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SAFETY CULTURE IN CONSTRUCTION INDUSTRY OF NEPAL

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ABSTRACT

Safety culture is a critical aspect of ensuring safe and productive construction sites. However, many studies in the field of construction that focus on safety culture overlook the unique attributes of construction environments. Current models for safety culture in construction fail to fully encompass the dynamic and diverse nature of construction sites where individuals with differing backgrounds, professions, and levels of experience collaborate to complete projects. These individuals not only come from different cultures and speak different languages, but they also have various psychological, behavioral, and knowledge traits that can affect their safety practices and behaviors. Moreover, different organizations have different settings and perceptions about the safety of their workers and workplace, which can further complicate the development of effective safety cultures in construction. Therefore, there is a clear need for research that focuses on developing more context-specific models for safety culture in construction that can account for these unique attributes and complexities (Hallowell et al., 2016; Hinze and Tracey, 2016; Lingard et al., 2018). The present study presents a framework that incorporates multiple facets of safety culture, including psychological factors, organizational factors, knowledge and awareness, behavioral factors, safe working conditions, safety-oriented climate, resilience, and unsafe behaviors. The proposed framework captures the relationship between these variables and the safety culture of the construction industry in Nepal. The results inferred from the analysis of the survey showed that among the eight variables included in the study (psychological dimension, organizational dimension, knowledge dimension, behavioral dimension, safe workplace, safety climate, resilience, and unsafe behavior), seven of them (excluding unsafe behavior) had a direct positive impact on safety culture in the construction industry of Nepal. In other words, these seven variables were found to be positively associated with the development of a strong safety culture in the construction industry of Nepal. On the other hand, unsafe behavior was found to have a negative impact on safety culture, implying that if workers engage in unsafe behavior, it can undermine the development of a positive safety culture in the workplace.

KEYWORDS

Safety practice, safety culture, construction.

INTRODUCTION

In Nepal, most construction firms adhere to conventional safety practices. However, due to the government's relatively weak occupational health and safety regulations, there is a lack of effective safety management procedures, which leads to numerous accidents every day. Large corporations that use a lot of human labor hire locals from the project site as workers, but they

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rarely or never provide them with any safety orientation. This highlights the need for a strong safety culture in the construction industry in Nepal. Freshly hired laborers are immediately put to work, where they are unaware of any potential risks related to the building environment. Furthermore, the lowest-qualified bidder frequently receives the contract, and as a result, businesses forego investing in training programs and other measures to improve the industry's safety culture (Adhikari and Pradhananga, 2018; Koirala and Wasti, 2019; Shakya et al., 2018).

The management of workers' health and safety is crucial since it improves any industry's profitability, performance, and production (Ranasinghe et al., 2020). Improving safety performance in construction enterprises requires a thorough grasp of the variables influencing hazard detection and risk perception (Pandit et al., 2019; Ranasinghe et al., 2020). Due to the very high rate of injuries and fatalities that commonly occur in construction fields, the construction industry has a code indicating that it is extremely risky or unsafe (Talmaki and Kamat, 2014; Ghasemi et al., 2015). When compared to the manufacturing-based industry, where the risk of injury is 2.5 times larger, the likelihood of death in the construction sector is 5 times higher (Khosravi et al., 2014). The small unit of fewer than 10 workers working outside the urban workforce border in Nepal is not benefited from OSHA's legislative effort. Koirala (2016) acknowledged that Nepal has not yet ratified the core OSHA principle of the International Labor Organization (ILO). According to Olsen (2009), Nepal has not yet ratified OSHA Convention No. 155 of the ILO. According to trends in occupational injuries related to construction in Nepal, the number of fatal events rose from 5 to 13 between 1995 and 2009. (Joshi et al., 2011; Koirala, 2016; Sanjel et al., 2016). According to reports from Hämäläinen et al. (2006) and Koirala (2016), the rate of fatalities was 10.5 in China, 11.5 in India, and 29.9 per 100,000 workers in Nepal.

There hasn't been much research or previous studies on improving safety performance in the Nepalese construction industry, and what little there is focused primarily on defining external factors that do so, ignoring internal factors and the fundamental relationship between the safety enhancement factors in construction firms (Gautam and Prasain, 2011; Sukamani and Wang, 2020). Construction companies in developing countries face difficulties that are more fundamental, intricate, and severe. These concerns arise in a developing country like Nepal due to the general socio-economic unrest, ongoing resource scarcity, and general inability to find solutions to pressing problems. The lack of effective safety management procedures is a significant problem in the construction industry in developing nations (Koirala, 2016; Sanjel et al., 2016). To focus on accomplishing the goals of improving safety performance, it is crucial to develop the frameworks that the organization should adhere to and manage its resources.

