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Original Research Article

Assessment of Safety Practices in Commercial Building Construction Projects in Nepal

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Abstract

Construction industry is high-risk industry with large number of accidents. Nepalese construction industries also suffer from numbers of issues related to safety and health. This study aim to assess the implementation status of safety practices and challenges in proper implementation safety practices in building construction projects of Nepal. For this study, primary data and information were collected from 487 out of 500 respondents of different building projects via checklist and questionnaires. Obtained result were analyzed by MS excel and SPSS. Study revealed overall implementation status of safety practices is moderate level as 70.64 percent responses fall under moderate level of bloom cut off category. Result of RII showed that use of barricades, timely maintenance of plants and equipment, first aid facilities, fire safety, emergency exit and insurance policy are relatively most implemented parameters under study. Design review for safety, safety training and job safety plan relatively less implemented parameters and the provision of safety officer and safety audits were absent in majority of building construction projects. PCA analysis results poor safety culture, Poor safety management, Lack of safety knowledge and resources, Lack of safety infrastructures and communication and problem in governance and implementation are major challenges in implementing safety practices.

Keywords: Construction industry, Commercial Building, Safety Practices, Implementation, challenges, Occupational Health and Safety.

1. INTRODUCTION

Construction industry is considered as industry with high work injury rate. Construction industries benefited with large infrastructure projects but construction industries has been resulted injuries and fatalities to the human (Spangenberg, 2010). Each year about 108,000 construction workers lose their lives in working sites. Construction industry constitutes almost one third of all occupational fatal injuries (Gürcanli and Müngen, 2013). It is impossible to estimate terrible effects of accidents and injuries on workers and their families cost of not investing in occupational safety and health to prevent accidents and disease is roughly equal to four percent of world's gross national product (GDP) per year (ILO, 2015). Building construction projects are prone to accidents because of hazardous and complex nature of construction activities. Different workers type like labor, engineers, supervisors in buildings construction projects are exposed to uncertain hazards such as falling object, running machinery, working at height and numbers of other hazards related to man, material, machine, management (4M) (Shao *et al.*, 2019).

In Nepal, every year approximately 20,000 workers suffer from workplace accidents and among those 200 workers lose their lives. Workplace accidents in building construction are more common in Nepal as compared to other countries (Gautam and Prasain, 2011). The occupational accidents in Nepal are in large numbers. However, it is believed that majority of accidents are not reported despite of the mandatory reporting system recommended by law. Lack of sensitivity and awareness in management and workers is regarded as major cause behind underreporting of accidents in Nepal (ILO, 2022).

Safety has not been a priority for Client, Consultant, Contractor and other stakeholders in Nepalese construction industries, as safety has not been a part of organization culture in Nepal. No safety plan and no job safety analysis in projects, Lack of provision of safety inspector, lack of proper training, inadequate awareness programs, lack of or inadequate first aid and medical facility are main challenges of occupational health and safety in Nepalese construction industries (Gautam and Prasain, 2011).

Government has initiated rules and regulations in Nepal regarding occupational health and safety through health and safety act 2074, but lacks proper implementation. Accidents in construction site has not decreased as expected (Sharma, 2019). Ministry of Labour, Employment and Social Security (MoLESS) has shown commitment on health and safety at work. Labor act 2017, national OSH policy 2019 and National OSH profile 2022 shows government willingness towards health and safety at work.

The major aim of this research is to identify the implementation status of safety practices in commercial building construction projects by using bloom cutoff and relative important index (RII). This study further tries to access the challenges in implementing safety practices in commercial building construction projects by using principal component analysis (PCA).

2. LITERATURE REVIEW

A. Occupational safety and health

Occupational safety and health encompasses the scientific study of anticipating, identifying, assessing, and mitigating workplace hazards that may pose a threat to employees' health and welfare, while also considering potential effects on the surrounding communities and ambient conditions (Benjamin O Alli, 2008). Occupational health and safety not only improves the physical, mental, and social well-being of workers but also supports the growth and preservation of employees' working capacities as well as their professional and social development at work (Organization, 1994).

B. Causes of accidents in construction industry and Building construction

Construction industry is high-risk industry as construction activity associated with many hazards. Construction accidents are unintentionally occurring undesirable, bad, or unforeseen events during construction activities that typically cause pain, injury, or even the loss of life or property. There may be hardware or software cause behind construction accidents. Some of hardware cause are tools and equipment, material, physical condition of worker, personal protective equipment (PPE) etc. and a few examples of software-based cause are inadequate work plans and programs, poor safety plans, inadequate training, a lack of signs and signals, inadequate training materials, carelessness, mistakes, and mistakes etc (Paivi hamalainen, 2005). The lack of awareness and experience among workers, the inadequate machinery and equipment provided at the worksites, the absence of appropriate personal protective equipment, the lack of training, and the absence of qualified occupational safety measures at these worksites are some of the factors contributing to occupational accidents and injuries in the construction industry (Abukhashabah *et al.*, 2020).

