Impact of Safety Worker Behaviour on Safety Performance in Construction Firm of Nepal; A Moderated Mediation Model

Dinesh Sukamani*, Junwu Wang, Manita Kusi, and Ashok Shah

Abstract— **The study concentrates to analyse systematic SEM-PLS modelling for the moderation role of safety Training (STT) and the mediation role of Safety Worker Behaviour (WB) to improve Safety Performance (SP) of construction firms. Besides, this research focuses on presenting causal relationships and interactions within enablers and goals or outcomes as SP which are engaged in study. To test the proposed SEM-PLS model, 320 valid responses from engineering personalities have been collected using a questionnaire survey. Hazard management (HM) have highly positive influences on WB. Besides, all the mediating variables showed a complementary partial mediation relationship. From evaluation matrix output, the safety worker behaviour of the International Non-Governmental Organizations (INGOs) has good (IV) range whereas public and private construction firms seem to have poor (II) range as per implementation of Maximum Degree of Membership (MDM) principle. This study presents the improvement of safety performance in the construction firms as it delivers strong visions into the cause-effect relationship of safety performance factors and goals.**

Keywords: **Safety worker behaviour; Safety training; Safety performance; SEM-PLS; Construction firm**

I. INTRODUCTION

The construction firm is the most critical firm due to its changing and sole nature in comparison to other firms [1, 2]. It is also critical because of recurring cases of accidents and injuries in sites. Movements of the construction industrial accident environment in Nepal illustrated that fatal accidents rise from 5 to 13 from 1995 to 2009 [3]. The previous studies found that the fatality rate at construction sites of Nepal is almost three times in comparison to China and India. The fatality rate found to be 10.5 in China, 11.5 in India and 29.9 in Nepal per 100000 employees [4]. The construction firms in Nepal are very few in comparison to China and India but the accident rate and the fatality rate are so high which shows safety performance evaluation is poor or in a primitive stage. This also shows that the government policy and regulation on safety are not enough or are not effective in Nepal. ILO's major principle of occupation, health and safety are not well retained [5]. In Nepal, the Department of Labour is responsible for health, occupation safety and the working situation at an effort place. There is no distinct department which only concentrates on safety and health in the workplace in any firm [6].

The safety management system is a multitasking field. In any construction, project safety calibration is considered as a promising solution to the supervisor and engineer to improve safety performance[7]. Safety performance evaluation is an important section of the safety management system. Meanwhile, it generally gives an idea of the system quality in terms of development, execution, and output [8]. The previous researchers identified the major representative of this type of evaluation are to get the causal relationship between leading indicator, undesired events that may occur and initiative performance [9]. A study on safety performance in previous studies dealt only with external factors like working environment, drinking water, accident frequency, severity rate, etc. But the analysis output of these aspects fails to show the cause and effect relationship which is required to develop a safety management system [10]. Past studies also indicated that the traditional indexes aspects only concentrated afterward investigation but give less importance to internal factors like safety climate, safety culture and so on [11]. The interaction that construction employer is doing and how safety behaviour and climate impact safety performance appear to be overlooked [12]. Besides, very few previous researches showed empirical validation of how constructs and its indicators are interrelated with the safety performance-based model [13]. However, previous studies had less focus regarding interrelation between determinants constructs of safety performance [14]. This research aims to make an advanced SEM-PLS framework with an approach to discourse these deficits.

The safety system is generally studied among four steps: input, process, output, and outcome. The very first step, input, covers project nature, human error, climate, etc. which are the reasons for the accident. The previous authors gave the concept of safe space and its two sections as extreme weakness and resistance respectively. The position of any project in that space will depend on how proper the project handle hazard inputs [15]. Earlier researchers considered that 88% of accidents are instigated by unsafe acts and 10% by unsafe conditions [16]. The process implemented in construction firms includes policy and practices which

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improves the safety behaviour of labour minimizing unsafe acts [17]. To eliminate the labour's unsafe act, construct like safety climate, safety culture, safety training and hazard management are measured as a process in the safety system. Similarly, safe workers' behaviour has a positive relationship with safety performance [18]. Safety performance is an outcome section of the safety system as shown in conceptual Figure 1. However, the model will be complex and disordered if we are going to measure interrelationship within the process also. So, in this research, the researchers have shown the relationship of process element (hazard management, safety climate, safety culture, and safety training) to output (safety worker behaviour as mediator) and outcome as safety performance of construction firm. Besides, it tries to show the interrelation of safety training as moderator with hazard management, safety climate and safety culture for better safety worker behaviour as output for a better outcome as safety performance.

The main objective of this research is to choose major constructs that affect safety performance, develop a model and a hypothesis. After the validity of the measurement model and structure model, empirical analysis of the mediation role of safety worker behaviour and moderation role of safety training to improve safety performance in the construction site will be done. Moreover, the analysed path coefficient from the validity model will be utilized to compare the construction firm (private, public and INGOs) based on better safety performance as an outcome.

Very few earlier studies used Safety Training (STT) as a moderator relationship between Safety Climate (SCL) and Safety Attitude (SA) to Safety Performance (SP) but the previous studies are seen unable to gain significant positive relation [19, 20].In this study, we are trying to use STT as a moderator relationship between SCU, SCL, and HM to safety worker behaviour (WB). To the best of our knowledge, this is the first study where STT is employed as a moderator between SCU, SCL, and HM for better Safety Worker Behaviour (WB).

The paper is organized in the structure as follows: In section 2, constructs were identified for the previous literature review to create the research framework for analysis. The third section will elaborate on the hypothesis based on empirical analysis. The fourth section is dedicated to the illustration of the methodology through primary data concerning safety performance on construction. The fifth section discusses the study of the interrelationship among variables concerned to improve safety worker behaviour or better safety performance framework. And also explore the reuse of the verified model to compare the safety performance of different types of construction firms in Nepal. The sixth section discusses the result and presents its analysis. The last section gives the conclusion and limitations of the research.

II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

A. *Influential Factors*

The formal indicators can be composed, related to a highlight on the economic, social and valid backgrounds of Nepal to assure the possibility of the study. In confirmation with the impressive primary work, the safety performance level of construction sites is essentially concerned by the following five aspects: namely, hazard management, safety culture, safety worker's behaviour, safety climate, and safety training. Key indicators of the corresponding latent construct or aspects are measured, studied and divided distinctly as follows:

Hazard Management

Hazard in any construction industry is an inevitable phenomenon and it mainly depends on its location. Site risk range depends on project hazard i.e. higher the site risk higher is the project hazard [21, 22]. Hazard management covers determining, calculating and supervising the hazard in the project. Management of hazards helps to improve the safety performance of any project. Hazard is ambiguous so its evaluation is not an easy task. However, earlier researchers [21] have endorsed the project hazard index (PHI) to figure out the hazard range. Similarly, Feng concluded that higher the project hazard higher will be the range of safety budgeting for investment [23]. An Indian researcher used some indicators of hazard management to show a relation with worker's behaviour. i.e. "I feel that everyone plays an active role in identifying site hazards", "Detecting potential hazards is a major aim of the site planning exercise" and "We have knowledge of overall hazards in our project" [14]. Following the research, this study has utilized those indicators in the context of Nepal.

Safety Climate

Safety climate is a psychological aspect in general, the opinion on the state of safety at a particular time [24]. Improving the environment of teamwork (safety environment) will contribute to a stronger atmosphere for defence (teamwork climate) [25]. The earlier researchers defined safety climate is taken as the sum of common opinion on safety shared by workers [26]. Reward system, intensity, and pressure on work are identified as dominating factor which affects the safety climate on the construction industry [27]. In road construction industry workforce stability, industrial relation, guidance, and supervision are major safety climate factor that affects safety performance in the site [28]. With the higher communication frequency, the safety climate of the construction industry will be good [29]. A researcher from China had used six indicators of safety climate after frequency analysis for Prospective Safety Performance Evaluation (PSPE) in the construction industry. "Co-workers influences, communication, reward system, guidance & supervision, health insurance & social security and intensity and work pressure" [30]. This study has also included those indicators for the research in the context of the Nepali construction industry.