LITERATURE REVIEW

The consequences of inadequate safety measures can have a significant impact on employees, their families, local communities, and the employer (Arboleda and Abraham, 2004). By reducing the frequency of workplace accidents, injuries, incidents, and illnesses, occupational safety can enhance efficiency, competitiveness, production, and profitability (as shown by studies from Chan et al., 2008; Hon et al., 2012, 2014). Accurate documentation of these incidents helps raise awareness and promotes the sharing of important safety information within the organization (Ra and Merisalu, 2010; Hussi, 2005). Effective communication of this information is crucial for managing safety knowledge within the organization (Nuez and Villanueva, 2011). Furthermore, businesses have a greater potential to learn and adopt best practices from other organizations and industry experts in the realm of construction safety (Järvis and Tint, 2008).

Organizational culture is often viewed as a component of safety culture, shaped by attitudes and values specific to health and safety issues (Clarke, 1999). According to Williams et al. (2020), the values, beliefs, rituals, traditions, and practices shared among members of an

organization make up the concept of "safety culture" (Kartikawati and Djunaidi, 2018). There have been many efforts to develop a theoretical model of safety culture, with the Layer models (Reason, 1997; Guldenmund, 2000) and Triad models being two of the most widely used (Geller, 1994; Cooper, 2000). The idea behind Layer models is that by understanding the content of organizational culture, it is possible to analyse and improve safety-related elements. However, Layer models are often criticized for lacking objective evaluation tools and failing to account for the dynamic nature of culture (Cooper, 2000; Choudhry et al., 2008). Triad models, on the other hand, focus on the connection between psychological, behavioural, and situational factors in safety management (Cooper, 2000; Geller, 1994). To address these criticisms, Geller (1994) proposed a comprehensive safety culture model that recognizes the dynamic and interrelated nature of individual, environment, and behaviour. Cooper (2000) also developed a reciprocal model of safety culture that consists of three parts: subjective situational characteristics, internal psychological factors (how people feel), and safety-related behaviours (what people do). The model proposed in this research, considers the impact of psychological, organizational, knowledge, and behavioural dimensions, as well as the resilience of the safety culture, the safety climate, and instances of unsafe behaviour.

An organization's atmosphere often includes a variety of individual assessments of the workplace (James & James, 1989). These evaluations include assessments or cognitive appraisals of numerous fundamental workplace elements or traits, such as participation, leadership, communication, and creativity. It is thought that the combination of these assessments can significantly shape the actions and expectations of employees within the organization (Schneider, 1975). The idea that organizations can be seen as having several distinct climates, such as the climate for customer service, the climate for safety, and so forth, stems from the premise that the safety climate is essentially an offshoot of organizational climate. Actions done to improve the overall climate of the organization should also improve the climate for safety to the extent that these general climate aspects shape the climate for safety. Evaluation of these broad climate aspects should, in the end, give designers of interventions a more solid foundation on which to build and more proof that managing safety is not fundamentally different from managing other essential organizational responsibilities.

Typically, acquiring knowledge and skills in the construction industry happens through "on-the-job learning," which is how manual workers improve their knowledge and abilities (Golden and Skibniewski 2009). Learning while working contains both social and individual components (Collin and Valleala 2005). The employee's personal effort in repeating tasks, which is influenced by task features like complexity and mechanization as well as employee professional profiles like talents and prior experience, represents the individual aspect (Srour et al. 2018). The interaction and sharing of knowledge among crew members, which is influenced by the schedule structure, employees' prior experience, crew demographics, and workers' attributes, is comparable to the social part of learning (Kiomjian et al. 2020). Knowledge must be properly defined to comprehend the dynamics of the social side of learning. Knowledge is the skill and know-how a person possesses that enables them to do specialized tasks more effectively (Bock et al. 2005). On construction sites, the informal character of the knowledge-sharing process makes it extremely reliant on the interpersonal interactions between the knowledge transmitter and receiver (Thomas et al. 1998). As a result, the knowledge sharer starts to consider the benefits of the exercise, such as applying knowledge to job performance while managing time and learning from mistakes, or even producing new information by working together to boost team productivity. The outcomes could be quicker payment, employment referrals from other employers, and networking. Nevertheless, it could appear that competition suffers when knowledge is shared. Supervisors must devise strategies to encourage staff members to communicate their tacit knowledge if they want to keep it alive. The process of information sharing among workers is anticipated to be influenced by several social and

personal elements, considering the social component of on-the-job training and the pragmatic aspect of tacit and explicit knowledge (Sanboskani et al. 2020).

