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Original Research Article

Impacts of COVID-19 on the Building Construction Industry in Nepal

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Abstract

The COVID-19 epidemic has created unprecedented challenges for global economies, affecting every industry, including the building construction industry in Nepal as well. This research aims to examine the impact of the COVID-19 epidemic on the building construction industry in Nepal. This study examines institutional, psychological, individual, operational, contractual, and financial factors. To achieve the objective, data were collected from 330 Nepalese construction professionals using a structured Likert scale questionnaire and analyzed with Smart PLS version 3 software for partial least squares structural equation modeling. The reliability and validity of both the measurement and structural models were tested and found satisfactory. All six factors were found to be significant at a 5% level of significance. Among all factors, the institutional factor was found as the most significant factor with a t-value of 7.654 and a beta value of 0.679, emphasizing the crucial role of institutional support in Nepal's building construction industry. The psychological factor also emerged as the second most significant influential factor (t value: 6.087, beta value: 0.463), underscoring the profound effect on the mental well-being of professionals in the field. The finding highlights the critical importance of institutional support and the profound influence of psychological factors on the well-being of construction professionals, necessitating targeted interventions to support the industry's recovery and resilience.

Keywords: Building Construction Projects, Impact of COVID-19, Institutional Factor, Psychological Factor, Structural Equation Modeling.

INTRODUCTION

On March 24, 2020, a countrywide lockdown was declared in Nepal. The Nepalese government implemented measures that essentially restricted any form of mobility, except for essential goods procurement. As a result, construction activities in urban areas such as Kathmandu were abruptly suspended following the implementation of the lockdown. Within 3-4 days, construction operations were brought to a halt due to a shortage of materials and the stringent enforcement of lockdown protocols by the government. Many of the larger contracts were put on hold due to force majeure (The Asia Foundation 2020). Certain construction sites equipped with accommodation facilities persisted in their operations for a few additional days until they eventually stopped due to a deficiency in official oversight and resources. On April 21, the government tried to alleviate the situation by stating that construction sites and industries capable of providing both lodging and sustenance for their workers in a relatively isolated environment could recommence activities, provided they implemented suitable social distancing measures. However, this relaxation of restrictions only applied to roughly 250 sites and industries. Even among these, operations are not running at their full potential due to a scarcity of labor and other contributing factors (The Asia Foundation 2020). The Nepalese government forecasted 2.5 percent GDP growth for 2020 during COVID-19, while the World Bank in 2020 revised its projection to 1.8 percent for fiscal year 2020 (Tandon *et al.*, 2020). The most affected industries, according to the UNDP reports of 2020, are lodging and food (including tourism and hotels), arts, entertainment, entertainment, and transportation, while manufacturing, construction, wholesale, retail trade, and agriculture are moderately affected (Dangol, Chitrakar, & Yoo, 2020). According to UNDP reports, the enterprise sector employs 3.5 million people and among them, 59% are micro companies (Dangol *et al.*, 2020).

Given the circumstances of the lockdown in Nepal, disruptions in global and regional supply chains due to COVID-19, the tourism sector's collapse, sharp declines in consumer confidence and manufacturing, as well as the IMF's notably reduced growth estimate of 1.2 percent for 2020 (down from 5.7 percent in 2019), the economic outlook appears significantly challenged (Sharma, Banstola, & Parajuli, 2021).

The imposition of a lockdown in Nepal caused an immediate halt in the entire transportation and aviation sector, while simultaneously, the construction industry has faced substantial challenges due to the COVID-19 pandemic. This includes a considerable number of employees contracting the virus, leading to quarantines and illness, resulting in labor shortages and project delays. Additionally, obtaining raw materials for building materials manufacturing and sustaining construction operations has been notably problematic. One of the major contributing factors to labor and material shortages is the closure of the international border between Nepal and India. These critical factors have had a severe impact on the construction industry, particularly in building construction projects. Despite these substantial effects, there has been a notable absence of studies that comprehensively incorporate these critical factors affected by COVID-19 in specific building construction projects. Recognizing this gap in research, it was imperative to undertake a study to assess the significant factors influenced by COVID-19 in this context.

Empirical studies within the Nepalese building construction industry are limited or non-existent, highlighting the need for research in this area. Structural Equation Modeling (Dinc & Budic) is valuable for analyzing COVID-19's impact on Nepal's building construction sector as it can handle complex variable relationships. SEM allows for the simultaneous examination of various factors, which is crucial for understanding the sector's interdependencies during the pandemic. It can assess observed and latent variables, providing a comprehensive view of the building construction industry. Theoretical support strengthens SEM's usefulness in validating conceptual models and offering empirical evidence to explain the impacts of the pandemic. Combining theory with empirical data, SEM provides a systematic approach to understanding and addressing COVID-19's impacts on Nepal's building construction industry, guiding strategies for resilience and recovery.

MATERIALS AND METHODS

Study Population, Sample Size, and Sampling Technique

This study adopted a cross-sectional design and relied on quantitative research methods. The targeted population for this study was individuals actively engaged in diverse building construction projects in Nepal, including project managers, contractors, consultants, site engineers, suppliers, and procurement officers. To achieve this, a sample size of 385 was determined using statistical parameters such as a population proportion of success of 0.50, a margin of error of 5%, and a Z^2 of 3.841, which corresponds to the standard error associated with a 95% confidence level, following the formula provided by (Israel, 1992; Pokhrel & Subedi, 2023). The sampling method employed for this research was convenience sampling, chosen for its ease of access to subjects rather than adhering to a more rigorous sampling procedure (Marshall, 1996). Following the calculation of the samples, diverse participants were interviewed from all Provinces across Nepal. Despite the goal for 385 samples, data were collected from 330 participants, resulting in a non-response rate of about 14%.