Safety Culture

Enlightening safety culture performance acute part to relentlessly improve safety performance in any organization [31].Besides, previous literature stated that 'Good Leadership' helps to construct safety culture in the construction industry [32]. The worker involvement aspect is highly important in the formulation of safety culture and also supports safety performance in the construction firm [33]. Regular improvement, training, and education, support to upgrade safety awareness among the workers to improve the safety culture of the project using a safety culture cooperation model [34]. Clear rights and duty are identified as the initial reaction phase to boost safety culture for improved safety performance [30] .“Willingness to raise a concern and supervisory responsibilities for safety” are major indicators that affect the safety culture to safety performance in American power operations [35].

Safety worker’s behaviour

Most of the studies have concluded that unsafe behaviour is the major cause of accidents [18]. Previous researches estimated that 85% of accidents can be attributed to unsafe acts [36]. Moreover, safe workers' behaviour has a positive relationship with safety performance [18, 37]. Most of the critical indicators included “I follow all the safety procedures for the jobs that I perform”, “All workers and employees follow all the safety procedures for the jobs that they perform” and “All workers and employees enjoy their jobs at sites” covered by the researchers in Indian construction [14]. Similarly, other indicators "I comply with safety rules and procedures", “I routinely review standard operating procedures before starting work” and “I keep myself in a good mental and physical state” were enlisted in Jordan construction by using SEM [38].

Safety Training

Training is defined as an operation that implements workers to achieve new ideas and behaviour in a better way. Safety training is a fruitful safety program for workers to boost their ideas of safety and skills in the site [39]. Vasoya and Shah identified “Conducting safety training and orientation, issuing of safety booklets, a talk by management on safety, displaying safety poster and training for first aid for all workers” as an indicator of safety training in an Indian construction firm. A survey conducted in 57 projects via an interview in America determined that intensive safety training improved safety performance [40]. Safety knowledge or training acts as an adjacent latent variable that has a positive relationship with the employer’s safety behaviour [41]. Construction firms can upgrade employee’s safety behaviour by awareness of health and safety practices through workshops, training, and conference [42]. A meta-analytical study displayed the impact of safety training on safety knowledge and safety performance [43]. The above indicators of safety training were considered in the context of the Nepali construction site.

III. CONCEPTUAL MODEL AND HYPOTHESIS

A. Conceptual framework

Various studies were carried out exploring the direct positive relation of all the safety constructs with safety performance [44, 45] but this research tries to consider WB as a mediator between HM, SCL, SCU, STT along with moderation impact of STT on HM, SCL, SCU to WB in construction sites of Nepal.

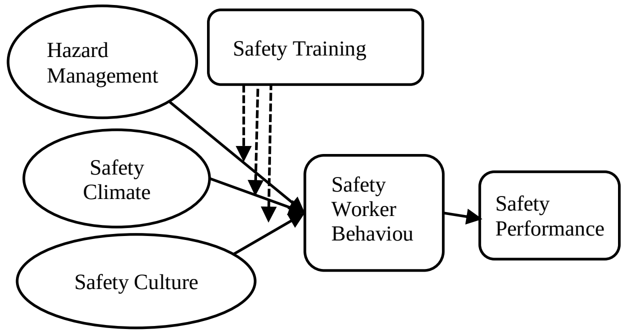


Fig. 1. Conceptual model

Hypothesis (Direct relationship)

1) Hypothesis H1(a): Safety hazard management positively affects safety performance
2) Hypothesis H1(b): Safety hazard management positively affects safety worker behaviour
3) Hypothesis H1(c): Safety climate positively affects safety performance
4) Hypothesis H1(d): Safety climate positively affects safety worker behaviour
5) Hypothesis H1(e): Safety culture positively affects safety performance
6) Hypothesis H1(f): Safety culture positively affects safety worker behaviour
7) Hypothesis H1(g): Safety training positively affects safety worker behaviour
8) Hypothesis H1(h): Safety worker behaviour positively affects safety performance

B. Mediating roles of safety worker behaviour to hazard management, safety climate and safety culture for safety performance (indirect relationship)

Assessing and determining hazards aspect leads to safe worker behaviour among workforces in a construction firm [14]. Proper hazard management upgrades the behaviour of workers which in turn leads to improvement of safety performance [18, 23]. The past study identified that proper concentration on a hazardous task improves site safety [46]. Also, proper implementation of safety climate will cultivate and enhance safety worker behaviour [47, 48]. Theoretically, safety culture as a sub-facet of firm culture is believed to affect worker behaviour in relation to safety performance [49]. Introduction of interaction model on safety culture revealed that smooth improvement, safety training & education help to advance the awareness, capabilities and foster the workers towards positive safety culture in a construction project [34]. Safety culture acts as an influential lever to manage worker behaviour in their daily work tasks in a project [50]. On the other side, the strength of safety training in explaining safety performance outcomes as a true means of shaping [11, 51]. The researcher explained a reason for the value of safety training is the progress in safety behavioural skills [52] stated progress in safety behavioural skills highly depends on safety training. Besides this study, one of the past researchers has inspected the mediation relation of worker behaviour on safety climate and safety performance [53].

1) Hypothesis H2 (a): Safety worker’s behaviour as mediation have positively affected safety performance and safety hazard.

2) Hypothesis H2 (b): Safety worker's behaviour as mediation have positively affected safety performance and safety climate.
3) Hypothesis H2 (c): Safety worker's behaviour as mediation have positively affected safety performance and safety culture.
4) Hypothesis H2 (d): Safety worker's behaviour as mediation has positively affected safety performance and safety training.

C. Moderating roles of safety training

Proper safety training is obligatory for identifying hazards to improve the safety performance of construction firms [54]. Implementation of safety training results improved knowledge of worker behaviour and its practical implication which further upgrades the safety performance of the construction firms [55]. According to Jiang, individual-level safety training will improve the safety behaviour of workers reducing injuries and near-miss which will increase the safety performance of the project [56]. The past author suggested that the team training involvement are a feasible method by which construction firm can gain desired output through effective team performance [57]. Previous studies expressed how upgrading safety climate with moderate training transfers behaviour which they have learned in safety training conducted as per job condition [58].

Proper safety training about a hazard is the core of hazard management to visualize the hidden hazards. Besides, it also helps to foresee the return on investment (ROI) through proper safety training [59]. Proper hazard management upgrades worker behaviour that leads to the improvement of safety performance [18]. The previous study exposed that regular improvement, training, and education upgrades safety awareness of workers which improves the safety culture of the project using the safety culture cooperation model [34]. Theoretically, safety culture as a sub-face of firm culture, which is believed to affect worker behaviour in relation to safety performance [49]. Proper safety training can upgrade the level of safety climate and its applicable features in construction firm [60]. Some earlier studies discovered that effective safety training programs can change labours' unsafe behaviours [10].

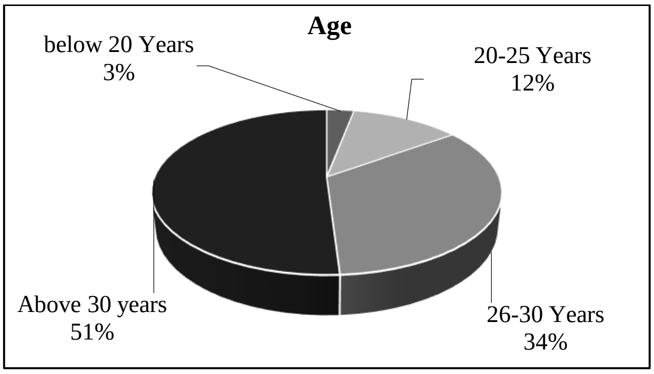
1) Hypothesis H3 (a): The relationship between safety hazard management will be positively moderated by safety training, in that the relationship between safety hazard management and safety worker behaviour will be stronger when there is high safety training than when there is low safety training.
2) Hypothesis H3 (b): The relationship between safety climate will be positively moderated by safety training, in that the relationship between 'safety climate and safety worker behaviour will be stronger when there is high safety training than when there is low safety training.
3) Hypothesis H3 (c): The relationship between safety culture will be positively moderated by safety training, in that the relationship between 'safety culture and safety worker behaviour will be stronger when there is high safety training than when there is low safety training.

