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Investigation of Project Delays: Towards a Sustainable Construction Industry

Aftab Hameed Memon [1,*], Abdul Qadir Memon [1], Shabir Hussain Khahro [2,*] and Yasir Javed [3]

[1] Department of Civil Engineering, Quaid-e-Awam University of Engineering, Science and Technology, Nawabshah 67480, Pakistan
[2] Department of Engineering Management, College of Engineering, Prince Sultan University, Riyadh 11586, Saudi Arabia
[3] Department of Computer Science, College of Computer Information and Sciences, Prince Sultan University, Riyadh 11586, Saudi Arabia
* Correspondence: aftab@quest.edu.pk (A.H.M.); shkhahro@psu.edu.sa (S.H.K.)

Abstract: The construction industry is one of the key industries for any country. It has been observed that this industry is suffering from sustainable solutions during project execution. It is evident from the literature that most of the construction projects are seriously affected by delays. Pakistan's construction industry also suffers similar challenges. After the COVID-19 pandemic, the construction industry is experiencing several challenges which have resulted in project delays. Thus, this study investigates the key challenges affecting the timely completion of construction projects. The challenges were discovered from the literature and investigated to analyze their significance towards a sustainable construction project. This study also observes the relationships between the key challenges using Partial Least Squares Structural Equation Modeling (PLS-SEM). A structural model was developed based on the 55 common challenges identified from literature. Data collection was administered through a structured questionnaire survey using a 5-point Likert-scale. The challenges were grouped into six constructs. The outcome reported 20 critical challenges, with information and communication-related factors being the most important challenge in the construction industry. Contract management also significantly affects project time overrun. The created model served as a starting point for academics, researchers, and practitioners to create an effective system for regulating time overrun challenges.

Keywords: delays; project time overruns; construction industry; PLS-SEM; structural equation modeling; developing countries

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1. Introduction

Many countries around the world place a high value on infrastructure development as part of their development strategy, particularly those that are still economically developing. It is critical to the evolution of society and serves as the foundation for economic growth [1]. It is critical for the advancement of civilization, urbanization, and industrial development, as well as for raising living standards. According to the Pakistan Economic Survey 2019–2020, the construction sector is worth Rs 316 billion, but analysts believe it is worth between 10% and 13% of the country's GDP [2]. With the construction industry contributing between 2.33% and 2.85% during the last five fiscal years, it represents around 2.53% of Pakistan's GDP. The construction industry had to deal with a variety of issues to complete the project's objectives. As a result, there has been a lack of high-quality output as well as poor performance, especially in terms of cost and time overruns.

Time overruns in the construction industry have long been studied by researchers from around the world. Before 2016, 113 studies on this topic had been conducted. This emphasizes the severity of the problem [3]. Any construction project must be completed on time, on budget, and to the desired standard of quality [4]. These three objectives

are notoriously difficult to achieve in construction projects. Time overrun in construction projects affect overall project performance [5]. It has also been noted that the amount of time overruns in a project is negatively correlated with the quality level [6]. According to one study, 70% of all construction projects worldwide experienced time delays in 2017, with a magnitude of overruns as 10% to 30% of the scheduled time [7].

In Pakistan, construction projects frequently fall behind schedule and go over budget. However, with every construction project, some challenges must be carefully managed [8]. Construction projects in Pakistan are typically 11 to 30 percent behind schedule [9]. In a survey of 87 randomly chosen professional respondents (consultants, clients, or contractors), the following factors were discovered to be the main causes of time overruns: contractor financial difficulties, contractor inexperience, weather effects, delayed material deliveries, errors in design, a lack of skilled labor, an incompetent subcontractor, and inaccurate time estimates [10]. Understanding the behavior of looming factors is critical for avoiding or at least mitigating the impact of time overruns in Pakistani construction projects. Based on the above facts, a research question was developed; what are the key challenges faced by construction projects in Pakistan that cause project delays? Thus, the purpose of this study is to determine the challenges and root causes of time overruns in Pakistani construction projects. It established the structural relationships to prioritize the challenges by using Structural Equation Modeling (SEM), a sophisticated multivariate technique.