Questionnaire Preparation and Data Collection

The development of the questionnaire began with an extensive literature review, focused on understanding the impact of COVID-19 on building construction projects worldwide. Based on the insights from this research, a draft questionnaire was created and further refined by experts from Nepal's building construction sector. These experts provided valuable feedback, shaping the questionnaire to cover critical factors associated with construction projects during the pandemic, as detailed in Table 1. To ensure content validity, the questionnaire was aligned with the prevailing challenges faced by the construction industry during COVID-19, as evaluated by these experts. Additionally, the face validity of the questionnaire was maintained by presenting the items in a clear and accessible manner. To facilitate distribution, the questionnaire was digitized using the KoBo Collect application. Respondents are asked to indicate their perspective by responding to a set of Likert scale questions, ranging from one (1) to five (5), reflecting their level of agreement from 'Strongly Disagree' to 'Strongly Agree', respectively. This method aims to gather nuanced insights into the perceived impact of COVID-19 on the identified factors within building construction projects.

Table 1: Major factors associated with building construction projects

S.N	Major factors	Indicator items	Abbreviated form of Indicator items	Source(s)
1	Financial Factors (FF)	Government Budget Reduction	FF1	(Timilsina *et al.*, 2021)
		Deteriorating Financial Situation of the Contractor	FF2	(Timilsina *et al.*, 2021)
		Late Payment	FF3	(Timilsina *et al.*, 2021)

S. N	Major factors	Indicator items	Abbreviated form of Indicator items	Source(s)
		Cost Overruns of the Projects	FF4	(Timilsina *et al.*, 2021)
		Difficulty in Sustaining Operations During the Pandemic	FF5	(Timilsina *et al.*, 2021)
		Sudden Fluctuation of Material Price	FF6	(Timilsina *et al.*, 2021)
2	Operational Factors (Shumway & Stoffer)	Delay in Project Completion	OF1	(Timilsina *et al.*, 2021)
		Supply Chain Disruption of Materials, Manpower, and Equipment	OF2	(Timilsina *et al.*, 2021)
		Difficulty in Maintaining Health and Safety of the Workforce	OF3	(Gamil and Alhagar 2020)
		Future Uncertainty of Availability of Materials and Manpower	OF4	(Thapa 2021)
		Halt of the Entire Aviation and Transportation Industry	OF5	(Xiang *et al.*. 2020, Pamidimukkala and Kermanshachi 2021)
3	Institutional Factors (ID)	No Adequate Support from Government	IF1	(Timilsina *et al.*, 2021)
		Inadequate Evaluation and Monitoring of Regulatory System (PPMO):	IF2	(Thapa 2021)
		No Special Packages During the Pandemic from Financial Institutions	IF3	(Timilsina *et al.*, 2021)
		No Support from Professional Associations	IF4	(Timilsina *et al.*, 2021)
		Higher Interest Payments to the Bank by the Contractor Due to Project Being Delayed During COVID-19 Lockdown	IF5	(Thapa 2021)
		The Government Has Addressed Contractual Disputes Related to COVID-19 at the Policy Level	IF6	(Thapa 2021)
4	Contractual Factors (CF)	Failure to Apply Force Majeure Condition in Contract	CF1	(Alenezi 2020)
		No Adjustment for Policy in Escalation and Inflation of Material Prices	CF2	(Alenezi 2020)
		Poor Scheduling and Planning of Project	CF3	(Alenezi 2020)
		Insufficient Coordination Between Contracted Parties (Client, Consultant, Contractor)	CF4	(Gamil and Alhagar 2020, Abdullah *et al.*, 2021)
		Suspension of Projects	CF5	(Gamil and Alhagar 2020)
5	Individual Factors (IF)	Responsibility for Personal and Family Needs When Working	IDF1	(Bavel and Baicker 2020, Alsharef *et al.*, 2021, Pamidimukkala and Kermanshachi 2021)
		Learn various communication tools and overcoming technical difficulties	IDF2	(Bavel and Baicker 2020, Pamidimukkala and Kermanshachi 2021)
		Feelings of Not Contributing Enough to Work	IDF3	(Alsharef *et al.*, 2021, Pamidimukkala and Kermanshachi 2021)
		Adjusting to New Work Schedules	IDF4	(Alsharef *et al.*, 2021, Pamidimukkala and Kermanshachi 2021)
		Work from Home Related Challenges	IDF5	(Abdullah *et al.*, 2021)
		Concern About the Employees' Health and Safety	IDF6	(Beraha and Đuričin 2020)
6	Psychological Factors (PF)	Social Isolation Due to Teleworking	PF1	(Brooks *et al.*, 2018, Pamidimukkala and Kermanshachi 2021)

S. N	Major factors	Indicator items	Abbreviated form of Indicator items	Source(s)
		Stress and Burnout	PF2	(Obradovich *et al.*, 2018, Pamidimukkala and Kermanshachi 2021)
		Absenteeism of Project Staffs	PF3	(Pamidimukkala and Kermanshachi 2021)
		Uncertainty of Survival	PF4	(Gamil and Alhagar 2020, Abdullah *et al.*, 2021)
		Worker Vulnerability to Unemployment and Financial Hardship Heightened Risk of Suicide During and After the COVID-19 Pandemic	PF5	(King and Lamontagne 2021)
		Reduction in the Productivity	PF6	(Araya and Sierra 2021)
7	Impact of COVID-19*	Vulnerability of Construction Firms to COVID-19	EC1	(Ebekozien, Aigbavboa, & Samsurijan, 2023)
		Necessity for Management Focus on Corrective Measures	EC2	(Hao, Shah, Nawazb, Barkat, & Souhail, 2020)

Note: **Dependent Variable*

Data Analysis

The recorded responses from the participants were processed and analyzed using software like MS Excel and Smart PLS version 3. Partial Least Square Structural Equation Modeling (Smart PLS-SEM) was used which comprises two models to meet the objective of the study: the measurement model, which outlines the connection between latent variables and factors, and the structural model, which examines the relationship between the independent variables and a dependent variable. This study used constructs specified through the reflection method, and their measurement quality was assessed in terms of indicator reliability, discriminant validity, and convergent validity. Furthermore, a structural model was employed to tackle concerns related to multi-collinearity, path coefficient values, and test hypotheses.