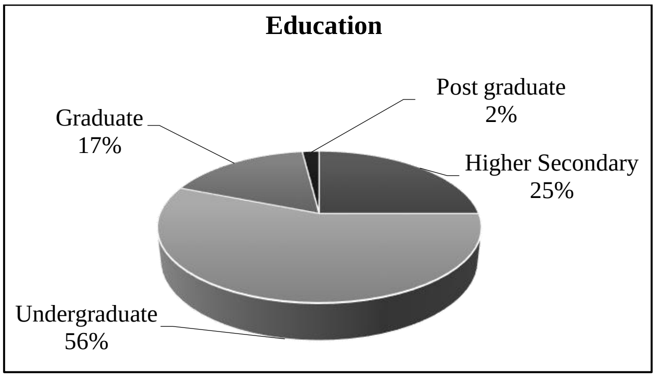
IV. METHODOLOGY

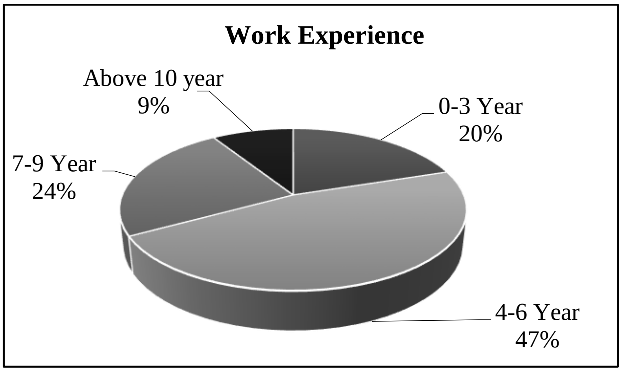
A. Questionnaire response

All the respondents of this research are front line staff or leaders of construction firms i.e. project manager, coordinator, safety engineer, site engineer, etc. The survey was carried out among the respondents from reputed construction firms of Nepal (Lama Construction Pvt. Ltd., CE Construction Pvt. Ltd., Himalayan Builders and Engineers, High Himalayan Hydro Construction Pvt. Ltd, Arun III Hydropower Project etc.), where responses coined that they have given the importance of safety culture, safety climate, hazard management, safety worker behaviour, and safety training as main concentration. Out of 500 questionnaires distributed, 357 respondents submitted the response. Among 357 returned responses, 37 respondents were found filling the questionnaire incompletely. Therefore, 320 responses were taken as valid responses out of 500 responses. The total valid responses fulfil the rule of thumb for respondent magnitude which is essential in PLS-SEM [61]. Around 67% of the data were collected from field-based data collection and rest were collected through email or phone interviews.

The diagram presented below (Figure 2) clarifies that among 320 valid responses, half of the sample population were aged >30 years. Similarly, more than 50% of the respondents had education above the undergraduate level and almost 60% of them have a clear understanding of safety performance. Also, 47% of them have 4-6 years and an almost equal percentage of them had working experience of 0-3 years and 7-9 years. Overall, the majority of the respondents are aware of construction engineering practice, which improvises data quality from respondents and strengthens the study output to some extent.







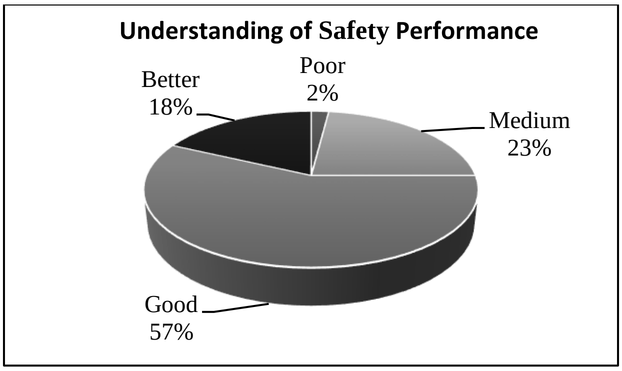


Fig. 2. A statistical study among 320 valid respondents

B. *Questionnaire design*

From the above literature review, 35 indicators of 6 constructs are used to design questionnaires. To reduce respondent's anxiety, indicators of each construct are tabulated separately as shown in table I. Likert scale is used in a questionnaire with (1=Strongly Agree; 2=Agree; 3=No opinion; 4=Disagree; 5=Strongly Disagree). The respondent can honestly select a number from 1 to 5 based on their view and working environment. For this statement, the higher the agreement in the statement of indicators, the lower will be the selection range for the respondent. The questionnaire is designed with a focus to eliminate common method bias [62, 63]. A pilot survey was done with five project managers to confirm the clarity of the question and as per the guidance questions were reformed to procure content validity.

TABLE I
CONSTRUCT FACTORS ALONG WITH ITS CORRESPONDING INDICATORS

Latent factor	Code	Indicator factor	Supporting sources
Hazard Management	HM1	I feel that everyone plays an active role in identifying site hazards.	[14]
	HM2	Detecting potential hazards is a major aim of the site planning exercise.	[14]
	HM3	We know the overall hazards in our project.	[14]
Safety Climate	SCL1	My supervisor reports incidents periodically and revises my behaviours to improve my performance.	[30]
	SCL2	Proper incentives can encourage me to perform my work safely and efficiently.	[30]
	SCL3	The company provides legally contracts, accident and medical insurance for employees.	[30]
	SCL4	Co-workers often help me with safety-related issues and correct my unsafe behaviours.	[30]
	SCL5	Work hours, pressure and intensity there are reasons to avoid fatigue poor work performance.	[30]
	SCL6	We keep smooth communication and give us advice rather than a top-down flow of ideas.	[30]
Safety Worker behaviour	WB1	I comply with safety rules and procedures	[38]
	WB2	I routinely review standard operating procedures before starting	[38]
	WB3	I keep myself in a good mental and physical state	[38]
	WB4	All workers and employees enjoy their jobs at sites	[18, 40]
Safety Culture	SCU1	Top management adopts the right resource allocation and governance to guarantee safety.	[30]
	SCU2	When I make a mistake, I am not afraid to report it to my supervisor.	[35]
	SCU3	My supervisor is usually available when I have a question or problem	[35]
	SCU4	I am willing to participate in the safety training, from which I can benefit and learn a lot.	[30]
	SCU5	There are policies to promote the direct involvement of employees in decisions affecting their jobs.	[30]
	SCU6	Some characteristics as justice, rigor, clear right and duty and good operability.	[30]
Safety Training	STT1	My company gives comprehensive training to employees regarding workplace health and safety issues.	[64]
	STT2	Newly recruits are trained adequately to learn safety rules and procedures.	[64]
	STT3	Safety issues are given high priority in training programs.	[64]
	STT4	I am not adequately trained to respond to emergencies in my workplace.	[64]
	STT5	Management encourages workers to attend safety training programs.	[64]
	STT6	Safety training given to me is adequate to enable me to assess hazards in the workplace.	[64]
Safety Performance	SP1	Pathways of workplaces are neat and tidy in my company	[65]
	SP2	Machinery is equipped with good safeguards in my company.	[66]
	SP3	Electrical equipment is with good safeguards in my company.	[66]
`	SP4	Hazardous workplaces are equipped with good ventilation in my company	[66]

Latent factor	Code	Indicator factor	Supporting sources
	SP5	My company provides employees with Personal Protective Equipment (PPE).	[66]
	SP6	My company implements the measurement of hazardous environments periodically.	[65]
	SP7	My company establishes safety & health labels/signage in the workplace	[65]
	SP8	My company carries out self-inspections	[65]
	SP9	My company keeps/saves self-inspection records properly	[65]

V. RESULT

A. PLS-SEM model testing and result

This research used PLS-SEM, specifically Smart PLS Version 3.2.8, and SPSS V 23 to estimate the model. PLS-SEM is suitable for small sample-sized data and which are not normally distributed [67, 68]. Besides the benefit of PLS-SEM is it has higher statistical power which is best to use in the exploratory study [69]. Initially, a preliminary analysis was carried out to confirm the fitness of data for PLS-SEM modelling. Secondly, PLS-SEM validity of measurement and structural model along with hypotheses test were carried out. Here, the measurement model fixes the relationship between constructs and attributes while the structural model determines the relationship between constructs and unobserved variables [70, 71]. Lastly, the evaluation matrix was carried out to, the identified the real condition of all categories of construction in terms of safety performance.

B. Preliminary analysis

The content validity of questionnaire was confirmed by using earlier tested and validated scales from different literatures to measure the designated variable used in this study. Moreover, it was assured by the panel of experts via backward-forward translation of questionnaire. We also ensured the secrecy of the respondents identify and used both other-report along with self-report survey instead of merely self-report replies [72, 73].