In a previous study, eleven major factors were identified as the most frequently occurring causes of accidents among the sixty factors linked to incidents in the building construction industry. Those factors are lack of personal protective equipment, unsafe or defective equipment, inadequate training, lack of awareness of safety among workers or managers, unsafe methods of handling materials or equipment during operations, lack of experienced project managers or workers, worker fatigue due to overtime, unsafe workplace conditions, management, ineffective operation or noncompliance with safety regulations, and an inadequate or nonexistent housekeeping program (Williams *et al*., 2018).

Recent research on commercial buildings of Nepal by Adhikari and team suggested causative factors in different category; management related factors, worker related factors, project related factors and equipment related factors. Few examples of management related factors are no compliance to governmental safety rules and regulation, no training program for the workers, lack of supervision and control on workers, not enough rest time during the task, no safety engineers at site, lack weekly safety meeting etc. Workers related factors like negligent in wearing personal protection items, overconfidence of the worker, physical and mental fatigue of labor, working overtime in the site etc. Project related factors like lack of working space and site layout, weather conditions were extreme, Job or task was too difficult to perform. Machine and equipment related factors like Condition of equipment, design and Specs of Equipment's for specific task, supply and availability of equipment etc (R. Adhikari, 2020).

C. International and National Status of construction accidents and Safety Practices

An approximation on 2015, more than 2.3 million lives lost due to workplace accidents and diseases. Fatal accidents are cause of 350,000 deaths. More than 313 million workers are suffer from non-fatal workplace incidents that result in significant injuries and absent from work. Statistics implies, each day 860,000 individuals are injured at work, and 6,400 people die from illnesses or accidents related to their jobs (ILO, 2015). Past study projected 14 fatal occupational accident rate per 100,000 workers globally, expecting that higher number of occupational accidents than anticipated (Jukka Takala, 1999).

In the United States in 2004, construction workers accounted for 22% of work-related fatalities (Abukhashabah *et al*., 2020). A survey conducted in Saudi Arabia in 2014 found that there were 69,241 occupational accidents and injuries in the private sector. Over 51% of these incidents and injuries were related to the construction sector (Mosly, 2015). According to data from the Turkish Social Security Institution, there are between 6,000 and 9,000 industrial accidents annually, resulting in 400 worker fatalities and an additional 400 lifelong impairments. Thirty-four percent of occupational fatalities are related to construction. Furthermore, a recent trend of an increase in workplace accidents and fatalities has been observed that costs 1.6% of total benefits of construction industry (Jukka Takala, 1999). Similar studies are in accordance with the finding that construction industry accounted for higher percentage of occupational accidents.

In Nepal, the concept of OSH is still at early stage. Labor Act of 1992 and associated regulations from 1993 is the piece of legislation that addresses worker safety and health. This topic is rapidly becoming popular among Nepal's working class but status of safety and health in Nepal is not satisfactory (Gautam and Prasain, 2011). Occupational accidents are more in numbers and majority of them from construction sectors similar to international scenario. Number of occupational accidents in Nepal are much higher than reported. Table shows only reported occupational accident during last 10 fiscal year (ILO, 2022).

The parameters used in this study to identify the implementation status of safety practices in commercial building construction projects are extracted by through literature review related to construction safety.

Table 2.1: Parameters to assess safety practices implementation in commercial building construction projects