The following hypotheses were examined the direct relationships between a dependent variable and the independent variable;

Hypothesis H_1 (1): The impacts of COVID-19 are directly associated with the contractual factor.
Hypothesis H_1 (2): The impacts of COVID-19 are directly associated with financial factor.
Hypothesis H_1 (3): The impacts of COVID-19 are directly associated with the institutional factor.
Hypothesis H_1 (4): The impacts of COVID-19 are directly associated with the operational factor.
Hypothesis H_1 (5): The impacts of COVID-19 are directly associated with the psychological factor.
Hypothesis H_1 (6): The impacts of COVID-19 are directly associated with the individual factor.

To ensure the reliability of the results, a non-parametric bootstrapping procedure of 5000 samples was used. This bootstrapping technique estimated t-values, which helped set significant thresholds (1.96 at p = 0.05, 2.58 at p = 0.01, 3.29 at p = 0.001). This rigorous approach improved the study's reliability and validity, allowing for a thorough investigation of the essential elements influencing the impacts of COVID-19 in Nepal's building construction industry. The measurement and structural models were calculated to ensure the reliability and validity of the respondents' responses.

RESULTS AND DISCUSSION

Demographic and Professional Information of Respondents

Table 2 presents detailed information on the demographic and professional characteristics of all 330 respondents. In terms of age distribution, the majority fall into the 20-25 and 26-35 age groups, accounting for 48.18% and 40.91% respectively. The older age groups, 36-45 and 46 and above make up smaller proportions, representing 8.18% and 2.73% respectively. Moving on to education, the largest group has completed graduate studies, making up 29.70% of the sample. This is followed closely by undergraduates at 26.97%, while those with higher secondary education constitute 22.42%. Post-graduate education is the least common, representing 20.91% of the sample. A question was also asked regarding professional experience, revealing that 35.15% had 1-4 years of experience, while 35.45% had 5-8 years. Participants with 9-12 years of experience make up 17.58% of the group, while those with 13 or more years of experience constitute 11.82%. In terms of professions, the largest group consists of contractors at 36.97%, followed by consultancy professionals at 28.79%. Site engineers make up a substantial portion at 20.30%, while suppliers represent the smallest groups, accounting for 13.94%.

Table 2: Demographic and Professional Information of Respondents

Variable	Frequency	Percent	Variable	Frequency	Percent
Age (in years)			*Education*		
20-25	159	48.18	Higher Secondary	74	22.42
26-35	135	40.91	Undergraduate	89	26.97
36-45	27	8.18	Graduate	98	29.7
46 or above	9	2.73	Postgraduate	69	20.91
Work experience (in the year)			*Professionals*		
1-4	116	35.15	Contractor	122	36.97
5-8	117	35.45	Consultancy	95	28.79
9-12	58	17.58	Suppliers	46	13.94
13 or more	39	11.82	Site Engineers	67	20.3

Analysis and Validity of Measurement Model

The initial steps in performing a partial least squares (PLS) analysis include determining the reliability and validity of the measurement model. This evaluation involves evaluating indicator loading, Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach's Alpha (CA), as shown in Table 3 and Figure 1. An indicator loading value exceeding 0.7 for a specific construct indicates its reliability (Hulland 1999). Likewise, all constructs in the model demonstrate Composite Reliability (CR) and Cronbach's Alpha (CA) values exceeding 0.7, indicating strong internal consistency reliability (Gefen *et al.*, 2000). Each of the constructs demonstrates an Average Variance Extracted (AVE) value surpassing the threshold of 0.5, signifying strong convergent validity (Fornell and Larcker 1981a, Bagozzi and Yi 1988). Discriminant validity was assessed using Fornell and Larker criteria, Heterotrait Monotrait Ratio (HTMT), and cross-loading analyses (Khanal, Shahi, Paudel, & Pokhrel, 2024).

Table 3: Result of Indicator and Convergent Validity

Construct	Items	Loading	AVE	CR	CA
Contractual Factors	CF1	0.870	0.729	0.942	0.928
	CF2	0.853			
	CF3	0.870			
	CF4	0.808			
	CF5	0.911			
	CF6	0.807			
Financial Factors	FF1	0.862	0.759	0.950	0.938
	FF2	0.890			
	FF3	0.886			
	FF4	0.825			
	FF5	0.849			
	FF6	0.914			
Operational Factors	OF1	0.870	0.745	0.936	0.915
	OF2	0.853			
	OF3	0.870			
	OF4	0.808			
	OF5	0.911			
Institutional Factors	ID1	0.975	0.698	0.872	0.867
	ID2	0.727			
	ID3	0.785			
Individual Factors	IF1	0.906	0.806	0.926	0.880
	IF2	0.915			
	IF3	0.872			
Psychological Factors	PF1	0.934	0.826	0.935	0.897
	PF2	0.925			
	PF4	0.867			
Impact of COVID	EC1	0.955	0.918	0.957	0.911
	EC2	0.962			