During data screening, a few missing values were found which were replaced with the mean of the corresponding non missing values [74]. We used item parcel instead of items common in data analysis for gaining more stable parameters estimates and a simplification of model explanation [75]. This research assembled items of SCU, STT, SCL, WB and SP constructs into combined variables as shown in fig.1

As all data accumulated from a common source at one point of time Common Method Bias (CMB) may be a challenge [76]. Harmon's one-factor test was carried out by using SPSS to evaluate CMB. The output showed that there is the nonappearance of CMB from the data set as the first factor explained only, 25.08% which is less than the threshold value (50%). Similarly, by using AMOS the indices of model fit showed that the final model had acceptable fit (X2/df = 2.822, GFI = 0.82, CFI= 0.904, TLI= 0.894, RMSEA = 0.076 and Standardized RMR = 0.0521) after sketch few covariance among the error terms of the terminated items. All the values were in the good range from the threshold value [77]. Moreover, by using SPSS, all the Durbin-Watson values were close to 2, representing that the data were free from autocorrelation [78].

C. Analysis and validity of the measurement model

The initial procedure of PLS analysis is to manipulate the reliability and validity of the measurement model. Indicator loading, Average Variance Extracted (AVE), Composite reliability (CR) and Cronbach's alpha (CA) were estimated as shown in table II. Indicator loading value was higher than 0.7 with the respective construct showed the reliability [79]. Similarly, CR and CA of all constructs in the model were above 0.7 which specifies internal consistency reliability [70]. All the constructs exhibit average variance extracted value (AVE) above the cut off level 0.5 which indicates convergent validity [80, 81]. The discriminant validity was evaluated using Fornell and larker criteria, Heterotrait-Monotrait Ratio (HTMT) and cross-loadings.

TABLE II
RESULT OF INDICATOR AND CONVERGENT VALIDITY

Construct	Items	Loading [a]	AVE[b]	CR[c]	CA[d]
Hazard Management	HM1	0.929	0.852	0.945	0.913
	HM2	0.923			
	HM3	0.913			
Safety Climate	SCL1	0.813	0.726	0.941	0.926
	SCL2	0.830			
	SCL3	0.864			
	SCL4	0.847			
	SCL5	0.911			
	SCL6	0.841			
Safety Culture	SCU1	0.808	0.729	0.942	0.926
	SCU2	0.858			
	SCU3	0.881			
	SCU4	0.834			
	SCU5	0.870			
	SCU6	0.868			
Safety training	STT1	0.850	0.733	0.95	0.942
	STT2	0.871			
	STT3	0.863			
	STT4	0.858			
	STT5	0.818			
	STT6	0.857			
	STT7	0.874			
Worker Behaviour	WB3	0.939	0.878	0.935	0.861
	WB4	0.936			
Safety Performance	SP1	0.845	0.665	0.941	0.928
	SP2	0.826			
	SP4	0.762			
	SP5	0.807			
	SP6	0.827			
	SP7	0.814			
	SP8	0.819			
	SP9	0.820			

Note: This table shows indicator items loading, average variance extracted (AVE), composite reliability (CR) and Cronbach alpha (CA) values for evaluating the measurement value of the construct's indicator in the model. An indicator loading value larger than 0.5 shows the indicator reliability [79]. CR and Cronbach's alpha values larger than 0.7 show the internal consistency reliability [70]. The AVE value greater than 0.5 signifies the convergent validity [80, 81]. Items SP3, WB1, and WB2 are removed as its loading is below 0.5.

Similarly, Table III displays the cross-loading of all consistent apparent variable has a higher value compared to their linked latent variable with other cross-loadings [82, 83]. The bold element in the diagonal indicators item cross-loading on its construct.

TABLE III
DISCRIMINANT VALIDITY: INDICATOR ITEMS CROSS-LOADING

	Hazard Mgmt.	Safety Climate	Safety Culture	Safety Perfor -mance	Safety Training	Worker Behaviour
HM1	**0.916**	-0.159	-0.150	0.253	-0.172	0.352
HM2	**0.933**	-0.160	-0.076	0.300	-0.125	0.255
HM3	**0.920**	-0.195	-0.106	0.260	-0.125	0.246
SCL1	-0.072	**0.819**	-0.122	0.281	-0.080	0.170
SCL2	-0.191	**0.839**	-0.075	0.191	-0.227	0.099
SCL3	-0.202	**0.866**	-0.083	0.188	-0.205	0.116
SCL4	-0.202	**0.845**	-0.087	0.208	-0.198	0.137
SCL5	-0.129	**0.906**	0.009	0.335	-0.137	0.234
SCL6	-0.216	**0.837**	0.019	0.178	-0.223	0.127
SCU1	-0.170	0.029	**0.800**	0.233	-0.134	0.195
SCU2	-0.079	-0.083	**0.862**	0.329	-0.127	0.200
SCU3	-0.120	-0.008	**0.882**	0.278	-0.135	0.183
SCU4	-0.099	-0.125	**0.834**	0.221	-0.183	0.158
SCU5	-0.095	-0.093	**0.874**	0.240	-0.198	0.140
SCU6	-0.067	-0.049	**0.866**	0.281	-0.185	0.209
SP1	0.233	0.305	0.245	**0.843**	0.156	0.620
SP2	0.210	0.323	0.187	**0.824**	0.261	0.568
SP4	0.260	0.206	0.245	**0.761**	0.131	0.535
SP5	0.282	0.174	0.279	**0.814**	0.136	0.413
SP6	0.273	0.198	0.274	**0.829**	0.146	0.540
SP7	0.197	0.281	0.288	**0.817**	0.164	0.531
SP8	0.211	0.208	0.280	**0.817**	0.218	0.534
SP9	0.258	0.153	0.257	**0.817**	0.237	0.559
STT1	-0.075	-0.096	-0.129	0.260	**0.850**	0.356
STT2	-0.159	-0.214	-0.171	0.182	**0.871**	0.179
STT3	-0.185	-0.224	-0.195	0.096	**0.863**	0.121
STT4	-0.135	-0.213	-0.171	0.129	**0.858**	0.184
STT5	-0.134	-0.172	-0.162	0.148	**0.818**	0.146
STT6	-0.193	-0.201	-0.175	0.143	**0.857**	0.128
STT7	-0.131	-0.151	-0.152	0.249	**0.874**	0.202
WB3	0.236	0.178	0.216	0.660	0.278	**0.941**
WB4	0.352	0.169	0.184	0.580	0.195	**0.933**

Note: This table shows that cross-loading of all consistent apparent variable has a higher value in comparison to their linked latent variable when tying with another cross-loading (Chin 1998; Chin 2010b).

The HTMT ratio of correlations between the model constructs is reported in table IV. Heterotrait-Monotrait Ratio (HTMT) value is under the threshold of 0.9 [84] as displayed in Table IV.

TABLE IV
DISCRIMINANT VALIDITY: HETEROTRAIT-MONOTRAIT RATIO (HTMT)

	HM	SCL	SCU	SP	STT	WB
HM						
SCL	0.216					
SCU	0.132	0.104				
SP	0.321	0.287	0.335			
STT	0.18	0.24	0.208	0.214		
WB	0.349	0.193	0.236	0.736	0.241	

Note: This table shows that Heterotrait-Monotrait Ratio (HTMT) value is under the threshold of 0.9 [84].

Similarly, Table V illustrates the square root of AVE values for each construct and its correlation with other constructs. The bold values are square root AVE values which met the discriminant validity as it is greater than its correlation coefficient with other constructs.

TABLE V
DISCRIMINANT VALIDITY (FORNELL AND LARKER CRITERIA)

	HM	SCL	SCU	SP	STT	WB	Discriminant validity Met?
HM	**0.923**						Yes
SCL	-0.185	**0.852**					Yes
SCU	-0.121	-0.063	**0.854**				Yes
SP	0.293	0.287	0.314	**0.816**			Yes
STT	-0.154	-0.196	-0.185	0.223	**0.856**		Yes
WB	0.312	0.185	0.214	0.663	0.254	**0.937**	Yes

Note: This table represents that diagonal item which is printed boldly is higher and the square root of the Average Variance Extracted (AVE) latent variable which indicates highest in any column and row. The non-diagonal numbers except bold diagonal items signify correlations of the construct with other constructs [85].

D. Evaluation of structural model

Collinearity test, structural model path coefficient, evaluating the level of R^2, effective size f^2, and predictive relevance Q^2 are major five steps to measure the structural model [86]. Table VI shows that all direct relation is supported, worker behaviour has a higher path coefficient of 0.506 which shows that it contributes to the higher value of variance and greater effect towards safety performance. Higher the beta value corresponding to the t-value higher will be the corresponding relation, where the t-value should be greater than 1.96 at a 5% significance level [61].