Parameters to assess implementation of safety practices	**Sources**
Use of PPE’s	(N. Krishnamurthy, 2017), (Mosly, 2015)
Obey safety rules by workers	(R. awwad *et al*., 2016), (Attarde, 2021)
Proper safety signs and signals	(Basnet, 2021) (Mosly, 2015)
Injury recording system/risk register	(Purohit *et al*., 2020)
Safety meeting	(Hinze *et al*., 2013)
Safety training	(Hinze *et al*., 2013)
Design reviewed for safety	(N. Krishnamurthy, 2017)
Timely maintenance of plants and equipment’s	(Basnet, 2021)
Proper housekeeping	(Mosly, 2015)
Use of barricades	(Mosly, 2015)
Provision of safety nets	(Dorcas *et al*., 2019)
Knowledge and practice of respondent about safety act and regulations	(R. awwad *et al*., 2016), (Attarde, 2021), (Basnet, 2021)
Safety budget	(R. awwad *et al*., 2016)
First aid facilities	(Hinze *et al*., 2013), (Dorcas *et al*., 2019)
Feedback mechanism regarding safety	(Dorcas *et al*., 2019)
Job safety plan	(Hinze *et al*., 2013)
Safety provision in contract documents	(R. awwad *et al*., 2016)
Reward and punishment regarding obeying and violating safety	(R. awwad *et al*., 2016), (Attarde, 2021), (Fekele *et al*., 2016)
Investigation regarding accidents at sites	(Hinze *et al*., 2013)
Implementation of building code (NBC 114:1994)	(DUDBC, 1994)

d. Challenges in Implementing Safety Practices

Previous study in Lebanon construction industries stated that there is existence of labor safety law but lack of safety awareness and commitment among stakeholders result in absence of effective enforcement. Existence of safety programs but lack of proper monitoring and follow up. Extensive subcontracting, absence of adequate safety training, absences of safety officers on site, ineffective laws and lack of enforcement, extensive use of foreign workers, lack of workers’self protection and awareness. Moreover, uncooperative clients and inadequate work procedures, lack of management commitment to safety budget allocation, poor accident record keeping are major challenges in implementing safety practices (R. Awwad *et al*., 2016). Numerous research that looked into the reasons for safety performance as well as assessing current safety practices were carried out in developing nations. The majority of the studied literature points to excessive subcontracting, a lack of safety knowledge, ineffective safety laws and regulations, and unsupportive top management as the primary causes of the high incidence of injuries and fatalities as a major challenges in safety practices (Wong and So, 2002). Another study conducted in India discussed that organization safety policy, safety meetings, safety trainings, availability of safety equipment, safety inspections, safety incentives and penalties, workers attitude towards safety, labor turnover rates, compliance with safety legislations as a factors/challenges for safety management (Attarde, 2021).

Nepalese contractors are no so much concerned about safety at work. Contractors are profit oriented and they supposed to save cost by not adopting safety standard. Under reporting of accidents, lack of training, poor employment practices are some of the major challenges among the Nepalese contractors (Sukamani and Wang, 2020). Safety has not been a priority and part of organization culture in Nepalese construction industries. No safety plan and no job safety analysis in projects, Lack of provision of safety inspector, lack of proper training, inadequate awareness programs, lack of or inadequate first aid and medical facility are main challenges of occupational health and safety in Nepalese construction industries (Gautam and Prasain, 2011). Though the government of Nepal has initiated the rules and regulations regarding safety, it lacks proper implementation (Sharma, 2019).

Parameters used in this study to assess the challenges in implementing safety practices in commercial building construction projects are enlisted below.

Table 2.2: Challenges in implementing safety practices in commercial building construction projects

Challenges in implementing safety practices	**Source**
Traditional working approach	(Williams *et al*., 2018),
Insufficient laws and rules	(Sharma, 2019)
Ineffective acts and regulations	(Attarde, 2021)
Extensive subcontracting	(Hinze *et al*., 2013)
Lack of management commitment	(Agumba and Haupt, 2018), (Williams *et al*., 2018), (Sharma, 2019)
Incompetent management and workers	(Williams *et al*., 2018)
Improper use of machine equipment and tools	(R. Adhikari, 2020)
Lack of timely maintenance of plants and equipment's	(Sukamani and Wang, 2020), (Basnet, 2021)
High employee turnover	(Attarde, 2021)
No safety Experts/Officers	(Basnet, 2021),(Abukhashabah *et al*., 2020), (R. Adhikari, 2020)
Problem in design	(N. Krishnamurthy, 2017)
Inadequate training	(Sukamani and Wang, 2020), (Dorcas *et al*., 2019)
Lack of barricades, safety nets	(Mosly, 2015),
Poor accident record keeping	(Sukamani and Wang, 2020), (Sharma, 2019)
Lack of safety signs and signals	(Mosly, 2015)
Insurance policy	(Sharma, 2019), (Shrestha, 2018)
Improper use of machine equipment and tools	(Williams *et al*., 2018)
Safety as aided cost/priority	
Lack of responsibility and accountability	(Sharma, 2019),
Willingness of meeting only contractual requirements	(Yiu *et al*., 2019)
Lack of safety inspection & monitoring	(Basnet, 2021)
Lack of standard language for safety	(Yiu *et al*., 2019)

3. METHODOLOGY

Research was conducted on commercial buildings construction projects of Nepal. The study attempted to identify implementation status with the help of 20 parameters of safety practices and 22 parameters of assessing challenges in implementation of safety practices. These parameters were extracted from various literature review and from safety practitioners of Nepalese construction industry. Questionnaire and checklist were the tools for the data collection and dada collected through google form, printed medium, telephonic interview and direct interview. Questions were in the form of five point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). Out of 500 questionnaires distributed, 487 responses were received. Out of 500 respondents, 242 respondents were from the public construction projects. The respondents includes project manager, site engineers, overseers, supervisors, and front-line workers having more or less knowledge on safety in construction site.