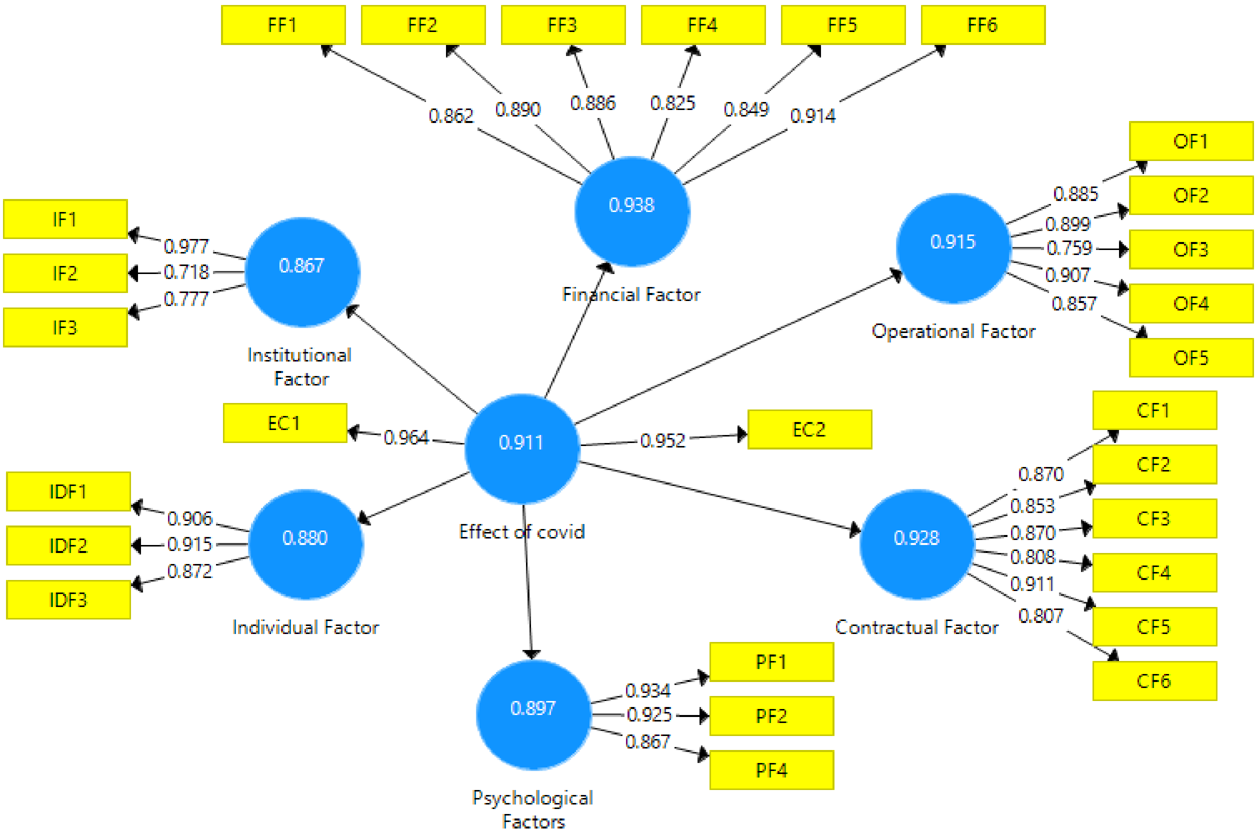

Figure 1: Measurement Model Analysis

In Table 3, one can find information regarding indicator item loadings, Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach's alpha (CA) values. These metrics are employed to evaluate the measurement quality of the construct's indicators within the model. An indicator loading value exceeding 0.5 signifies the indicator's reliability (Hulland 1999). CR and Cronbach's alpha values higher than 0.7 demonstrate internal consistency reliability (Gefen *et al.*, 2000). The AVE value of more than 0.5 indicates convergent validity (Fornell & Larcker, 1981; Pokhrel & Acharya, 2024).

Discriminant Validity: Heterotrait-Monotrait (HTMT) Ratio

The Heterotrait-Monotrait (HTMT) ratio is a useful statistical tool for determining discriminant validity in structural equation modeling (Dinc & Budic). The major goal is to determine how distinct the constructs in a research model are from each other. An HTMT value of 0.85 or lower indicates discriminant validity, which indicates adequate differences between the components. In contrast, if the HTMT score exceeds 0.85, it signals potential difficulties with discriminant validity, indicating that further refinement of the components may be necessary. In this study, the HTMT ratio value, as demonstrated in Table 4, falls below the threshold of 0.85 (Henseler *et al.*, 2009). This confirms that the constructs exhibit adequate distinctiveness in the SEM analysis.

Table 4: Discriminant Validity: Heterotrait-Monotrait (HTMT) Ratio

Factors	CF	EC	F	IDF	IF	OF	PF
CF							
EC	0.258						
FF	0.164	0.222					
IDF	0.330	0.392	0.290				
IF	0.148	0.087	0.074	0.101			
OF	0.269	0.298	0.217	0.289	0.245		
PF	0.499	0.500	0.486	0.535	0.055	0.499	

Discriminant Validity (Fornell and Larker Criteria)

Table 5 provides an illustration of the square root of Average Variance Extracted (AVE) values for each construct, along with their correlations with other constructs. In this table, the diagonal elements, printed in bold, represent higher values and signify the square root of the AVE. These bold values demonstrate that the AVE values meet the criteria for discriminant validity, as they exceed the correlation coefficients with other constructs. The AVE of the latent variable with the highest value can be identified within any given column or row (Fornell and Larcker 1981b).

Table 5: Discriminant Validity (Fornell and Larker Criteria)

Factors	CF	EC	F	IDF	IF	OF	PF
CF	**0.854**						
EC	0.266	**0.958**					
FF	0.176	0.223	**0.871**				
IDF	0.330	0.357	0.274	**0.898**			
IF	-0.130	0.090	-0.110	-0.040	**0.836**		
OF	0.270	0.292	0.221	0.267	-0.193	**0.863**	
PF	0.478	0.464	0.458	0.475	-0.054	0.454	**0.909**

Analysis and Validity of Structural Model

A collinearity test was performed as part of the structural model analysis and validation procedure. After that, the structural model's route coefficients were calculated and shown for reference purposes in Tables 6 and 7.