Value of Coefficient of determination (R^2) in the PLS path model, a value greater or equal to 0.67, 0.33 and 0.19 are considered as strong, reasonable and poor respectively [82]. The R^2 value of the endogenous latent variable, safety performance and worker behaviour were 0.542, 0.437 respectively which is moderated value. The f^2 value of 0.020, 0.15, and 0.33 was poor, moderate and strong structural range respectively [2, 87]. All f^2 value in table VIII, was in the threshold range. Finally, with blindfolding process, all Q^2 values were assessed in table VIII where all Q^2 value was above zero which supported predictive relevance of the structural model for all endogenous construct [88].

Furthermore, the PLS path modelling was first tested for direct effects and then subsequent analyses were performed to evaluate the indirect effect by WB as mediating mechanisms. In conceptual model, WB to SP relationship with direct effect 0.742 is used to calculate all indirect effect to all corresponding relation. For example, indirect effect of HM →WB →SP relationship is calculated by multiplying direct effect of HM →WB and WB →SP (i.e. 0.438 * 0.742 = 0.325). The significance of direct and indirect effect can be studied by t-values during bootstrapping in Smart PLS software. The tested all the t-values of direct and indirect effect of model are greater than minimum threshold value 2.58 at 1% level of significance[2]. Where, minimum t-value is 2.593 and maximum t- value is 24.408 as shown in Appendix B.

TABLE VI
TESTING THE HYPOTHESES IN THE STRUCTURAL MODEL (DIRECT)

Hypothesis	Relation	Std. Beta	Std. Error	t- value	P Values	Decision	1% CILL	99% CIUL
H1(a)	HM → SP	0.215	0.042	5.082**	0	Supported	0.118	0.312
H1(b)	HM →WB	0.506	0.045	11.176**	0	Supported	0.398	0.612
H1(c)	SCL →SP	0.250	0.039	6.381**	0	Supported	0.156	0.339
H1(d)	SCL →WB	0.398	0.048	8.367**	0	Supported	0.283	0.502
H1(e)	SCU →SP	0.249	0.042	5.903**	0	Supported	0.149	0.350
H1(f)	SCU→WB	0.390	0.045	8.686**	0	Supported	0.270	0.486
H1(g)	STT →WB	0.481	0.046	10.427**	0	Supported	0.369	0.576
H1(h)	WB →SP	0.496	0.048	10.321**	0	Supported	0.377	0.596

Note: t-value >= 1.96 at p = 0.05 level, t-value >= 2.58 at p = 0.01 level**, t-value >= 3.29 at p = 0.001 level***

The result of collinearity assessment is shown in table VII, where the Variance Inflation Factor (VIF) was below threshold value 5, which specifies that data were free from multi-collinearity problem [84].

TABLE VII
INDIRECT RELATIONSHIP (MEDIATION) FOR HYPOTHESIS TESTING

Hypo thesis	Relationship	Std. Beta	Std. Error	t- value	P Values	Decision	1%CILL	99% CIUL
H2(a)	HM →WB →SP	0.251	0.035	7.220**	0	Supported	0.175	0.336
H2(b)	SCL→WB →SP	0.197	0.032	6.172**	0	Supported	0.124	0.272
H2(c)	SCU→WB→SP	0.193	0.035	5.511**	0	Supported	0.115	0.276
H2(d)	STT→WB →SP	0.239	0.039	6.181**	0	Supported	0.151	0.322

Note: t-value >= 1.96 at p = 0.05 level*, t-value >= 2.58 at p = 0.01 level **, t-value >= 3.29 at p = 0.001 level.

From table V and table IX we can say that mediation is complementary partial mediation of worker behaviour as both direct and indirect relationships supported in a positive direction [90]. Moreover, all the mediation hypothesis was supported at t-value >= 2.58 at p = 0.01 level ** (significant at 1%). Here, worker behaviour (WB) mediates more to HM→SP relationship with a higher path coefficient of 0.251 which shows that it contributes to the higher value of variance and greater effect towards safety performance.

TABLE VIII
MODERATION FOR HYPOTHESIS TESTING

Hypo thesis	Relationship	Std. Beta	Std. Error	t- value	P Values	Decision	5% CILL	95% CIUL	f^2
H3(a)	STT*HM→WB	0.014	0.038	0.378	0.353	Un supports	-0.059	0.065	0.378
H3(b)	STT*SCL→WB	-0.040	0.053	0.752	0.226	Un supports	-0.186	0.014	0.001
H3(b)	STT* SCU →WB	0.092	0.114	0.809	0.209	Un supports	-0.232	0.181	0.004

Note: t-value >= 1.96 at p = 0.05 level*, t-value >= 2.58 at p = 0.01 level, t-value >= 3.29 at p = 0.001 level

All the moderation hypothesis was unsupported with P- value greater than (p>0.05) as shown in table X. Moreover, moderating STT*HM →WB and STT*SCU →WB had a positive effect with path coefficient and STT*SCL→WB had negative path coefficient but weren't significant at 5% interval level.

TABLE IX
RESULT OF COLLINEARITY ASSESSMENT

Predictor Construct	Dependent Variable	VIF
Hazard Management	Worker Behaviour	1.114
Safety Climate	Worker Behaviour	1.116
Safety Culture	Worker Behaviour	1.083
Hazard Management	Safety Performance	1.260
Safety Climate	Safety Performance	1.143
Safety Culture	Safety Performance	1.125
Worker Behaviour	Safety Performance	1.307
Safety Training	Safety Performance	1.145

Note: In the table, all VIF values are below 5, which shows that there is no strong indication or absence of multicollinearity [61, 89].

TABLE X
EVALUATING VALUE OF F^2, Q^2

Predictor	Endogenous	Effective Size(f^2)	predictive relevance(Q^2)
Hazard Management	Worker Behaviour	0.409	0.304
Safety Climate	Worker Behaviour	0.252	0.183
Safety Culture	Worker Behaviour	0.249	0.182
Safety Training	Worker Behaviour	0.360	0.263
Hazard Management	Safety Performance	0.080	0.031
Safety Climate	Safety Performance	0.119	0.051
Safety Culture	Safety Performance	0.121	0.051
Worker Behaviour	Safety Performance	0.411	0.001

Note: The f^2 value of 0.02, 0.15, and 0.33 is poor, moderate and strong structural range respectively [2, 87] . Moreover, Q^2 value is above zero which supported the predictive relevance of the structural model for all endogenous constructs [88].

E. Evaluation process

Many researchers had used numerous methods for evaluation but in this research, we chose a systematic approach for evaluation of safety performance based on SEM. SEM gives a feasible causal relationship and statement between goals and enablers of safety performance. Generally, this evaluation method contains three phases as shown below.

Evaluation matrix

There is no doubt that workers are familiar with the major problem of the real field and weakness of performance level. The collected data is divided into 3 groups: private, public and INGOs construction firms. Further, data was assessed using 12 indicators of SCU and SCL constructs for safety worker behaviour for the desired safety performance. The result from the above analysis has shown the positive significance of WB to SP (Table VI). Hazard management indicators were not used as it only had 3 indicators which were not applicable for multi-dimensional data to form an evaluation matrix. The judgment level was used as in the questionnaire for latent construct factor, which is represented by:

R_{ij}^{ln}= (i=1, 2, j=1, 2, 3, 4, 5, 6; l=1, 2, 3; n=1, 2, 3, 4, 5) (1)

Here, 'i' represents a number of predictor constructs and 'j' represent a number of indicators of each construct. Similarly, 'n' represents the base of judgment ranging 1 (completely agree) to 5 (completely disagree) and 'l' represents the category of construction firms. Higher the judgment better will be the safety worker's behaviour in the site. Evaluation of safety worker behaviour was divided into 5 segments: V (excellent), IV (good), III (fair), II (poor) and I (very poor). The fraction of each indicator was represented by R_{ij}^{ln} which was calculated by eq^n (2). The evaluation matrix for the fraction sharing of ith from regarding lth construction type was represented by the vectorR_i^l, is as shown in eq^n (3).