Table 3.1: Demographic details

Dimension	**Number**	**Percentage**
Designation		
Project Manager	54	11.09
Senior Engineer	131	26.90
Site Engineer	92	18.89
Sub Engineers	64	13.14
Others	146	29.98

Educational Qualifications		
Master	161	33.06
Bachelor	180	36.96
Diploma/Intermediate	94	19.30
Others	52	10.68
Experience		
0-5 years	219	44.97
5-10 years	199	40.86
10-15 years	54	11.09
More than 15 years	15	3.08

Field observation sheet (Checklists), RII (Relative important index) and bloom cutoff were used to find out the implementation status of safety practices. Bloom cutoff helps in categorizing obtained responses in different level such as high, moderate and low level in terms of agreement or disagreement to particular questions (Alzahrani *et al.*, 2022). RII was calculated to find out the most implemented and less implemented parameters under the research. Formula for calculating RII is,

$$RII = \frac{\sum W}{A*N} = \frac{1*n1+2*n2+3*n3+4*n4+5*n5}{5*N}$$

Where,

W is the weightage given to each factor by the respondent ranging from 1 to 5,
N is the number of respondents/samples.
A is the highest weight on the scale, in our case, A=5

The RII value range is 0 to 1 (Tholibon *et al.*, 2021).

Principal component analysis (PCA) was used to extract the major challenges in implementing safety practices in selected projects. Principal component analysis (PCA) is a variable reduction technique. Its aim is to reduce a larger set of variables into a smaller set of 'artificial' variables, called 'principal components', which account for most of the variance in the original variables. The main advantage of PCA is reducing the number of dimensions in data, without much loss of information (Narasimhan and Shah, 2004).

4. RESULTS AND DISCUSSION

a) Status of Safety Practices in Building Construction Projects

All the responses obtained from clients, consultants and contractors representatives on twenty parameters of identifying safety practices ranging from strongly disagree (1) to strongly agree (5) were considered. Then, mean of individual responses on all twenty parameters were calculated and categorized into 3 levels naming as high level, moderate level and low level. The mean score 4 or above was categorized as high level, mean score 3 to 4 was categorized as moderate level and mean score less than 3 as low level. Implementation status on the basis of responses obtained from client, contractor and consultant representatives is presented in the table below.

Table 4.1: Bloom cut off categories for the implementation status of safety practices in commercial building construction projects

Category	**Scores (%)**	**Frequency (n)**	**Percentage (%)**
Overall implementation status according to obtained responses			
High Level	4-5(80-100%)	79	16.22 %
Moderate Level	3-4(60-80%)	344	70.64 %
Low Level	Below 3(<60%)	64	13.14 %
Total		**487**	**100 %**

The mean score of majority of responses fell under moderate level (70.64%) followed by high level (16.22%) whereas; least of responses fell under low level (13.14%). Which indicates majority of responses believed that implementation status of safety practices was moderate level, few of them believed that implementation status of safety practices was high level and least of them believed that implementation status of safety practices is low level in commercial buildings under study. In general, implementation status of safety practices in commercial building construction projects in Nepal found moderate level.

Study tried to rank the parameters of safety practices under study according to their implementation based on responses obtained from construction projects respondents with the help of relative important index value.