French and Geller (2012) contend that for a safety infrastructure to be effective, it must actively encourage employee engagement. People modify their attitudes and beliefs to match their behaviors when they decide to change their conduct. Changes in behavior and attitudes are mutually reliant; there is a spiraling, reciprocal interdependence between our outward behaviors and our feelings. This is how minor adjustments in conduct and attitude can finally result in full commitment and involvement from an individual. Therefore, researching the behavioral factor appears to hold promise for enhancing safety performance in an organizational setting. The conduct of employees is the focus of the behavior-based approach to safety. This mechanism can lower injury rates through altering behavior. The behavioral-based approach to safety is solely concentrated on the measurable, observable behaviors that are essential to safety in a specific facility (Burton, 2012). When safety behavior programs are correctly implemented, they result in large improvements in safe performance and significant drops in occupational injuries and illnesses in workplaces with problematic rates of unsafe performance (Cambridge Centre for Behavioral Studies, n.d.). Recognizing employee safety behavior is crucial to raising an organization's overall safety performance. It is possible to evaluate how safe habits might be rewarded by identifying the factors that influence workers' safety behavior.

For the construction sector, safety is essential. Government agencies, business leaders, and university researchers have worked hard to enhance safety performance during the past few decades. For instance, Ontario province passed the Building Trades Protection Legislation in 1911 to govern the safety of tradespeople working in building construction; the Construction Safety Act replaced this act in 1962. (Ontario Ministry of Labor, 2012). A multitude of studies have been conducted to examine the effect of safety culture on safety performance, driven by events such as the Chernobyl Disaster in 1986 (Cooper and Phillips, 2004; Coyle et al., 1995; Dedobbeleer and German, 1989; Glendon and Litherland, 2001; Isla Daz and Daz Cabrera, 1997; McCabe et al., 2008; Neal and Griffin, 2006; Niskanen, 1994; Pidgeon, 1991; Siu et al., 2004). Because of these activities, the proportion of deaths in the construction industry has drastically decreased. However, several nations or regions, like Ontario and the US, have recorded a safety plateau. Over the previous ten years, the fatality rates in the US and Ontario construction industries have been flat. The secret to getting above the plateau is figuring out what influences construction safety performance. One of the elements that may enhance safety performance is the safety atmosphere. People's collective attitudes about workplace safety have been used as a barometer for the existence of abstract safety culture (Zohar, 1980). Regarding the parameters of the safety climate, there is no consensus. In the research studies on the safety climate in the construction industry, attention has been given to the following factors: management commitment, safety rules and procedures, housekeeping and safety equipment, supervisor, and coworkers safety perception (Colley et al., 2013; Dedobbeleer and Béland, 1991; Fung et al., 2005; Mohamed, 2002; Siu et al., 2003). However, other factors that are equally important to safety performance, such as reporting (Fung et al., 2005) and readiness (Hon et al., 2014), are rarely measured. In the meanwhile, the availability of injury data has decreased, making it harder to anticipate safety performance. All of this has forced us to look for a fresh strategy.

The concept of resilience has demonstrated its capacity to enhance safety performance over time. According to Bruyelle et al. (2014), Ross et al. (2014), and Vogus and Sutcliffe (2007), it is regarded as a capacity for an optimistic response and healing capabilities to routine usage as well as maintaining a high level of safety during stress and disturbance. This capacity is essential for human and organizational capabilities and viability (Carmeli et al., 2013). It has been suggested as a fresh strategy for the following generation of safety advancement (Hollnagel, 2015). In high-risk systems with difficulties associated, such as (a) a high degree of

interconnection between the system's components; (b) unpredictability and variability, the application of resilience is especially applicable (Costella et al., 2009). A building site requires resilience to create prevention tactics because it is a complex, dynamic, and unstable system (Costella et al., 2009). Managerial commitment, reporting culture, learning culture, anticipation, awareness, and flexibility are the resilience dimensions that are most frequently recognized (Woods and Wreathall, 2003).