$$R_{ij}^{ln} = \frac{a_{ij}^{ln}}{\sum_{n=1}^{5} a_{ij}^{ln}} \text{ i= 1, 2; j=1, 2, 3, 4, 5, 6; l=1, 2, 3; m = 1, 2, 3, ….5} \quad (2)$$

$$R_i^l = \begin{bmatrix} R_{i1}^{l1} & R_{i1}^{l2} & R_{i1}^{l3} & R_{i1}^{l4} & R_{i1}^{l5} \\ R_{i2}^{l1} & R_{i2}^{l2} & R_{i2}^{l3} & R_{i2}^{l4} & R_{i2}^{l5} \\ R_{i3}^{l1} & R_{i3}^{l2} & R_{i3}^{l3} & R_{i3}^{l4} & R_{i3}^{l5} \\ R_{i4}^{l1} & R_{i4}^{l2} & R_{i4}^{l3} & R_{i4}^{l4} & R_{i4}^{l5} \\ R_{i5}^{l1} & R_{i5}^{l2} & R_{i5}^{l3} & R_{i5}^{l4} & R_{i5}^{l5} \\ R_{i6}^{l1} & R_{i6}^{l2} & R_{i6}^{l3} & R_{i6}^{l4} & R_{i6}^{l5} \end{bmatrix} \quad (3)$$

Weight determination

Path coefficient value from the PLS model was implemented after verification of supported discriminant and convergent validity (Table I, II, III, and IV & V). σ_{ij}= (i=1, 2, j=1, 2, ...,6) which demonstrates the value of path coefficient of jth indicator in ith form (table VI). The jth indicator weight in ith indicator was denoted by β_{ij}, the calculated value from eq^n (4). All indicator in ith form was specified by eq^n (5). Likewise, let xi (i=1, 2) symbolize the value of path coefficient in the ith form where ith form weight was represented by wi, obtained by eq^n (6). All the aspects of weight can be calculated by using eq^n (7).

$$\beta ij = \frac{\sigma_{ij}}{\sum_{j=1}^{6} \sigma_{ij}}, \text{ i=1, 2; j=1, 2..6} \quad (4)$$

$$B_i = \beta i = [\beta i1\ \beta i2\ \beta i3\ \beta i4\ \beta i5\ \beta i6] \quad (5)$$

$$wi = \frac{x_i}{\sum_{i=1}^{6} x_i}, \text{ i=1, 2} \quad (6)$$

$$W= [w1\ w2] \quad (7)$$

Calculation and result

The efficient measurement of safety worker behaviour helps in decision making and inspires to find safety performance in construction sites. Based on evaluation matrix R_i^l and weight matrix B_i, the extensive evaluation vector of the ith indicator regarding lth construction group, denoted by Q_i^l was calculated by eqn (8). Likewise, the extensive evaluation vector of the lth construction stands as Q^l which was calculated by eq^n (9). The Maximum Degree of Membership (MDM) principle [91] was applied where the level of safety worker behaviour evaluation was recognized in such a way that maximum value within five-level was taken as a final result. For example, Q^l with spreading (0.2, 0.3, 0.25, 0.27, 0.28) as (very poor, poor, fair, good, excellent), it is evaluated as II (Poor) as in the second level it had maximum value among all five-level.

$$Q_i^l = B_i \ x \ R_i^l = [P_i^{l1}\ P_i^{l2}\ P_i^{l3}\ P_i^{l4}\ P_i^{l5}], \text{ i=1, 2…5; l=1, 2, 3} \quad (8)$$

$$Q^l = W \ x \begin{bmatrix} Q_i^{l1} \\ Q_i^{l2} \end{bmatrix} \quad (9)$$

Analysis of results

To summarize the calculation process, an example was taken SCL1 indicator from construction with a respondent reply in each judgment level as shown in table XI. By operating the evaluation matrix R_i^l of safety climate of INGOs, the construction site was calculated by eq^n(2). Weightage of indicator of SCL and SCU construct were calculated βi [0.133279 0.284581 0.497154 0.515952 0.284202] from eq^n (4). The weight of the SCL and SCU construct was determined as W [0.505 0.495] from eq^n (6). Finally, evaluation outcome of safety worker behaviour construct was obtained as Q^l = [0.123810145 0.310196755 0.44292477 0.56599056 0.27464751]. As per the MDM principle, it was a fourth (IV) level which is a good range.

TABLE XI
RESPONDENT JUDGEMENT ON SAFETY CLIMATE OF INGOs CONSTRUCTION SITE

S. N	Judgment: Completely agree (I)	Agree (II)	Fair (III)	Disagree (IV)	Completely disagree (V)
SCL1	15	34	66	61	35
SCL2	10	34	73	67	27
SCL3	18	31	56	88	18
SCL4	16	39	64	62	30
SCL5	20	36	54	41	60
SCL6	19	36	55	63	38

$$R_i^l = \begin{bmatrix} 0.122 & 0.276 & 0.537 & 0.496 & 0.285 \\ 0.081 & 0.276 & 0.593 & 0.545 & 0.220 \\ 0.146 & 0.252 & 0.455 & 0.715 & 0.146 \\ 0.130 & 0.317 & 03.520 & 0.504 & 0.244 \\ 0.163 & 0.293 & 0.439 & 0.333 & 0.488 \\ 0.154 & 0.293 & 0.447 & 0.512 & 0.309 \end{bmatrix}$$

TABLE XII
FINAL OUTPUT OF SAFETY PERFORMANCE WITH RESPECT TO 3 VARIOUS CONSTRUCTION INDUSTRY TYPES

Category	Evaluation distribution: I (Very Poor)	II (Poor)	III (Fair)	IV (Good)	V (Excellent)
Public construction	0.10064	**0.33347**	0.24862	0.20178	0.07193
INGOs construction	0.12381	0.31020	0.44292	**0.56599**	0.27465
Private construction	0.15859	**0.34164**	0.25825	0.17195	0.07405

F. KMO, BARTLETT'S test and model fit verification in structural Equation Model by using SPSS AMOS.

TABLE XIII
RESULT ON KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin (KMO)		0.883
Bartlett's Test of Sphericity	Approx. Chi-Square	9527.068
	Df	595
	Sig.	0.000

Note: KMO<0.7 and Bartlett's Test of Sphericity (>0.05) is in excellent range than threshold value[92].

The KMO value should be greater than 0.7 during

Exploratory Factor Analysis and the Bartlett value should be relevant for a p-value smaller than 0.005. Here, KMO (0.883>0.7) suggested sufficient items for each model factor and Bartlett's Sphericity Test (p<0.001) suggested that the matrix of correlation was significantly different from the matrix identified [92].

G. Assessment of normality

Overall, kurtosis and skewness value meet the threshold value as shown in Appendix A. In general, Kurtosis and skewness values must be within range of -1.96 to +1.96 for normal distribution [93]. Prior study suggested that kurtosis is more relevant than skewness during SEM modelling as skewness only has huge impact on mean whereas kurtosis impact tests of covariance and variances [94]. In SEM analysis, the "maximum" and "minimum" standard deviation estimates are often not defined [95, 96].

H. Power analysis

Power analysis in the PLS model is important to ensure process reliability with respect to sample size implications. We've used G-power (3.0.10) tools to check model power analysis as prior study used in their work [2]. Implementation of this software at 5% significance level, with an effective size of 0.506 as the maximum path coefficient along with 4 model predictors, we achieved 100% with a sample size of 80 as shown in fig.3. Therefore, it is apparent that the sample size used in the analysis is adequate to obtain sufficient power.