Table 4.2: Rank of parameters to assess safety practices in commercial building construction projects

Parameters to assess implementation of safety practices	**RII and Ranks of RII**	
	(RII)	**(Rank)**
Use of PPE's	0.755	8

Obey safety rules by workers	**0.827**	**2**
Proper safety signs and signals	0.687	15
Injury recording system/risk register	0.651	17
Safety meeting	0.664	16
Safety training	0.534	19
Design reviewed for safety	0.509	20
Timely maintenance of plants and equipment's	**0.826**	**3**
Proper housekeeping	0.758	7
Use of barricades	**0.862**	**1**
Provision of safety nets	0.755	8
Knowledge of respondent about safety act and regulations	0.751	10
Safety budget	0.711	13
First aid facilities	**0.794**	**5**
Feedback mechanism regarding safety	0.721	11
Job safety plan	0.596	18
Safety provision in contract documents	0.772	6
Reward and punishment regarding obeying and violating safety	0.719	12
Investigation regarding accidents at sites	0.704	14
Implementation of building code (NBC 114:1994)	**0.819**	**4**

RII on above parameters indicates us of barricades, obey safety rules by workers, timely maintenance of plants and equipment's, implementation of building code (NBC 114:1994) and first aid facilities are majorly implemented parameters among the building construction projects under study. Job safety plan, safety training and design review for safety are less implemented parameters under study.

4.2 The Challenges in Proper Implementation of Safety Practices in Selected Commercial Building Construction Projects

This section discussed the challenges in proper implementation of safety practices by conducting PCA analysis followed three major steps.

a) Assessment of suitability of data

Kaiser-Meyer-Olkin (KMO) is a tool to evaluate if data are suitable for factor analysis. KMO measures how adequate the sampling is. Similarly, Bartlett's test of sphericity, correlation matrix and determinant score are computed to detect the appropriateness of the data set for functioning factor analysis (Shrestha, 2021).

Table 4.3: KMO and Bartlett's test for challenges in implementing safety practices in commercial building construction projects

KMO and Bartlett's test		
Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy		0.874
Bartlett's test of sphericity		
	Approx Chi-Square	1320.356
	Df	231
	Sig.	0.000

KMO tests the adequacy of sample size. KMO values between 0.8 to 1.0 indicate the sampling is adequate. KMO values between 0.7 to 0.79 are middling values and values between 0.6 to 0.69 are average. KMO values less than 0.6 indicate the sampling is not adequate and the remedial action need to be taken. An average value>0.6 is acceptable for sample size<100; an average value between 0.5 to 0.6 is acceptable for sample sizes between 100 and 200 (Shrestha, 2021).

The Bartlett's test of sphericity is highly significant at p <0.001, which indicates that the correlation matrix has significant correlations among at least some of the variables. Here, test value is 1320.356 and an associated degree of significance is less than 0.001. the significant value<0.05 indicates that a factor analysis may be valuable for the data set (Shrestha, 2021).

It was determined that the factor member, KMO value 0.874; Bartlett value χ^2= 1320.356; df=231(p=0.000) in the scale consist of 22 items. Table 4.3 illustrates the value of KMO statistics in equal to 0.874>0.7, which indicates sampling is adequate and the factor analysis is appropriate for the data.

b) Factor Extraction for Challenges in Implementing Safety Practices in Selected Commercial Building Construction Projects

The Eigen Value of Kaiser's Criterion and the Scree Test were employed to decide how many factors to keep in this study. For this purpose, the 22 indicator Challenges in implementing safety practices in commercial building construction projects were included in PCA analysis. The eigenvalue technique was used to determine the number of factors to extract. In which case, only factors with eigenvalues of 1.0 or more were retained.

In multivariate statistics, a scree plot is a line plot of the eigenvalues of factors or principal components in an analysis. The scree plot is used to determine the number of factors to retain in an exploratory factor analysis (FA) or principal components to keep in a principal component analysis (PCA). As the Figure 4.1 of scree plot describes that, five latent variables have Eigen values >1.