Construction sector accidents are complicated occurrences that can involve both the independent and reciprocal impacts of risky activities and conditions. Workers' performance and vision in the workplace might be impacted by dangerous behaviors. However, the driving forces behind the dynamic personalities in the construction business might be more complicated, making it crucial to concentrate on these important driving forces that affect employees' behavior (Jiang et al., 2015). Psychosomatic stress (Siu et al., 2004), safety climate (Fang et al., 2015), danger perception (Bohm et al., 2010), employee engagement, administration commitment, adequate source portion, and collaboration are some of the major elements that have been linked to workers' risky behaviors (Abudayyeh et al., 2005). Early in the 1980s, the safety atmosphere emerged as one of the key subcategories of safety, emphasizing management over actual safety. According to (Zohar et al., 2015 and Cheng et al., 2011), employees' perceptions of safety influence how they behave at work. The relationship between safety policies, procedures, and practices is emphasized by people's perceptions. Other studies have examined key factors that contribute to a safe work environment, such as safety perception, working conditions, safety programs, and management systems, and researchers have tried to identify dimensions of safety climate (Cheng et al., 2011).

METHODOLOGY

A survey was conducted to collect the perceptions of 44 construction practitioners and site personnel regarding the suggested variables. In addition to that, demographic factors like age, experience, profession, and gender were collected and inferences of these factors on other variables were computed and observed. This research is a descriptive study and inferential analysis is done to obtain the results of the research. This research is based on a survey of 44 respondents which is done through a questionnaire. Likert scale questionnaires were used to collect responses from construction practitioners and site personnel who participated in the survey. The Likert scale used a 5-point scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree" about their perceptions on various constructs developed in the theoretical framework as indicated in figure 1. The data collected was analyzed using SPSS software and MS- Excel. The interpretation is done by descriptive statics, ANOVA, Chi-Square, correlation, and regression tests.

To improve the research's validity and dependability, the researcher indulged himself to facilitate the respondents so that the response rate could be maximized, and probable errors could be minimized. Both the independent and dependent variables were separately tested using Cronbach’s alpha test of reliability to make certain that all designed questions are reliable. A validity construct of variables used in this study was analysed based on different scholarly articles and literature and is presented in table 1.

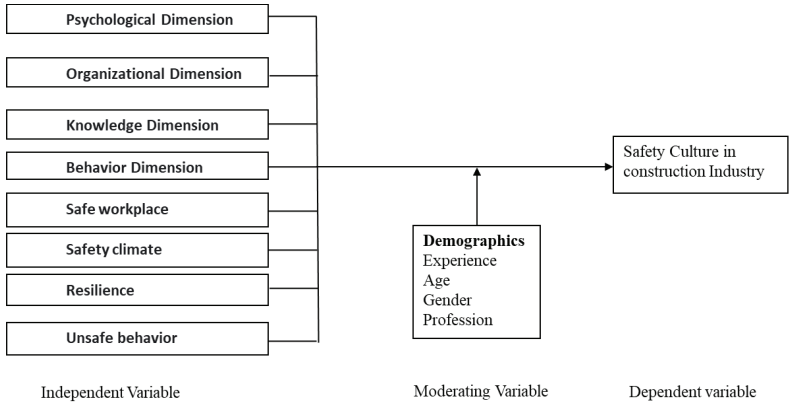

Figure 1: Theoretical Framework

Table 1: Reliability Test

Particular	Cronbach's Alpha if Item Deleted	Remarks
Psychological dimension	0.908	Good
Organizational dimension	0.898	Good
Knowledge dimension	0.901	Good
Behavior dimension	0.898	Good
Safe workplace	0.899	Good
Safety climate	0.902	Good
Resilience	0.904	Good
Unsafe behavior	0.972	Good

The shows the reliability test of individual construct and the overall reliability is found to be 0.91.

RESULT AND DISCUSSION

INDEPENDENT SAMPLE T TEST

An independent sample T test is used to assess the impact of gender groups on the safety culture of the construction sector.

Table 2: Independent sample T Test between Gender Group of Respondent and Safety Culture in Construction Industry

Particular	N	Mean	Std. Deviation	F	Sig. (P value)
Male	33	3.56	0.946	1.817	0.185
Female	11	2.97	0.609	ff	ff

The P value (0.185)>0.05 there is no significant relationship between gender and safety culture in construction industry.

ONE WAY ANNOVA TEST

Since years of experience, age group and profession are used as moderating variables with more than two variables, a one-way ANNOVA test is done to evaluate the influence of these moderating variables on safety culture in construction industry.

Table 3: One Way Annova Test between years of experience of Respondent and Safety Culture in Construction Industry

Particular	N	Mean	Std. Deviation	F	Sig. (P value)
less than 1 year	3	3.8160	0.24966	1.558	0.215

Particular	N	Mean	Std. Deviation	F	Sig. (P value)
1-3 years	14	3.3055	0.68720		
3-5 years	4	4.2344	0.30672		
More than 5 years	23	3.2912	1.06632		
Total	44	3.4173	0.90539		

The P value (0.215)>0.05 there is no significant relationship between experience and safety culture in construction industry.