Table 6: Result of Collinearity Assessment

Predictor construct	Dependent variable	Variance Inflation Factors (VIF)
Contractual Factor	Impact of COVID-19	1.349
Financial Factor	Impact of COVID-19	1.291
Individual factor	Impact of COVID-19	1.327
Institutional Factor	Impact of COVID-19	1.064
Operational Factor	Impact of COVID-19	1.314
Psychological Factor	Impact of COVID-19	1.994

Table 6 displays the outcome of the collinearity evaluation. The Variance Inflation Factor (VIF) values were found to be below the threshold of 5, indicating the absence of an issue with multi-collinearity (Henseler *et al.*, 2009, Cassel *et al.*, 1999, Hair *et al.*, 2011).

Table 7: Testing the Hypothesis in the Structural Model

Hypothesis	Relation	Beta	LLCI (5%)	ULI (95%)	T Statistics (|O/STDEV|)	P Values	Decision
H_1 (a)	EC -> CF	0.266	0.131	0.436	3.395	0.001***	Supported
H_2 (b)	EC -> FF	0.224	-0.264	0.375	1.996	0.046*	Supported
H_3 (c)	EC -> IDF	0.359	0.302	0.597	4.318	0.000***	Supported
H_4 (d)	EC -> IF	0.679	0.104	0.787	7.654	0.000***	Supported
H_5 (e)	EC -> OF	0.293	0.166	0.496	3.396	0.001***	Supported
H_6 (f)	EC->PF	0.463	-0.25	0.214	6.087	0.000***	Supported

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 path coefficient is the typical change in the endogenous construct when the predictor construct undergoes unit change. The Beta value represents an assessment of the relationships among all latent variables; a higher Beta value indicates a more substantial or pronounced influence of the exogenous (predictor) variable on the endogenous (dependent) variable (Aibinu and Al-Lawati 2010). The Beta value is derived from the t-values, which are obtained through non-parametric bootstrapping. This technique involves creating a predetermined number of samples to compute the t-value. To determine the t-values in this investigation, 5000 samples were created using the bootstrapping approach, per the recommendations of (Henseler *et al.*, 2009, Hoonakker *et al.*, 2010). A two-tailed test, according to an earlier study, should have a significance level of p = 0.05 if the t-value is larger than or equal to 1.96, p = 0.01 if the t-value is greater than or equal to 2.58, and p = 0.001 if the t-value is greater than or equal to 3.29 (Hair *et al.*, 2011). We adhered to the same threshold criteria. As depicted in Table 7, all the paths yielded t-values surpassing the 1.96 threshold, signifying statistical significance at a 5% level. This indicates a robust impact of COVID-19 across all paths in the model.