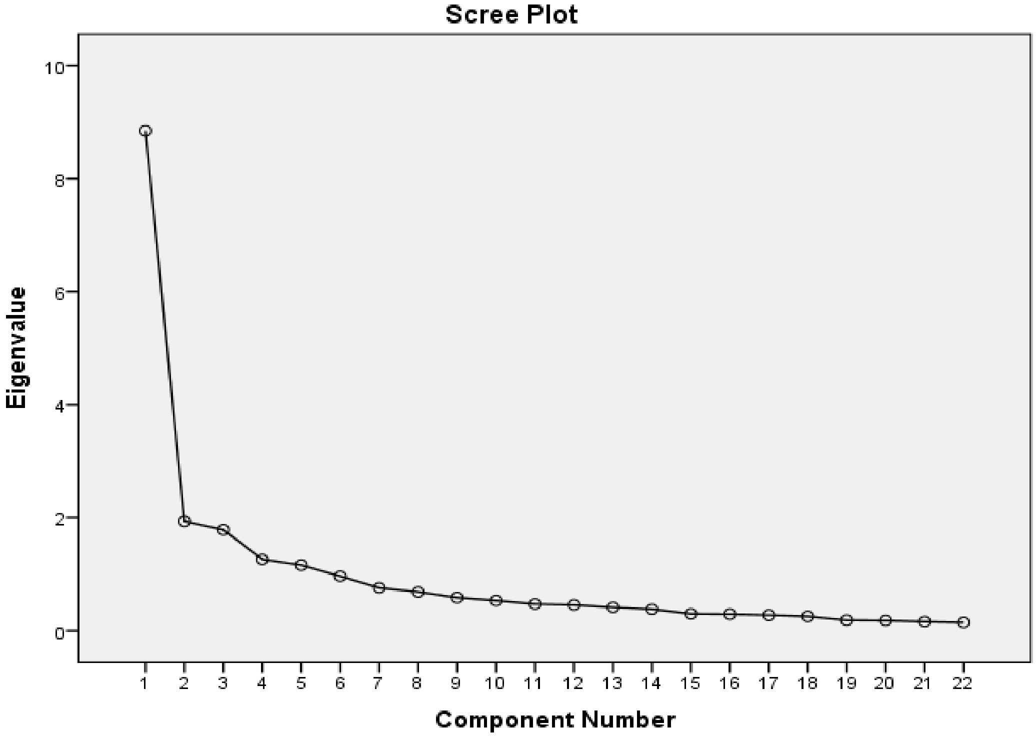

Figure 4.1: Scree plot of challenges in implementing safety practices

The scree plot is used to determine the number of factors to retain. For this, a graph plotted with eigenvalues on the y-axis and the twenty-two component numbers in their order of extraction on the x-axis. The initial factors extracted are large factors with higher eigenvalues followed by smaller factors. The scree plot in this case reveals that five factors account for the majority of the total variability in the data, each of which has an eigenvalue greater than one. The other variables contribute relatively little to the variability and are viewed as not being of primary importance (Shrestha, 2021).

Table 4.4: Eigen values and total variance extraction method for challenges in implementing safety practices in commercial building construction projects

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.848	40.217	40.217	8.848	40.217	40.217	4.081	18.550	18.550
2	1.934	8.972	49.010	1.934	8.792	49.010	3.107	14.124	32.674
3	1.786	8.118	57.128	1.786	8.118	57.128	2.664	12.109	44.782
4	1.260	5.728	62.856	1.260	5.728	62.856	2.596	11.799	56.581
5	1.159	5.267	68.123	1.159	5.267	68.123	2.539	11.543	68.123
6	0.962	4.373	72.496						
7	0.757	3.441	75.937						

8	0.684	3.108	79.045						
9	0.583	2.650	81.695						
10	0.531	2.415	84.110						
11	0.471	2.141	86.251						
12	0.455	2.066	88.318						
13	0.412	1.873	90.190						
14	0.378	1.719	91.910						
15	0.296	1.347	93.257						
16	0.290	1.319	94.576						
17	0.274	1.245	95.820						
18	0.251	1.143	96.963						
19	0.185	0.841	97.805						
20	0.179	0.813	98.618						
21	0.160	0.726	99.344						
22	0.144	0.656	100.000						
Extraction Method: Principal Component Analysis.									

The eigenvalues and total variance explained are shown in Table 4.4. Out of twenty two components in this study, there are five distinct linear components within the data set for the eigenvalue > 1 after extraction and rotation. The five factors are extracted accounting for a combined 68.123% of the total variance, which is greater than 50% of total variance.

The result shows that 68.123% common variance shared by twenty-two variables can be accounted by five factors. This is the reflection of KMO value, 0.874, which can be considered good and also indicates that factor analysis is useful for the variables. This initial solution suggests that the final solution will extract not more than five factors. In the scope of the study, it was determined that there are 5 factors with an eigenvalue greater than 1. The variance explained by the first factor is 40.217% with Eigen value 8.848; the variance explained by the second factor is 8.972% with Eigen value 1.934; the variance explained by the third factor is 8.118% with Eigen value 1.786; the variance explained by the fourth factor is 5.728% with Eigen value 1.260; the variance explained by the fifth factor is 5.267% with Eigen value 1.159.

c) Factor Rotation and Interpretation for Challenges in Implementing Safety Practices in Selected Commercial Building Construction Projects

Table 4.5 Principal Component Analysis for challenges in implementing safety practices in commercial building construction projects:

Extraction Method: Principal Component Analysis

Rotation Method: Varimax with Kaiser Normalization

Rotation converged in 7 iterations

Table 4.5: Factor rotation and interpretation for challenges in implementing safety practices in commercial building construction projects