2. Causes of Delays in Construction Projects

The success of a construction project is determined by how quickly it is completed, how much it costs, how well it is completed, and whether there are any disagreements. As a result, time and cost are increasingly being used as key metrics for determining project success [11]. Time overruns in construction projects are common and are thought to be a global issue [12]. Time overrun is the tardiness with which tasks are completed after time has passed [13]. When a project takes longer than expected, the contract may need to be terminated to avoid increased costs, decreased productivity, and third-party claims. As a result, the project will take a long time to complete. Due to delay, the project incurs a higher cost which is not recoverable and creates unnecessary financial burdens. Thus, it is very essential to compete the projects on time. To complete projects on schedule, the first step is to recognize the challenges and reasons for delays so that required measures could be made.

Numerous studies have been conducted in various countries throughout the world to precisely identify the factors that contribute to building project time overruns. A thorough review of the literature was done to comprehend the problems with time overrun. Since 1971, when the first study was carried out regarding time overruns in construction projects in the United States of America, the researchers reported that weather changes, labor and material shortages, equipment problems, design changes, a lack of documentation of the design documents, substructure conditions, and flaws in the project's implementation are major contributors to time overrun [14]. Mezher and Tawil [15] investigated the factors that influence the length of time it takes to complete a construction project in Lebanon and identified 64 causes of delay. The study revealed that the owners had more concerns related to financial issues, while contractors ranked contractual relationships highest, and finally, A/E firms ranked project management highest.

According to an investigation by Odeh and Battaineh [16] among Jordan's construction consultants and contractors, the top challenges causing time overruns are interference from the business owner, issues with inexperienced or unqualified subcontractors, and problems getting financing or paying bills on time. According to a study of international development initiatives in India, Bangladesh, China, and Thailand, India had the most schedule delays (55 percent of the actual schedule). Variation was only permitted 13 percent of the time in China [17]. Like Acharya [18], who investigated time overruns in construction projects in Nepal's Gandaki province and shared some additional causes of time overruns, such as the availability of local construction materials, low contract bidding, the number of

ongoing projects at hand, a lack of consultant site staff, delays in site mobilization, delays in subcontractors' work, a shortage of necessary materials, and insufficient project planning and scheduling.

Unreasonably long contract durations set by clients, an overreliance on subcontractors, and lengthy wait times for permits from local authorities were discovered to be the most common causes of construction project delays in Morocco [19]. Project delays were also blamed on ineffective collective bargaining, ineffective planning and scheduling, and ineffective planning and scheduling. According to researchers in Nigeria who have studied the subject extensively, the most significant causes of time overruns are poor project time/duration estimates, project risk and uncertainty, project complexity, a lack of regulation and control, and a severe lack of financial resources [20]. As a result of a global investigation into delays in high-rise building construction projects, a mathematical model was developed, and the most important variables influencing the causes of construction project delays were identified in 2010. Delays were attributed to client, contractor, resource, and general issues. The goal of this research was to identify and categorize the causes of significant factors [21].

From the survey in Saudi Arabia, it was found that most significant risks factors contributing to the delay of building construction projects' completion are contractor's financial difficulties, owner's delay in making progress payments for completed works, contracts awarded to the lowest bidder, change orders during construction, ineffective project planning and scheduling by the contractor, shortage of manpower, and contractor's poor site management and supervision [22]. Currency depreciation, financial difficulties with completed work, a change in scope, and poor site supervision and scheduling were major challenges faced in Egypt which resulted in project delays [23]. The main causes of time overrun or delay in high-rise projects in India are design variation or scope change, poor planning, a lack of resources, and incorrect productivity calculation [24].