Table 4: One Way Anova Test between age of Respondent and safety culture in construction industry

Particular	N	Mean	Std. Deviation	F	Sig.
18-30	29	3.4381	0.98945	0.022	0.978
30-45	14	3.3754	0.77454		
Above 45	1	3.3979			
Total	44	3.4173	0.90539		

The P value (0.978)>0.05 there is no significant relationship between age group and safety culture in construction industry.

Table 5: One Way Annova Test between job role and safety culture in construction industry

Particular	N	Mean	Std. Deviation	F	Sig.
Foreman	10	2.683	0.98454	2.556	0.036
Engineer	8	3.8599	0.7439		
Construction Labor	9	3.2032	1.10078		
Accountant/Office Manager	2	3.5240	0.17825		
Plumber/Electrician	4	4.0635	0.18603		
Project Manager	10	3.7517	0.52712		
Environmentalist	1	2.9604			
Total	44	3.4173	0.90539		

The P value (0.036) <0.05 there is significant relationship between job type and safety culture in construction industry.

In general, if the p-value is less than or equal to a predetermined significance level (usually 0.05), then the null hypothesis is rejected in favor of the alternative hypothesis. This means that the observed results are considered statistically significant, indicating that there is evidence to suggest that the relationship between the variables being tested is not due to chance. On the other hand, if the p-value is greater than the significance level, the null hypothesis cannot be rejected, meaning that the observed results are not statistically significant, and there is insufficient evidence to suggest a relationship between the variables.

Correlation Analysis

A correlation analysis can only tell whether a strong relationship exists between two variables. But even if a correlation coefficient indicates that a strong relationship exists between two variables, we still do not know the exact shape of the relationship between the two variables. The correlation results were used to answer the research questions or hypotheses.

The table below shows the correlation matrix between dependent variable and independent variables, where, X1 = psychological dimension (Independent variable), X2 = organizational dimension (Independent variable), X3 = knowledge dimension (Independent variable), X4 = behavior dimension (Independent variable), X5 = safe workplace (Independent variable), X6 = safety climate (Independent variable), X7 = resilience (Independent variable), X8 = unsafe behavior (Independent variable), X9 = safety culture in construction industry (Dependent variable).

Table 6: Correlation between Dependent and Independent Variables

	X1	X2	X3	X4	X5	X6	X7	X8	X9
X1	1	859**	.759**	.769**	.731**	.793**	.754**	-0.218	.863**
		0.000	0.000	0.000	0.000	0.000	0.000	0.154	0.000
X2		1	.874**	.892**	.875**	.857**	.862**	-0.173	.957**
			0.000	0.000	0.000	0.000	0.000	0.261	0.000
X3			1	.858**	.933**	.817**	.760**	-0.199	.924**
				0.000	0.000	0.000	0.000	0.195	0.000
X4				1	.932**	.887**	.891**	-0.242	.949**
					0.000	0.000	0.000	0.113	0.000
X5					1	.870**	.804**	-0.251	.938**
						0.000	0.000	0.101	0.000
X6						1	.823**	-0.294	.914**
							0.000	0.053	0.000
X7							1	-0.217	.898**
								0.157	0.000
X8								1	-0.120
									0.439
X9									1

** Correlation is significant at the 0.01 level (2-tailed)

The correlation coefficient of psychological dimension, organizational dimension, knowledge dimension, behavior dimension, safe workplace, safety climate and resilience vs safety culture in construction industry are 0.863, 0.957, 0.924, 0.949, 0.938, 0.914 and 0.898 which means there is positive correlation between these independent variables and safety culture in construction industry. This means that if the industry focuses on improving these variables, it will result in an improvement in the safety culture of the construction sites, which in turn can help reduce the number of accidents and injuries. The corresponding p-value is 0.000, which is less than level of significance (α) = 0.05, signifying that there is significant relationship between these independent variables and safety culture in construction industry.

Whereas the correlation coefficient unsafe behavior and safety culture in construction industry is -0.120 which means there is negative correlation between these unsafe behavior and safety culture in construction industry. This means that if the industry focuses on reducing unsafe behavior, it will result in an improvement in the safety culture of the construction sites, which in turn can help reduce the number of accidents and injuries. The corresponding p-value is 0.439, which is greater than level of significance (α) = 0.05, signifying that there is no significant relationship between unsafe behavior and safety culture in construction industry.