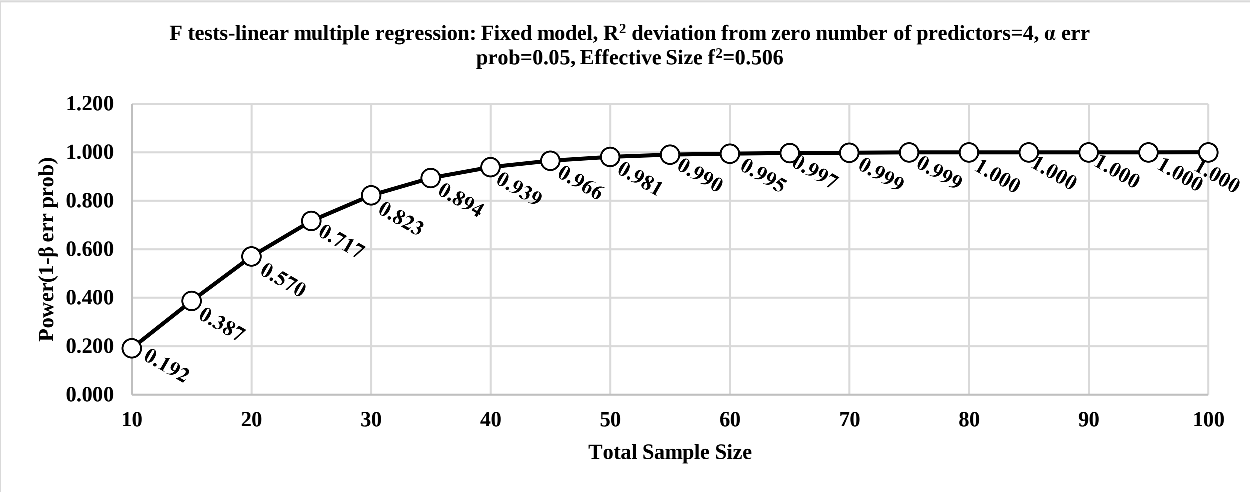


Figure 3: Power Analysis for Adequacy of sample Size

VI. DISCUSSION

The given figure illustrates the major outcome concerning the worker behaviour studied in this research. The R^2 values of WB and SP constructs are 0.437 and 0.542 respectively. Similarly, the Q^2 value of WB and SP constructs is 0.362 and 0.333 respectively. This result shows a satisfactory level of PLS path models and significant predictive accuracy [68]. The estimations of path coefficient, effective size, hypothesis test in direct, indirect and moderation relationship are discussed in fig.4 as below.

All proposed direct hypothesis was supported at 1% of a significant level as shown in table VI. Hazard Management, Safety Climate, Safety culture, and Safety training have a positive influence on the extent of worker behaviour, which is proved as H1(b), H1(d), H1(f) and H1(g) hypothesis. An increase in one standard deviation of the HM, SCL, SCU & STT constructs will increase 50.6%, 39.8%, 25% & 48.1% respectively to standard deviation of WB at (f^2= 0.409, p<0.01), (f^2=0.252, p<0.01) (f^2=0.249, p<0.01) & (f^2=0.36, p<0.01) respectively. It concludes that HM influences WB more than another construct in the model. The derived output found supporting the statements made by previous

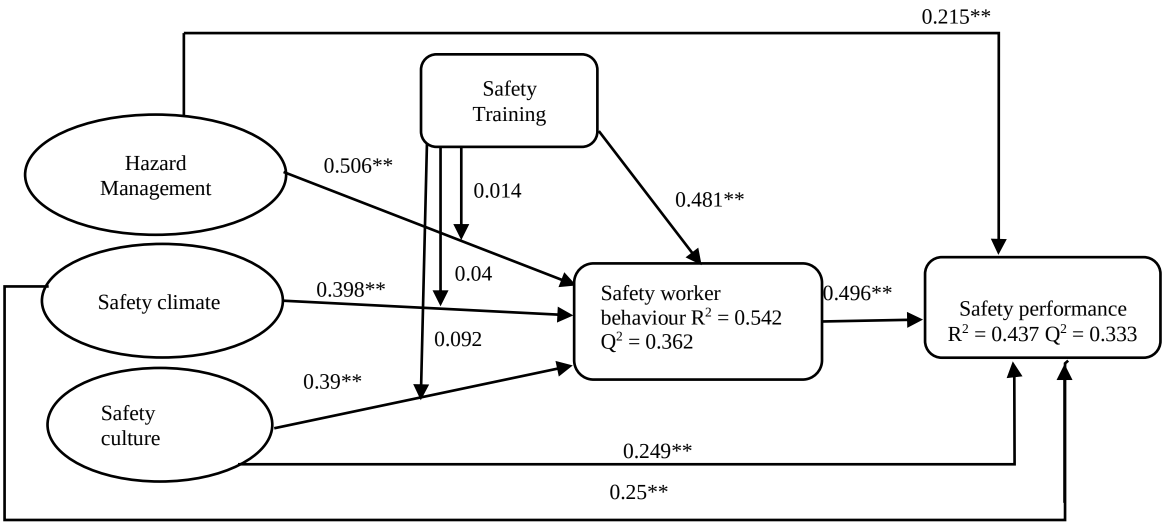


Fig. 4. The main result of the Safety Performance with ** represented a significant level at 1 percent

researchers. Equivalent to H1(b) of this study, Patel and Jha also stated that determining hazards feature leads to safer worker behaviour between labours in a construction firm [14]. The earlier researcher stated that proper application of safety climate will promote and boost safety worker behaviour [47, 48] which is supporting the H1(d). Similarly, Cooper mentioned that safety culture comfort by acting significant lever in handling the worker behaviour in their daily work task in a project [50] which is supporting the H1(f). Moreover, other earlier researchers have claimed that construction firms can upgrade employer safety behaviour by awareness of health and safety practice training and conference [39, 42] that supports the study's H1 (g).

Similarly, Hazard Management, Safety Climate, and Safety Culture have a positive influence on the extent of Safety Performance, which supports H1(a), H1(c) and H1(e) hypothesis. An increase in one standard deviation of the HM, SCL & SCU constructs will increase 21.5%, 25% & 24.9% respectively to standard deviation of SP at (f^2= 0.08, $p<0.01$), (f^2=0.119, $p<0.01$) & (f^2=0.121, $p<0.01$) respectively. Worker Behaviour has a positive influence on Safety Performance in a construction site and with an increase of one standard deviation, the WB construct will increase 49.6% to the standard deviation of SP construct at f^2= 0.411, $p<0.01$, which support H1(h). Some previous researchers have stated that the practice of identifying and assessing hazards leads to improve the safety performance of construction firm [23, 46] which supports H1(a). Earlier researchers confirmed that safety climate is a predictor of construction safety performance [97, 98] which supports H1(c). The previous study mentioned that safety culture is empirically and statistically important to safety performance in the nuclear power industry in the USA [35] support H1(e). The actual measure of safety behaviour can progress safety performance significantly [11, 99] supports H1(h).

All Mediation relationship (H2(a)-H2(d)) is complementary partial mediation of worker behaviour as both direct and indirect relationship supported in positive direction i.e. path coefficient of direct relationship and indirect relationship are positives shown in table VI& IX [90]. For example, relationship HM →WB →SP has a positive path coefficient 0.251 from table IX and relation HM →WB with positive path coefficient 0.506 & relation WB →SP positive path coefficient 0.496 in table VI. This shows that the relationship HM →WB →SP is complementary partial mediation. From past literature, proper HM progresses the work behaviour of labours and so do the safety performance in construction firm [18, 23] support H2(a). Similarly, safety climate and safety performance (accidents & injuries) were mediated by worker behaviour [53] support H2(b). Safety Culture as a sub-face of firm culture, which is thought to impact worker behaviour concerning safety performance [49] supports H2(c) empirically. And the strength of safety training in explaining safety performance outcomes is a true means of shaping workers' safety behaviours [51] to support H2(d) empirically.

Table X shows the Path coefficient of moderating STT*HM →WB and STT*SCU →WB has a positive effect on the path coefficient but isn't significant at a 5% interval level. HM, the construct has a large effect with WB with f^2 = 0.409. While the SCL & SCU constructs have medium effect with WB with effective size f^2 = 0.254 & f^2 = 0.249 respectively [100]. Proper safety training is compulsory for detecting hazards [54] and proper hazard management upgrades the behaviour of workers that leads to improvement of safety performance in the firm [18, 23]. The logic behind the insignificance of H3(a) can be perceived as; inadequate safety training hurdle identifying the hidden hazard and degrade the safety behaviour & safety performance of the firm. Besides, researcher exposed that regular improvement in training and education upgrades the safety awareness to the workers which improve the safety culture of the project [34] and safety culture comforts by acting significant level in handling the worker behaviour in their daily work task in a project [50]. In contrast, the study showed insignificance for H3(b) which relates to the above statement by Copper and Fang and the researcher can conclude that inadequate safety training program and knowledge on return on investment (ROI) from safety training for the worker results in incompetency and lapse the safety behaviour. Moreover, proper safety training can upgrade the level of safety climate and its applicable features in a construction firm. Some earlier studies discovered that effective safety training programs can change labours' unsafe behaviours [10]. Referring to this, unsupported hypotheses H3(c) might have a conclusion that weak participation of a worker in safety training, inadequate or improper demonstration of safety procedure will degrade the safety climate and results in negligible improvement in safety behaviour of worker.