Time overruns are common in both developed and developing countries. This ongoing issue also affects Pakistan. Some Pakistani researchers have investigated the causes of construction project delays. The main reasons for time overrun concerns in Pakistan were found to be legal obstacles, such as court stay orders, land acquisition, and relocation of public infrastructure, as well as technical mistakes, such as subpar designs, rework, and mistakes at the bidding stage, and poor project management [25]. Pakistani highway projects experience schedule and expense overruns due to a variety of causes, such as inadequate planning, contractor incompetence, delays in handing over site control, extra work/scope revisions, and unsuitable government policies and objectives [26]. Haseeb et al. [27], on the other hand, identified 16 major reasons for delays in large construction projects in Pakistan, including poor site management, outdated technology, inaccurate time estimates, material quality, and payment delays to suppliers and subcontractors. The Water and Power Development Authority (WAPDA) in Khyber Pukhtunkhwa, Pakistan began three hydropower projects that ended up costing twice as much and taking twice as long to complete [28]. Jamil et al. [29] examined time slippage among public sector construction projects in Pakistan using three case studies on medium-sized projects and discovered that improper planning during various project phases had a significant negative impact on both cost and time. Due to a lack of in-depth investigation and advanced analysis for pointing out the critical factors of time overrun, this paper focused on using structural equation modeling (SEM) to assess causal relationships of the factors of time overrun to prioritize the critical issues. A thorough review of the literature on time overrun factors was conducted to achieve the study's goal, and the results are listed in Table 1 as 55 common time overrun factors divided into six groups.

Table 1. Factors causing time overrun in construction projects.

Construct	Item Code	Item Description	References
Contract Management	CM01T	Unsuitable construction methods	[19,30,31]
	CM02T	Inadequate planning and scheduling	[31–43]
	CM03T	Poor contract management	[31,33,36,38,44]
	CM04T	Mistakes and discrepancies in the contract document	[31,43,45]
	CM05T	A policy of lowest-cost bidding policy	[16,30,32,33,36,39]
	CM06T	Bureaucracy in tendering method	[33,38]
	CM07T	Inadequate monitoring and control	[33–36]
	CM08T	Fraudulent practices and kickbacks	[33,38]
	CM09T	Mode of financing, bonds and payments	[33,38,44]
	CM10T	Economic instability	[38]
	CM11T	Inappropriate overall organizational structure	[45]
	CM12T	Lack of constructability	[40,46]
	CM13T	Delay in obtaining permits from governmental agencies	[19]
	CM14T	Inaccurate site investigation	[33,46]
	CM15T	Unforeseen ground condition	[16,31,36,39,42,44]
Client Responsibilities	CR01T	Unnecessary interface by the owner	[31,39]
	CR02T	Financial difficulties of the owner	[30,46–48]
	CR03T	Delay in progress payment by the owner	[19,31,36]
	CR04T	Slow decision-making by owners	[45]
	CR05T	Change in the scope of the project	[16,23,24,31–35,37,41,42,46,47,49,50]
	CR06T	Unrealistic contract duration imposed	[16,19,31,33,38,40,42,50,51]
Design and Project Management	DPM01T	Frequent changes in design	[19,32,33,38–40,44,45]
	DPM02T	Delay in inspection and approval of completed works by consultant	[31,36,41]
	DPM03T	Mistakes and errors in design	[19,51]
	DPM04T	Delay in design	[43]
	DPM05T	Complicated design	[37]
	DPM06T	Inaccuracy in cost estimation	[43]
	DPM07T	Poor project management on site	[33]
	DPM08T	Poor financial control on site	[33,38]
Information and Communication	ICT01T	Lack of coordination between parties	[16,32,33,38,41,48]
	ICT02T	Lack of communication between parties	[16,19,31,39,42,45]
	ICT03T	Slow information flow between parties	[16,19,32,36,40,50]
Resource Management	RM01T	Shortages of materials	[19,24,31,34–36,44,46–48]
	RM02T	Late delivery of materials on site	[19,30,34–36,41,47,48]
	RM03T	Fluctuation of prices of materials on site	[19,30,32,33,36–39,41,43,45,46]
	RM04T	Poor quality of materials	[19,23,31,35,41,47]
	RM05T	Shortage of labour on site	[33,35,36,38–41,47,48]
	RM06T	Low productivity of labour	[31,35,40,42,47,48]
	RM07T	Shortage of technical personnel (skilled labour)	[16,19,36,41,42]
	RM08T	Relationship between management and labour	[33,38]
	RM09T	Lack of modern equipment	[47]
	RM10T	Delay in material procurement	[32,34,36,39,42]
	RM11T	High cost of machinery and its maintenance	[33,38]
	RM12T	Financial difficulties faced by contractors	[19,23,30,36,39,41,43,45]