Regression Analysis

Table 7: Regression analysis of variables

	Beta	T-value	P-value	VIF
(Constant)	0.618	3.314	0.000	
Psychological Dimension	0.144	4.287	0.000	1.358
Organizational Dimension	0.548	0.691	0.000	1.210
Knowledge Dimension	0.067	2.243	0.000	1.236
Behavior Dimension	0.082	7.071	0.000	1.361
Safe Workplace	0.138	0.963	0.000	1.508
Safety Climate	0.11	1.108	0.000	1.436
Resilience	0.521	9.469	0.000	1.695
Unsafe Behavior	-0.133	-0.147	0.439	1.406
R-square	0.693			
F	109.938			
P	0.000			

The regression coefficient specifies that an increase or decrease in value of 1 unit of independent variable results in beta value increase or decrease in unit of safety culture in construction industry.

For instance, the regression coefficient of unsafe behavior in regression analysis is -0.133 means decrease in value of 1 unit of decrease in unsafe behavior result in 0.133 increase in unit of safety culture in construction industry.

*R*2 value indicates how much of the total variation in the dependent variable is explained by independent variable. Here dependent variable (safety culture in construction industry) is explained by 69.3%. It consists of many other factors as well that influence the dependent variable.

Also, the F value and significance level are 109.938 and 0.000 which states that this regression equation is acceptable.

RESULT AND SUMMARY

Table 8: Summary Result of Hypothesis Testing

Hypothesis	P value	Remarks
Null 1 H_0: There is no significant relationship between psychological dimension and effect on safety culture in construction industry	0.000	Reject
Null 2 H_0: There is no significant relationship between organizational dimension and effect on safety culture in construction industry	0.000	Reject
Null 3 H_0: There is no significant relationship between knowledge dimension and effect on safety culture in construction industry	0.000	Reject
Null 4 H_0: There is no significant relationship between behavior dimension and effect on safety culture in construction industry	0.000	Reject
Null 5 H_0: There is no significant relationship between safe workplace and effect on safety culture in construction industry	0.000	Reject
Null 6 H_0: There is no significant relationship between safety climate and effect on safety culture in construction industry	0.000	Reject
Null 7 H_0: There is no significant relationship between resilience and effect on safety culture in construction industry	0.000	Reject
Null 8 H_0: There is no significant relationship between unsafe behavior and effect on safety culture in construction industry.	0.439	Accept

The study highlights the importance of assessing safety culture in the construction industry using a mixed-method approach that includes both quantitative and qualitative methods. By identifying safety-related problems, interventions can be developed to improve safety culture, which is a predictor of safety behavior and outcomes. However, the questionnaire revealed that various unsafe behaviors were performed by workers on a day-to-day basis, compromising safety and leading to injury or even fatality. These behaviors include ignoring safety equipment, disregarding safety precautions, not paying attention to rules and procedures of workplace safety, skipping daily safety work meetings, and not providing safety suggestions to the supervisor or the team. Unfortunately, workplace safety culture in Nepal is still developing, and many people lack a strong motivation and understanding of why safety is of paramount importance. Employers do not prioritize safety orientation and training, and the government does not have proper OHSA guidelines in place. Moreover, some workers think that wearing safety equipment like hard hats and boots makes them uncomfortable for work and choose not to wear them. Additionally, some individuals lack good judgement and engage in risky activities without realizing the irreparable damage that can be done to workplace safety. It is crucial for these individuals to understand the consequences of their actions, as their behavior can hinder efforts to induce and refine a culture of safety in the workplace.

CONCLUSION AND RECOMMENDATIONS

The study examined a model for a realistic construction safety culture that could help contractors in their efforts to enhance all-around site safety. The results show that the proposed model is sound and that there is a statistically significant relationship between its various components. Various factors like psychological dimension, organizational dimension, knowledge dimension, behavioral dimension, safe workplace, safety climate and resilience show significant relationship with safety culture. Hence, a commendable amount of work should be done in these factors by the organization to further increase safety. Safety is of paramount importance for every age and gender group, but the importance of safety is more to certain profession groups as interpreted by the results. So, people who are directly involved in the construction activities are more vulnerable than those who manage these projects. Therefore, an extra amount of care and precaution must be taken. Unsafe behavior is one of the main factors which directly leads to accidents, hence proper training and research must be done so that workers don't involve themselves in these activities. Construction is a collective work done by a group, negligence of one person or a group directly impacts the health and safety of other. So, paramount importance must be given to safety which is directly proportional to the culture of industry.

