve their organization and workers' safety behaviour by examining potential factors that may affect employees' BBS perception for a better BBS program. Many Malaysian construction businesses did not practice BBS, which limited data gathering and sample size. BBS management approaches should be adjusted to the needs of the organization to improve job satisfaction and reduce stress. Further research is needed to determine how BBS program affects safety performance, accident and incident rate when combined with other safety programs.

## **5. Conclusion**

A combination of qualitative and quantitative research methods was utilized to identify the key aspects influencing employees' perception of the BBS program, as well as the effects of this perception on job satisfaction and job stress in a construction work setting. The current

empirical investigation of this study has shown 7 success factors that might reflect the level of BBS knowledge in the construction industry. According to experts, malfunction of any of these factors could significantly impact the overall effectiveness of BBS on a construction site.

Additionally, the results indicate that workers' understanding of BBS has a positive impact on both job satisfaction and stress levels in the construction workplace that was studied. Understanding the BBS program will make employees more satisfied at work and less stressed out at work. In light of this, every manager, supervisor, contractor, and worker should see it as an important part of the company's safety culture. The successful implementation of a behaviour-based safety (BBS) technique relies on the establishment of trust among top management, supervisors, contractors, and workers. It is crucial that they not only accept the system but also embrace it as an attitude rather than viewing it as mere discipline.

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*An Inference-Based Bootstrap and Mixed Methods Approach to Examining the Impacts of Behavior-Based Safety*

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