Challenges in implementing safety practices	**Components**				
	Poor safety culture	***Poor safety Management***	***Lack of safety Knowledge and Resources***	***Lack of safety infrastructures and communication***	***Problem in governance and implementation***
Safety as aided cost/Priority	0.814				
Willingness to meet only contractual requirements	0.809				
Lack of safety inspection and monitoring	0.723				
Lack of management commitment		0.784			
Incompetent management and workers		0.762			
Inadequate training			0.755		
No safety experts/officers			0.714		
Poor accident record keeping				0.794	
Lack of safety sign and signals				0.781	
Lack of barricades, safety nets				0.736	
Insufficient laws and rules					0.830

Study found, only eleven challenges in implementing safety practices were as major parameters out of twenty-two challenges under study. These eleven parameters were further sub divided into five components. Correlation of variables with their component grouping and internal consistency of variables was tested by Cronbach's alpha test.

Table 4.6: Cronbach's Alpha Test

Component	Cronbach's Alpha
Poor safety culture	0.83
Poor Safety Management	0.78
Lack of Safety Knowledge and Resources	0.72
Lack of safety infrastructures and communication	0.827
Problem in governance and implementation	- NA

Cronbach's alpha (α) used to test accuracy and reliability of internal consistency of each of the factors. The adequate threshold value for Cronbach's alpha is that it should be > 0.7. In Table 4.6 the component Poor safety culture, Poor safety management, Lack of safety knowledge and resources, lack of safety infrastructures and communication and Problem in governance and implementation have Cronbach's alpha values 0.83, 0.78, 0.72 and 0.827 respectively, which confirmed the high reliability of the statistical tools. It shows that the variables exhibit a correlation with their component grouping and thus they are internally consistent.

Component 1: Poor Safety Culture

The component one is stated as 'Poor safety culture' which is considered as major challenges in implementing safety practices in commercial building construction projects under study. Which contains three items, those are Safety as aided cost/Priority, Willingness to meet only contractual requirements and Lack of safety inspection and monitoring and have a correlation of 0.814, 0.809 and 0.723 with component 1 respectively. The component 'Poor safety culture' explained 40.217% of the total variance with Eigen value of 8.848. This component contained three items that tends to be strongly agreeing according to its higher total variance and Eigen value. Previous study discussed that poor safety culture was one of the major problem in effective implementation of OHSAS of 18001 (Ghahramani, 2016).

Component 2: Poor Safety Management

The second component entitled as 'Poor management' considered as second major challenges in implementing safety practices in commercial building construction projects under study. This component contained two items such as lack of management commitment and Incompetent management and workers and have correlation of 0.784 and 0.762 with component 2 respectively. The component 'Poor Management' explained 8.972 % of the total variance with Eigen value of 1.934.

A research on 2019 A.D. assessed Poor management and leadership as the most significant obstacle category for implementing SMS, receiving the highest category value of 3.85. They mentioned lack of motivation by project team or sub-contractors, high turnover rate of workers, assumed belief of safety personnel to take all safety responsibilities, tight project schedule, only willing to meet minimum statutory/contractual requirements are the major management related challenges. Thus, Poor project management and weak leadership would certainly be considered as challenges for implementation safety practices and OSH regulations (Yiu *et al.*, 2019).

Component 3: Lack of Safety Knowledge and Resources

Similarly, The component named as "Lack of Knowledge and Resources" is third major challenges in implementing safety practices in commercial building construction projects. It contains two items namely inadequate training and no safety experts/ officer with correlation of 0.755 and 0.714 with component 3 respectively. This component explained with total variance 8.118 % and Eigen value 1.786. The obstacle of "insufficient safety knowledge or risk concepts for project team" addressed the competency levels of the project team. In general, safety practitioners were competent in terms of relevant academic background and working experiences. Other than safety practitioners, the competency of project team members were in doubt (Yiu *et al.*, 2019). Previous study stated lack of appropriate resources and equipment, limited budgets, lack of safety training, lack of workshops on safety are major hurdles in safety implementation and OSH regulation in the context of Nepalese construction industry (Sharma, 2019).

Component 4: Lack of safety Infrastructures and Communication

The component 4 is considered as fourth major challenges in implementing safety practices in commercial building construction projects marked as 'Lack of safety infrastructures and communication'. It contains three items namely Poor accident record keeping, Lack of safety sign and signals and Lack of barricades, safety net and have a correlation of 0.794, 0.781and 0.736 with component 4 respectively. This component contained explained with total variance 5.728 % and Eigen value 1.260. It is important for the staffing agency and the host employer to communicate and coordinate to provide and maintain a safe work environment for their workers (Attarde, 2021).