Future research can solve many problems that are related to the study that was given. The suggested model in the current study was validated using a convenience survey (i.e., nonprobability), which was employed to collect data. The most popular technique for assessing safety culture is non-probability surveys (Choudhry et al. 2008; Ojanen et al. 1988). The generalization of nonprobability survey results, however, is debatable (Abowitz and Toole 2010; Al-Bayati et al 2018). Therefore, future research should complement and validate the current findings by combining longitudinal field observations with quantitative and qualitative research (i.e., mixed approach). In fact, the necessity of mixed research methodologies for validating the results of construction research is stressed by Abowitz and Toole (2010) and Al-Bayati et al. (2018). The obstacles faced by the stakeholders in the construction industry in creating, sustaining, and reinforcing a strong safety culture may be revealed by such an attempt. Future work should concentrate on conducting field tests with construction professionals to assess the acceptability, usefulness, and simplicity of the suggested model in comparison to other models already in use by the sector. Future research must also consider the distinctive features of the construction industry. For instance, most construction sites employ numerous contractors and subcontractor organizations, all of which have different perspectives and safety procedures. Future studies could therefore consider the linkages between the safety climates of the contractors and subcontractors in the construction industry.

Even though the research has tried to improve the current safety performance in Nepali construction firms, there are several restrictions that may prevent the research's findings from being simplified or used widely. First off, because the research was carried out using a convenience sample technique just within the Kathmandu valley, results cannot be generalized as representative of the total population of the entire nation. In that sense, data from every province in the nation might be collected by future researchers, leading to more precise results. Second, "Class A" and "Class B" construction firms accounted for most respondents. The analysis of these circumstances may have a different impact on the predictors of "C & D class" Nepali construction enterprises. Finally, this research highlights the need for further exploration of the topic from various perspectives. Potential avenues for future research could include examination of variables such as salary and gender-specific roles as moderators of the relationship between dependent variables. It is also recommended that future studies consider additional factors, such as safety attitudes and safety budgets, to enhance the accuracy of predicting safety culture in the construction industry, even though the current study utilized multiple determinants in its assessment.

REFERENCES

Al-Bayati, A. J. (2021). Firm size influence on construction safety culture and construction safety climate. *Practice Periodical on Structural Design and Construction*, *26*(4), 04021028.

Arboleda, C. A., & Abraham, D. M. (2004). Fatalities in trenching operations—analysis using models of accident causation. *Journal of Construction Engineering and Management*, *130*(2), 273-280.

Bock, G. W., Zmud, R. W., Kim, Y. G., & Lee, J. N. (2005). Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS quarterly*, 87-111.

Chan, A. P., Javed, A. A., Wong, F. K., & Hon, C. K. (2014). Improving safety communication of ethnic minorities in the construction industry of Hong Kong. In *ICCREM 2014: Smart construction and management in the context of new technology* (pp. 463-474).

Choudhry, R. M., & Fang, D. (2008). Why operatives engage in unsafe work behavior: Investigating factors on construction sites. *Safety science*, *46*(4), 566-584.

Collin, K., & Valleala, U. M. (2005). Interaction among employees: How does learning take place in the social communities of the workplace and how might such learning be supervised?. *Journal of education and work*, *18*(4), 401-420.

Considine, J., Botti, M., & Thomas, S. (2005). Design, format, validity and reliability of multiple choice questions for use in nursing research and education. *Collegian*, *12*(1), 19-24.

Costella, M. F., Saurin, T. A., & de Macedo Guimarães, L. B. (2009). A method for assessing health and safety management systems from the resilience engineering perspective. *Safety Science*, *47*(8), 1056-1067.

Fredericks, T. K., Abudayyeh, O., Choi, S. D., Wiersma, M., & Charles, M. (2005). Occupational injuries and fatalities in the roofing contracting industry. *Journal of Construction Engineering and Management*, *131*(11), 1233-1240.

Gautam, R. P., & Prasain, J. N. (2011). Current situation of occupational safety and health in Nepal. *General Federation of Nepalese Trade Unions (GEFONT) Man Mohan Labour Building, GEFONT Plaza, Putalisadak, Kathmandu, Nepal*.

Geller, E. S. (1994). Ten principles for achieving a total safety culture. *Professional Safety*, *39*(9), 18.

Geller, S., & French, A. (2012). Creating a culture where employees own safety. *SAFETYWAIFAP APRIL*.

Ghasemi, F., Mohammadfam, I., Soltanian, A. R., Mahmoudi, S., & Zarei, E. (2015). Surprising incentive: an instrument for promoting safety performance of construction employees. *Safety and health at work*, *6*(3), 227-232.