Table 1. *Cont.*

Construct	Item Code	Item Description	References
Site Management	SM01T	Poor supervision on site	[16,19,31,39,42,48]
	SM02T	Lack of experience of the contractor	[19,23]
	SM03T	Mistakes during the execution of works	[31,36,40,45,48]
	SM04T	Incompetency of subcontractors	[31,40]
	SM05T	Number of projects going on at the same time	[33,38]
	SM06T	Waste on site	[33,38]
	SM07T	Schedule delay	[34,44,49]
	SM08T	Delay payment to supplier/subcontractor	[47]
	SM09T	Contractual claims, such as the extension of time with cost claims	[32]
	SM10T	Poor site management	[19,31,39,42,48]
	SM11T	Problem with neighbours	[31,41]

3. Structural Equation Modeling

Structural equation modeling (SEM) was used to investigate the structural relationships between various variables [52]. As a result of its rapid advancement, technology is now widely used across a wide range of fields and research areas [53]. The objectives and operating principles of partial least squares SEM (PLS-SEM) and covariance-based SEM (CB-SEM) differ. PLS-SEM can be used to develop new multivariable structural relationships, whereas CB-SEM can be used to validate existing theories. CB-SEM is used in confirmation studies, whereas PLS-SEM is used in exploration studies. Smart-PLS, a popular piece of software, allows for the creation and analysis of SE models. Multivariate analysis will be more convenient for researchers who have a large number of variables in their data. Its design is straightforward. SEMs are generated using a technique known as partial least theoretical path modeling [52,54]. The PLS analysis concept, which is commonly used in SEM design, can be used to measure the graphical model [55].

Smart-PLS is increasingly being used in scientific and business research. SEM is becoming more popular as a reliable analysis technique [56]. SEM can be used to enhance decision support systems, forecasting models, risk analysis, and other applications. For example, Doloi et al. [57] used SEM to analyze and pinpoint delays in Indian construction projects. Memon and Rahman [58] used SEM in Malaysia to identify potential causes of project cost overruns. Khahro et al. [59] used a PLS-based SEM method to modify the factors of green procurement. SEM was used by Liu et al. [60] to investigate how design-related risk affected the success of a design-build project. In Cambodia, SEM was used to assess service quality and customer satisfaction [61]. Rahman et al. [62] developed SEM to explain the causes and effects of changes in the UAE's construction industry. Li et al. [63] used SEM to develop a bid decision-making model. Due to its adaptability, SEM has grown in popularity among scientists [64]. A technique known as (SEM) can be used to investigate the relationships between a large number of independent variables and has received a lot of attention.

4. Hypothetical Model of Failure Factors of Pakistan Construction Industry

To determine the causative elements impacting the performance of the Pakistani construction sector, a hypothetical model must be built once all groups have been identified, classified, and all related factors have been defined for each group. A hypothetical model in Figure 1 depicts the relationship between the specified factors and the time overrun in the construction industry.