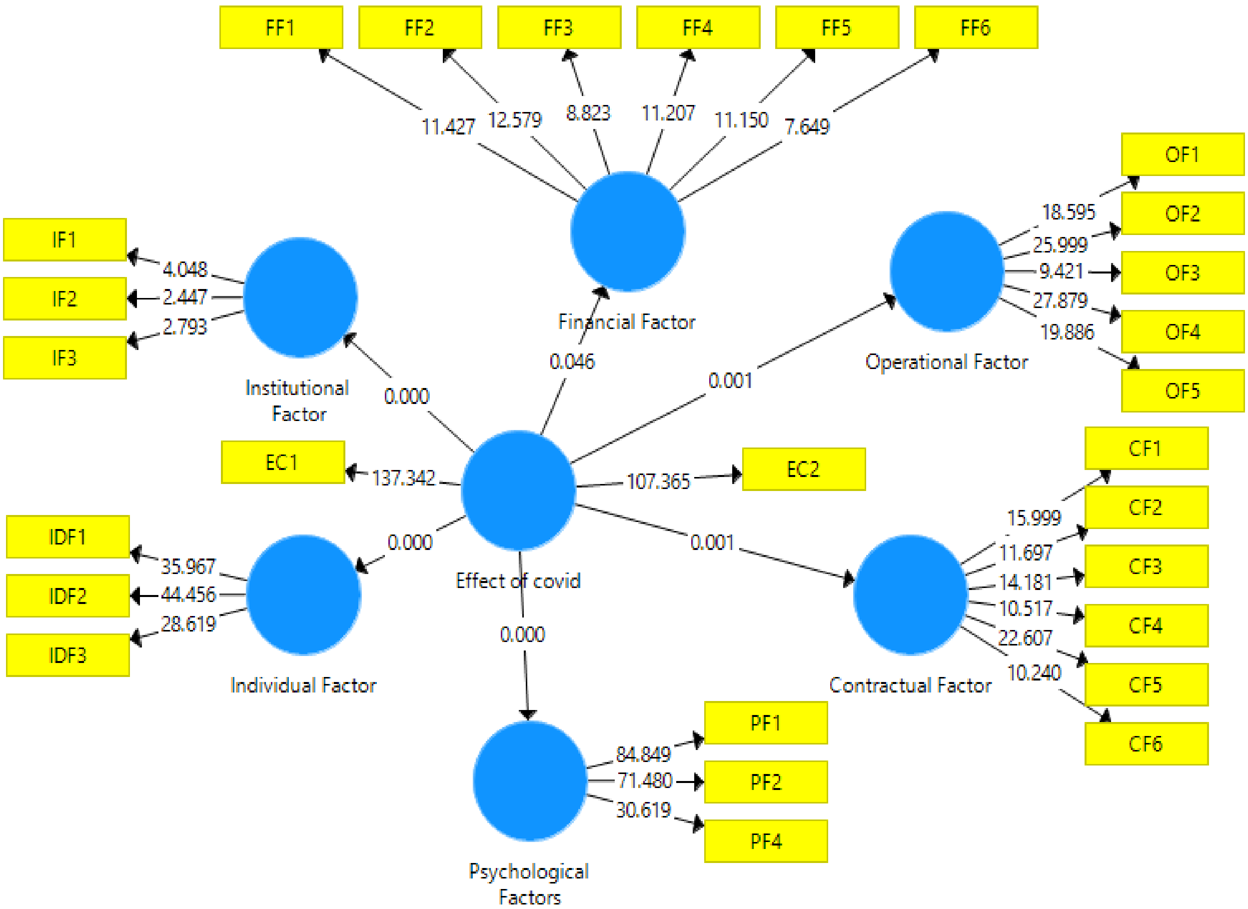

Figure 2: Structural Model Analysis

The outcomes of all six hypothetical paths (H_1-H_6) are presented in Table 7, along with their depiction in Figure 2, illustrating the significance of the SEM model. Among the total of 6 hypotheses, one direct hypothesis (H_2) received support at a 5% significance level, while five direct hypotheses (H_1, H_3, H_4, H_5, and H_6) obtained support at a significance level below 1%, as demonstrated in Table 7.

The assessment and determination of the path coefficient within the inner structural model revealed that the connection between institutional factor and the impact of COVID-19 on building construction projects was exceptionally substantial when compared to all other constructs. This relationship demonstrated the highest t-value of 7.654, with a corresponding beta value of 0.679. Timilsina *et al*., (2021) demonstrated that institutional factors played the most crucial role in the impact of COVID-19 on Nepal's building construction industry. Both the government and professional organizations are falling short of providing the necessary support. Furthermore, the study underscores the expectation among construction professionals for the government to boost the construction sector through measures like subsidized loans, tailored support packages, and contract extensions. Additionally, there is a call for collaborative efforts between the government and regulatory authorities to increase efficiency, competence, and resourcefulness within the construction industry.

Similarly, psychological factor, registering a t-value of 6.087 and a beta value of 0.463, emerged as the second most influential element in the impact of COVID-19 on building construction projects. Researchers presented a significant association between the effect of COVID-19 and psychological factors in the construction industry (Husien *et al.*, 2021, Pamidimukkala and Kermanshachi 2021, Pamidimukkala *et al.*, 2021). Pamidimukkala *et al.*, (2021) show that the COVID-19 pandemic has demonstrated the need to protect the physical and emotional health of construction workers. Because everyone needs to adjust to new ways of working, the health and safety of the construction industry's workers is more difficult than ever. Similarly as per Husien *et al.*, (2021), according to an evaluation conducted by the International Labor Organization, approximately 2.7 billion workers, constituting 81 percent of the worldwide workforce, are anticipated to experience the effects of COVID-19. This assessment unquestionably encompasses individuals employed in the construction sector. These workers have additionally grappled with notable psychological strains stemming from concerns about their prospects and the financial difficulties they may confront. This is particularly touching as a substantial portion of them bear financial responsibilities and have families to support.

Furthermore, with a t-value of 4.318 and a beta value of 0.359, individual factors (IDF) showed the third significant factor in COVID-19 impact on building construction projects. Some past research supported that individual factors (IDF) were significant predictors of the COVID-19 impact in building construction projects (Al Amri and Marey-Pérez 2020, Pamidimukkala and Kermanshachi 2021). Pamidimukkala and Kermanshachi (2021) demonstrated that the primary obligation lies with the individuals in addressing factors concerning their personal and family requirements while working on-site. This includes acquiring proficiency in diverse communication tools, surmounting technical challenges, experiencing a sense of insufficient contribution to work, and adapting to new work schedules. The significant impact of individual factors (IDF), supported by past research, underscores the crucial role of personal responsibility in navigating the challenges posed by COVID-19 in the construction industry. Addressing these factors requires individuals to enhance their communication skills, overcome technical obstacles, and adapt to new work routines to effectively contribute to project success during the pandemic.

Additionally, with a t-value of 3.396 and a Beta value of 0.293, operational factor is displayed as the fourth significant factor to the COVID-19 impact in building construction projects. Earlier authors' results have also supported our result that operational factors are a predictor of COVID-19 effects in construction (Sierra 2021, Stiles *et al.*, 2021, Timilsina *et al.*, 2021, Zamani *et al.*, 2021). Zamani *et al.*, (2021) find that COVID-19 impacting the building construction industry by causing operational issues. The operation is affected by project timelines due to shortening the time of construction activities and late approvals by related authorities. Similarly, Stiles *et al.*, (2021) discovered that the effective management of COVID-19 risk in construction involves adopting novel operational methods that integrate guidelines, implementing measures to mitigate the spread of COVID-19, and conducting testing and screening at construction sites, among other strategies. As well as Sierra (2021) also demonstrates the implementation of updated protocols to ensure on-site health and safety, such as hazard elimination, administrative adjustments to work practices, and measures to mitigate situations where complete social distancing is not achievable. Personal protective equipment is considered the last resort in this hierarchy (Tanko & Anigbogu, 2012).