The researcher conducted an informal interview with the respondents to find out the reason for the failure of the moderation hypothesis. Through the responses, it was noticed that inexperienced and untrained employers are appointed, whereas they mentioned that they have been appointed and trained before going to the workplace to show such documentation to the government. Besides, it is also noticed that some safety training used to be conducted after fatal accidents on-site or under the pressure of employer to a construction firm in the intention to show evidence. Moreover, in some cases, the passive participation of workers for safety training is also a cause of an insignificant moderation hypothesis. This result coincides with prior study in Pakistani construction [20]. Hence, the study concluded that the moderating effect of STT on HM, SCL& SCU for better WB cannot be obtained significant.

From the evaluation matrix table XII, it shows that private and public construction firms show poor safety worker behaviour in construction firm whereas INGOs shows good safety worker behaviour in the site. In INGOs, safety is concerned as a major part though is unable to meet an excellent level. Whereas in both public and private construction safety worker behaviour practice is a poor level, which is a major reason for the accident, hazard in the construction sites of Nepal.

VII. CONCLUSION

To the best of our knowledge, this is the first work to present the mediation role of safety worker behaviour (WB) and moderation role of safety training (STT) for the better safety performance of construction sites. To manage safety in Nepal construction firm is a huge challenge as it is a complex and interdisciplinary aspect. The main conclusion of the research is as follows:

1) The managerial level should focus on safety worker behaviour in the construction site. Besides, safety climate, safety culture, safety training, and hazard management also need to be upgraded as they positively influence the safety worker's behaviour. It is concluded that HM positively influences WB more than other constructs in the model.
2) The results confirm the hypothesis from H2(a) to H2(d) as mediation relation is complementary partial mediation. Hence, it focuses on the importance of the safety worker behaviour of the employer in the construction site and its mediation influence on HM, SCU, SCL for better improvement of the safety performance of the construction site. It can be considered that WB as mediation between HM and SP has a more positive relationship than other mediation relations.
3) From the moderation analysis, it can be concluded that safety training is found to be less considered. The shortage of knowledge about return on investment (ROI) for safety training by managerial level, leads to unidentified hidden hazard, injury or fatal accident that frequently occurs in the construction site. Besides, passive participation of workers in safety training, improper demonstration of safety procedures from where workers acquire safety knowledge by managerial level degrades safety worker behaviour and safety performance of construction firms.
4) Evaluation matrix concludes the relation between SCL &SCU with WB is poor level in both public and private construction site but the good level in INGOs construction site. So, both private and public construction organizations need to improve safety climate and safety culture for progressive safety worker behaviour.

VIII. THEORETICAL IMPLICATION

By recognizing the backgrounds of the impact of Safety Worker Behaviour on Safety Performance in the construction firm of Nepal, which is a developing country in South Asia, we have assisted to address the gap in contextualized information on safety worker behaviour. Furthermore, the reliability of our findings and those of earlier studies conducted in developing and developed countries indicates that Safety Worker Behaviour is a worldwide concept rather than a context-specific concept.

The application of SEM to research on the impact of Safety Worker Behaviour as mediation and moderation role of Safety Training on Safety Performance in construction firm also organizes a novel role to the literature and fills a methodological gap. Furthermore, this is the first study of safety worker behaviour on safety performance in a construction firm in the context of Nepal using SEM.

Implications for Manager

1) The managerial level should focus on the safety worker behaviour of the employer as it is complementary partially mediated with HM, SCU, SCL for better improvement in safety performance. Besides WB is positively related to HM, SCL, STT, and SCU for better Safety performance.
2) The absence of knowledge about return on investment (ROI) from safety training by managerial level, construction firms unable to identify hidden hazards in construction sites and injury or fatal accident occur frequently in the site. Similarly, lack of active participation of workers in safety training, lack of proper demonstration of safety procedure from where the worker will get acquisition safety knowledge by managerial level to degrade safety worker behaviour and safety performance of construction firms. Moreover, safety training is positively connected with a favourable behaviour or attitude of workers, when they get and acquire the usefulness of the training program.
3) The managerial level of private and public Nepalese construction sites needs to focus more on improving safety worker behaviour to upgrade the safety performance of the corresponding firm.
4) To summarize, this research shows a complete framework of the safety system in a construction site. This study investigates some existing relations between HM, SCL, SCU, WB, STT, and SP in the context of the Nepalese construction site. The researchers of this study tried to test a new relationship, for instance, the relationship between safety culture and safety training to safety worker behaviour, which was not much measured previously. The finding is the core attraction for framing safety training and safety culture in the construction firm. Lastly, the development of the framework, many practical and theoretical implications can be inferred from the output of this research and exploration of the importance of hazard management is the main contribution of this research.

Hence, if the above implications are practiced well, it can be expected that the construction site of Nepal have better safety worker behaviour which in return will improve the safety performance of the project. Proper safety training identifies the hidden hazard. Active participation of workers in safety training and proper demonstration of safety procedures by managerial level help to acquire safety knowledge for the worker and will improve the relationship between HM, SCL & SCU promoted WB for better safety performance.

IX. LIMITATION AND DIRECTION FOR FUTURE RESEARCH

During the research work, keeping numerous issues in mind is vital. Every research has its own kinds of limitations. This research believes the mediation role of safety worker behaviour and moderation role of safety training for a high level of safety performance. Future studies might look different construct as mediation and moderation role in a new framework, like workplace a mediation and demography factor (age, education, gender) as moderation. Further research is certainly essential to confirm and progress the validity and appropriateness of its outcome by measuring it in various contexts. The interrelation between determinants constructs of safety performance also can be studied in future research.

APPENDIX A

ASSEMENT OF NORMALITY

Variable	min	Max	skew	c.r.	kurtosis	c.r.
SCU1	1.000	5.000	0.204	1.489	-0.765	-2.794
SCU2	1.000	5.000	0.234	1.711	-0.806	-2.942
SCU3	1.000	5.000	0.453	3.307	-0.632	-2.307
SCU4	1.000	5.000	0.414	3.023	-0.541	-1.974
SCU5	1.000	5.000	0.381	2.781	-0.957	-3.496
SCU6	1.000	5.000	0.497	3.627	-0.818	-2.985
SCL6	1.000	5.000	0.308	2.248	-0.806	-2.943
SCL5	1.000	5.000	0.279	2.041	-1.085	-3.963
SCL4	1.000	5.000	0.227	1.660	-0.723	-2.639
SCL3	1.000	5.000	0.474	3.459	-0.468	-1.708
SCL2	1.000	5.000	0.286	2.092	-0.476	-1.739
SCL1	1.000	5.000	0.255	1.866	-0.638	-2.328
HM1	1.000	5.000	0.521	3.807	-0.624	-2.279
HM2	1.000	5.000	0.353	2.581	-0.835	-3.050
HM3	1.000	5.000	0.454	3.316	-0.825	-3.014
WB4	1.000	5.000	0.655	4.784	0.358	1.306
WB3	1.000	5.000	0.812	5.933	0.362	1.323
WB2	1.000	5.000	0.974	7.111	0.739	2.699
WB1	1.000	5.000	0.917	6.698	0.545	1.991
SP9	1.000	5.000	0.850	6.211	0.738	2.694
SP8	1.000	5.000	0.513	3.744	0.109	0.396
SP7	1.000	5.000	0.704	5.144	0.260	0.948
SP6	1.000	5.000	0.672	4.910	0.087	0.318
SP5	1.000	5.000	0.546	3.987	-0.257	-0.938
SP4	1.000	5.000	0.552	4.034	0.170	0.621
SP2	1.000	5.000	0.912	6.660	0.717	2.618
SP1	1.000	5.000	1.117	8.161	0.820	2.996
Multivariate					0.179	.0410

Note: C.R. is critical ratio

APPENDIX B

SIGNIFICANCE TESTING RESULTS OF THE DIRECT AND INDIRECT EFFECTS

From	To	Direct Effect	Indirect Effect	T-value
HM	WB	0.438	-	9.820
HM	SP	0.083	-	2.593
HM	WB&SP	-	0.325	9.048
SCL	WB	0.338	-	8.980
SCL	SP	0.142	-	4.782
SCL	WB&SP	-	0.251	8.478
SCU	WB	0.353	-	8.065
SCU	SP	0.135	-	4.085
SCU	WB&SP	-	0.262	7.246
WB	SP	0.742	-	24.408

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