Gillen, M., Goldenhar, L. M., Hecker, S., & Schneider, S. (2014). Safety culture and climate in construction: Bridging the gap between research and practice. *Washington DC: The Center for Construction Research and Training (CPWR)*.

Guldenmund, F. W. (2000). The nature of safety culture: a review of theory and research. *Safety science*, *34*(1-3), 215-257.

Hämäläinen, P., Takala, J., & Saarela, K. L. (2006). Global estimates of occupational accidents. *Safety science*, *44*(2), 137-156.

Hollnagel, E. (2008). Risk+ barriers= safety?. *Safety science*, *46*(2), 221-229.

Hon, C. K., Chan, A. P., & Yam, M. C. (2014). Relationships between safety climate and safety performance of building repair, maintenance, minor alteration, and addition (RMAA) works. *Safety science*, *65*, 10-19.

James, L. A., & James, L. R. (1989). Integrating work environment perceptions: Explorations into the measurement of meaning. *Journal of applied psychology*, *74*(5), 739.

Jiang, Z., Fang, D., & Zhang, M. (2015). Understanding the causation of construction workers' unsafe behaviors based on system dynamics modeling. *Journal of Management in Engineering*, *31*(6), 04014099.

Joshi, S. K., Shrestha, S., & Vaidya, S. (2011). Occupational safety and health studies in Nepal. *International Journal of Occupational Safety and Health*, *1*(1), 19-26.

Kartikawati, M., & Djunaidi, Z. (2018). Analysis of safety culture maturity level in construction at PT. MK gelora bung karno main stadium renovation project. *KnE Life Sciences*, 348-360.

Khosravi, Y., Asilian-Mahabadi, H., Hajizadeh, E., Hassanzadeh-Rangi, N., Bastani, H., & Behzadan, A. H. (2014). Factors influencing unsafe behaviors and accidents on construction sites: A review. *International journal of occupational safety and ergonomics*, *20*(1), 111-125.

Koirala, M. P. (2016). Risk in Housing, Infrastructures Projects due to Safety Engineering Practice in Nepal. *Nepal, Engineering Professional's Association*, *2*.

Leung, M. Y., Chan, Y. S., & Olomolaiye, P. (2008). Impact of stress on the performance of construction project managers. *Journal of construction engineering and management*, *134*(8), 644-652.

Pandit, B., Albert, A., Patil, Y., & Al-Bayati, A. J. (2019). Impact of safety climate on hazard recognition and safety risk perception. *Safety science*, *113*, 44-53.

Ranasinghe, U., Jefferies, M., Davis, P., & Pillay, M. (2020). Resilience engineering indicators and safety management: A systematic review. *Safety and Health at Work*, *11*(2), 127-135.

Reinhold, K., Järvis, M., & Tint, P. (2009). Risk observatory—a tool for improving safety and health at the workplace. *International Journal of Occupational Safety and Ergonomics*, *15*(1), 101-112.

Sanboskani, H., & Srour, I. (2022). Using Advanced Statistical Methods to Identify the Drivers of Knowledge Sharing Intention among Construction Workers. *Journal of Construction Engineering and Management*, *148(2)*.

Schneider, B. (1975). Organizational climates: An essay 1. *Personnel psychology*, *28*(4), 447-479.

Sukamani, D., & Wang, J. (2020). Prospective safety performance in construction industries in Nepal. *Jordan Journal of Civil Engineering*, *14*(4).

Talmaki, S. A., & Kamat, V. R. (2022). Sensor Acquisition and Allocation for Real-Time Monitoring of Articulated Construction Equipment in Digital Twins. *Sensors*, *22*(19), 7635.

Thygerson, S. M., Sanjel, S., & Johnson, S. (2016). Occupational and environmental health hazards in the brick manufacturing industry in Kathmandu Valley, Nepal. *Occup Med Health Aff*, *4*(5), 2-7.

Williams, J. H., & Geller, E. S. (2000). Behavior-based intervention for occupational safety: Critical impact of social comparison feedback. *Journal of Safety Research*, *31*(3), 135-142.

Woods, D., & Wreathall, J. (2003). Managing risk proactively: The emergence of resilience engineering. *Columbus: Ohio University*.

World Health Organization. (2018). Occupational safety and health in public health emergencies: a manual for protecting health workers and responders.

Zohar, D. (1980). Safety climate in industrial organizations: theoretical and applied implications. *Journal of applied psychology*, *65*(1), 96.