Previous research had suggested that greater care should be given on better communication for better competence in implementing safety practices; this implies poor communication among the stakeholders, workers in construction site is major challenges for implementation of safety practices and OSH regulations(Yiu *et al.*, 2019).

Component 5: Problem in Governance and Implementation

The component 5 considered as fifth major challenges marked as 'Problem in governance and implementation' in implementing safety practices in commercial building construction projects. It contains one items namely insufficient laws and rules has a correlation of 0.830, with component 5. This component contained explained with total variance 5.267% and Eigen value 1.159. Government is main responsible for regulating health and safety regulations in construction site but Nepal government's lack of concern, rules and regulation. In addition to this, existing laws were not implemented effectively. Nepal Government lags behind to enforce policies, regulations and legislation that affect the working efficiency (Sharma, 2019). Moreover, Sharma stated Nepal government is very passive regarding the promotion of safety on construction site. No basic guidelines or country's safety code are present based on which these organization can formulate the regulations. In absence of which all the organization involved in construction acts differently to earn, more profit which results in increase of accidents, injury on site.

Table 4.7: Summary of principal component analysis

S. N	Challenges	Results		Field Observation finding
1	Poor safety culture	Explained Variance: 40.217 Eigen Value: 8.848		Safety inspection is not regular and conducted to meet contractual obligations, no proactive monitoring in sites
		Parameters	***Correlation with component***	
		Safety as aided cost/Priority	0.814	
		Willingness to meet only contractual requirements	0.809	
		Lack of safety inspection and monitoring	0.723	
2	Poor safety Management	Explained Variance: 8.972 Eigen Value: 1.934		Management is just process oriented and no motivation to workers following safety rules, employee turnover due to seasonal workers in some sites.
		Parameters	***Correlation with component***	
		Lack of management commitment	0.784	
		Incompetent management and workers	0.762	
3	Lack of safety knowledge and resources	Explained Variance: 8.118 Eigen Value: 1.786		No safety officer in all sites, no culture of training and skill development.
		Parameters	***Correlation with component***	
		Inadequate training	0.755	
		No safety experts/officers	0.714	
4	Lack of safety infrastructures and communication	Explained Variance: 5.728 Eigen Value: 1.260		Most of sites lacs accident record keeping, partial use of safety sign and signals and almost all site barricaded their sites, some site has partially adopted safety nets and some site lacks.
		Parameters	***Correlation with component***	
		Poor accident record keeping	0.794	
		Lack of safety sign and signals	0.781	
		Lack of barricades, safety nets	0.736	
5	Problem in governance and implementation	Variance: 5.267 Eigen Value: 1.159		Expect government sites, no interference regarding safety by government bodies, law and rules are insufficient and no proper enforcement in all sites.
		Parameters	***Correlation with component***	
		Insufficient laws and rules	0.830	

5. Practical Implication:

This study's aim is to identify prevailing safety practices in commercial building construction projects in Nepalese building construction industry. Study tried to assess individual parameters and ranked them according to diminishing order of implementation with respect to commercial building construction projects under study. This will guide construction practitioners to focus precisely and minimize implementation gap in future projects. Moreover, study provides better understanding on major challenges in safety practices implementation. Thus, encouraging and creating responsibility to associated stakeholders on lowering challenges and upgrading safety practices in construction industry from policy level to particular construction projects.

6. CONCLUSIONS

Implementation status of safety practices in commercial building construction projects under study was found moderate level. Study showed that barricading was most implemented parameter among twenty parameters under study. Study indicates workers obey the safety rules if they were guided and oriented, maintenance of plants and equipment's was found to be timely, safety building codes were implemented and there is good provision of first aid facilities in the building construction projects under study. There is serious implementation issues regarding job safety plan, safety training and reviewing design for safety purpose. Safety practices mentioned in acts were not neglected but lacks strict enforcement.

Study revealed poor safety culture among client, consultant, contractor and other stakeholders leading challenges in commercial building construction projects. Taking safety as aided cost, willingness to meet only contractual requirements and Lack of safety inspection and monitoring were found key factors contributing poor safety culture. Lack of management commitment and incompetency among management and workers were major cause behind poor management. Poor accident record keeping, Lack of safety sign and signals, and Lack of barricades, safety nets were key issues for Lack of safety infrastructures and communication. Insufficient laws and rules was dominant factor for problem in governance and implementation.

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