Furthermore, with a t-value of 3.395 and a beta value of 0.266, the contractual factor emerged as the fifth most significant impact of COVID-19 on building construction projects. Some past research supported that contractual factors were a predictor of the COVID-19 effect in building construction projects (Yadeta 2020, Al-Mhdawi *et al.*, 2022). Yadeta (2020) demonstrated the importance for parties to thoroughly scrutinize their contract terms, especially any modifications to standard forms. This is crucial to ascertain the rights and responsibilities of both parties concerning extensions of time, entitlement to additional compensation, and the duties of the parties in the event of a site closure. Similarly, Al-Mhdawi *et al.*, (2022) conclude that prevalent contractual difficulties in construction projects encompass conflicting and ambiguous terms in contract documents, indistinct scope delineation, an ineffective negotiation process, and inadequate contract communication. These challenges about contracts can potentially result in legal repercussions, including fines and litigation for non-compliance with contractual stipulations, annulment of contracts that do not adhere to prevailing regulations, and even deterioration of relationships among the diverse project stakeholders.

Moreover, with a t-value of 1.996 and a beta value of 0.224, the financial factor was identified as the sixth most significant impact of COVID-19 on building construction projects. Past research supported that financial factors were a predictor of COVID-19 impact on building construction projects (Biswas *et al.*, 2021, Timilsina *et al.*, 2021, Zamani *et al.*, 2021). Timilsina *et al.*, (2021) showed that the decrease in the government budget has resulted in a reduction in the number of construction projects amid the COVID-19 pandemic. This has led to a declining financial state of contractors, primarily due to the subpar financial performance of the industry. Besides, contractors confronted the delinquent of late payment and over-cost runs of the projects. According to Zamani *et al.*, (2021) concluded that the COVID-19 pandemic has meaningfully affected the building construction industry, leading to various financial challenges. In such circumstances, most businesses find themselves in need of financial assistance. Consequently, these businesses must stay well-informed about both present and forthcoming financial support options provided by government and banking institutions.

CONCLUSION

This study thoroughly investigated the impacts of the COVID-19 pandemic on Nepal's building construction industry. The investigation included a thorough examination of a range of factors, including institutional, psychological, individual, operational, contractual, and financial. The path coefficients, beta values, and t-statistics have all been used to quantify the significant factors in determining the impacts of COVID-19. Notably, the institutional factor appeared as the most influential, highlighting the critical role of government and professional organizations in providing essential support and resources to help people negotiate the pandemic's obstacles. Similarly, psychological factor was observed as the second most significant factor, demonstrating the pandemic's devastating impact on the mental health of construction professionals. Likewise, individual, operational, and contractual factors all showed a significant relationship with the impact of COVID-19, emphasizing the industry's complex array of challenges. Additionally, although less significant, the financial factor still played an important role, highlighting the need for financial assistance measures. Based on the findings, the government and professional organizations must enhance institutional support and mental health services for construction professionals. Additionally, implementing comprehensive financial assistance programs will help mitigate the financial challenges faced by the industry during such pandemics.

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REFERENCES

- Abdullah, N. A., Mohd Kamar, I. F., Mustapa, N. A., Che Ahmad, A., Abdullah, M. N., & Syed Mustafa, S. A. H. (2021). Economic challenges: Conceptual framework on factors affecting construction cost during the COVID-19 pandemic in Malaysia. *IOP Conference Series: Earth and Environmental Science, 881*(1), 012020.
- Aibinu, A. A., & Al-Lawati, A. M. (2010). Using PLS-SEM technique to model construction organizations' willingness to participate in e-bidding. *Automation in Construction, 19*(6), 714–724.
- Al Amri, T., & Marey-Pérez, M. (2020). Impact of COVID-19 on Oman's construction industry. *Technium Social Sciences Journal, 9*, 661–670.
- Alenezi, T. A. N. (2020). The impact of COVID-19 on construction projects in Kuwait. *8*(4), 5.
- Al-Mhdawi, M. K. S., Brito, M. P., Abdul Nabi, M., El-adaway, I. H., & Onggo, B. S. (2022). Capturing the impact of COVID-19 on construction projects in developing countries: A case study of Iraq. *Journal of Management in Engineering, 38*(1), 05021015.
- Alsharef, A., Banerjee, S., Uddin, S. M. J., Albert, A., & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. *International Journal of Environmental Research and Public Health, 18*(4), 1559.
- Araya, F., & Sierra, L. (2021). Influence between COVID-19 impacts and project stakeholders in Chilean construction projects. *Sustainability, 13*(18), 10082.
- Bagozzi, R. R., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74–94.
- Bavel, J. J. V., & Baicker, K. (2020). Using social and behavioral science to support COVID-19 pandemic response. *Nature Human Behaviour, 4*(5), 460–471.
- Beraha, I., & Đuričin, S. (2020). The impact of COVID-19 crisis on medium-sized enterprises in Serbia. *Economic Analysis, 53*(1), 14.
- Biswas, A., Ghosh, A., Kar, A., Mondal, T., Ghosh, B., & Bardhan, Dr. P. K. (2021). The impact of COVID-19 in the construction sector and its remedial measures. *Journal of Physics: Conference Series, 1797*(1), 012054.
- Brooks, S. K., Dunn, R., Amlôt, R., Rubin, G. J., & Greenberg, N. (2018). A systematic, thematic review of social and occupational factors associated with psychological outcomes in healthcare employees during an infectious disease outbreak. *Journal of Occupational & Environmental Medicine, 60*(3), 248–257.
- Cassel, C., Hackl, P., & Westlund, A. H. (1999). Robustness of partial least-squares method for estimating latent variable quality structures. *Journal of Applied Statistics, 26*(4), 435–446.
- Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In *Modern Methods for Business Research* (pp. 295–336). Lawrence Erlbaum Associates.
- Chin, W. W. (2010). How to write up and report PLS analyses. In V. Esposito Vinzi, W. W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of Partial Least Squares* (pp. 655–690). Springer Berlin Heidelberg.
- Dangol, J., Chitrakar, S., & Yoo, K.-S. (2020). Impact of COVID-19 on Nepalese small and medium enterprises. *Journal of Business and Social Sciences Research, 5*(2), 1–14.
- Dinc, M. S., & Budic, S. (2016). The impact of personal attitude, subjective norm, and perceived behavioural control on entrepreneurial intentions of women. *Eurasian Journal of Business and Economics, 9*(17), 23–35.
- Ebekozien, A., Aigbavboa, C., & Samsurijan, M. S. (2023). An appraisal of blockchain technology relevance in the 21st century Nigerian construction industry: Perspective from the built environment professionals. *Journal of Global Operations and Strategic Sourcing, 16*(1), 142–160.
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.
- Gamil, Y., & Alhagar, A. (2020). The impact of pandemic crisis on the survival of the construction industry: A case of COVID-19. *Mediterranean Journal of Social Sciences, 11*(4), 122.
- Gefen, D., Straub, D., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems, 4*, 1–77.

- Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice, 19*(2), 139–152.
- Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. In R. R. Sinkovics & P. N. Ghauri (Eds.), *Advances in International Marketing* (pp. 277–319). Emerald Group Publishing Limited.
- Hoonakker, P., Carayon, P., & Loushine, T. (2010). Barriers and benefits of quality management in the construction industry: An empirical study. *Total Quality Management & Business Excellence, 21*(9), 953–969.
- Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal, 20*(2), 195–204.
- Husien, I. A., Borisovich, Z., & Naji, A. A. (2021). COVID-19: Key global impacts on the construction industry and proposed coping strategies. *E3S Web of Conferences, 263*, 05056.
- Israel, G. D. (1992). Determining sample size.
- Khanal, S., Shahi, T. C., Paudel, N., & Pokhrel, S. (2024). Analysis of challenges of post-earthquake reconstruction of health sector building projects in rural Nepal: A SEM approach. *Saudi Journal of Civil Engineering, 8*(6), 76–87.
- King, T. L., & Lamontagne, A. D. (2021). COVID-19 and suicide risk in the construction sector: Preparing for a perfect storm. *Scandinavian Journal of Public Health, 49*(7), 774–778.
- Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice, 13*(6), 522–526.
- Obradovich, N., Migliorini, R., Paulus, M. P., & Rahwan, I. (2018). Empirical evidence of mental health risks posed by climate change. *Proceedings of the National Academy of Sciences, 115*(43), 10953–10958.
- Pamidimukkala, A., & Kermanshachi, S. (2021). Impact of COVID-19 on field and office workforce in the construction industry. *Project Leadership and Society, 2*, 100018.
- Pamidimukkala, A., Kermanshachi, S., & Nipa, T. J. (2021). Impacts of COVID-19 on health and safety of workforce in construction industry.
- Pokhrel, S., & Acharya, P. (2024). Factors influencing university students' behavioral intention and use of eLearning in Kathmandu Valley. *Journal of Advanced Education and Philosophy, 8*(5), 364–376.
- Pokhrel, S., & Subedi, S. (2023). Factors affecting the use and understanding of nutrition labeling on food labels among Nepalese youths. *Kathford Journal of Engineering and Management, 3*(1), 50–61.
- Sharma, K., Banstola, A., & Parajuli, R. R. (2021). Assessment of COVID-19 pandemic in Nepal: A lockdown scenario analysis. *Frontiers in Public Health, 9*, 599280.
- Shumway, R., & Stoffer, D. (2011). *Time Series Analysis and Its Applications*. Springer New York, NY, USA.
- Sierra, F. (2021). COVID-19: Main challenges during the construction stage. *Engineering, Construction, and Architectural Management*.
- Stiles, S., Golightly, D., & Ryan, B. (2021). Impact of COVID-19 on health and safety in the construction sector. *Human Factors and Ergonomics in Manufacturing & Service Industries, 31*(4), 425–437.
- Sukamani, D., & Wang, J. (2020). Prospective safety performance in construction industries in Nepal. *Jordan Journal of Civil Engineering, 14*(4), 19.
- Sukamani, D., Wang, J., Kusi, M., & Shah, A. (2020). Impact of safety worker behavior on safety performance in construction firms of Nepal: A moderated mediation model. *28*(4), 16.
- Tandon, A., Roubal, T., McDonald, L., Cowley, P., Palu, T., de Oliveira Cruz, V., Eozenou, P., Cain, J., Teo, H. S., & Schmidt, M. (2020). Economic impact of COVID-19: Implications for health financing in Asia and Pacific. *World Bank.*
- Tanko, B. L., & Anigbogu, N. (2012). The use of personal protective equipment (PPE) on construction sites in Nigeria. Paper presented at the *Proceedings of the 4th West Africa Built Environment Research (WABER) Conference*.
- Thapa, P. (2021). Assessment of impact of COVID-19 lockdown on Nepal's construction sector based on selected construction project. *Journal of Advanced Research in Civil and Environmental Engineering*.
- The Asia Foundation. (2020). The impact of COVID-19 lockdown on Nepal's construction sector. *The Asia Foundation*.
- Timilsina, S. P., Ojha, S. K., & Dhungana, B. R. (2021). Impact of COVID-19 on the construction industry of Nepal. *Modern Economy, 12*(08), 1232–1244.
- Xiang, Y. T., Yang, Y., Li, W., Zhang, L., Zhang, Q., Cheung, T., & Ng, C. H. (2020). Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *The Lancet Psychiatry, 7*(3), 228–229.
- Yadeta, A. E. (2020). Analysis of the global impact of the pandemic (COVID-19) on construction industry: Possible scenarios. *Current Trends in Civil & Structural Engineering, 6*(4).
- Zamani, S. H., Rahman, R. A., Fauzi, M. A., & Yusof, L. M. (2021). Effect of COVID-19 on building construction projects: Impact and response mechanisms. *IOP Conference Series: Earth and Environmental Science, 682*(1), 012049.