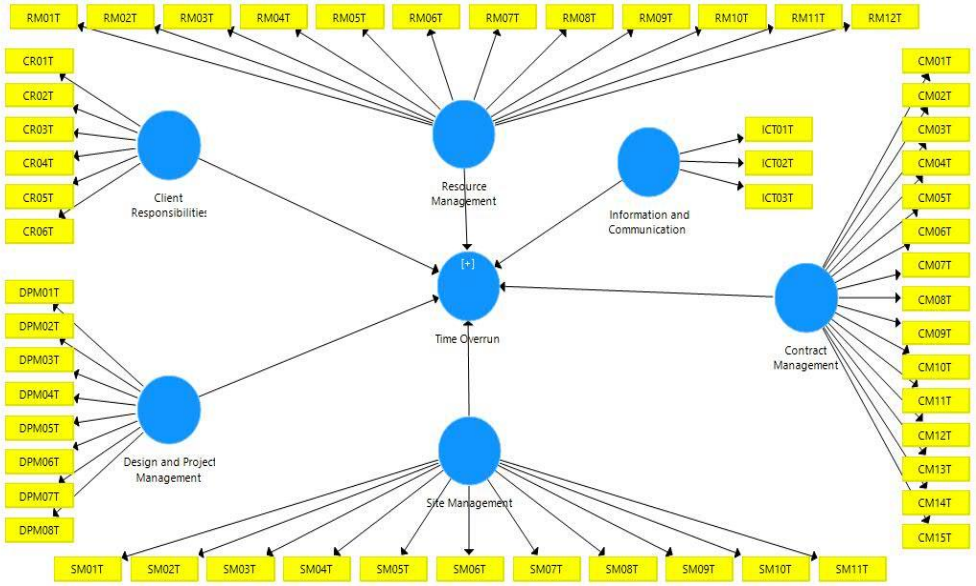


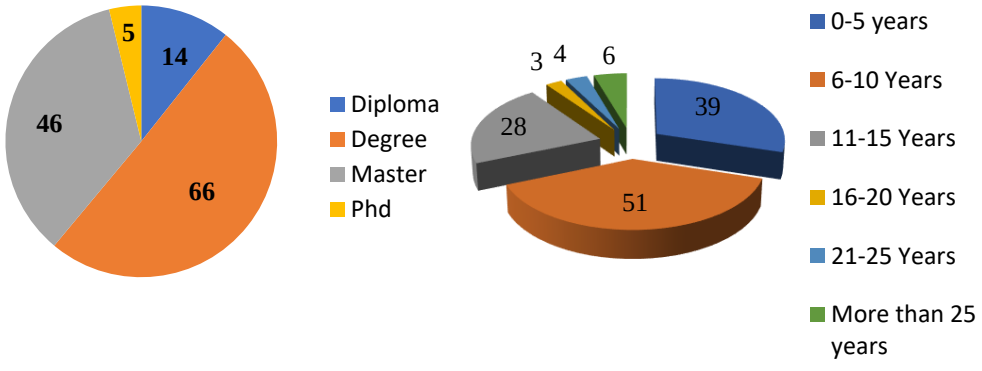
Figure 1. Conceptual model.

As shown in Figure 1, the proposed study model includes time overrun as a dependent variable. Each of the six groups/constructs has its own set of independent latent variables, such as Design and Project Management, Contract Management, Resource Management, Site Management, Client Responsibilities, and Information and Communication.

5. Research Methodology

Quantitative ordinal data were collected using a questionnaire. The goal of this survey was to learn more about how professionals in the Pakistani construction industry perceive the causes of time overruns. The practitioners' responses were recorded on a 5-point Likert scale, with 01 = Not Significant, 02 = Slightly Significant, 03 = Moderately Significant, 04 = Very Significant, and 05 = Extremely Significant. Contractors, consultants, and client organization representatives assigned to ongoing construction projects in Pakistan were given questionnaires at random. The data from the completed questionnaires were analyzed using factor analysis and structural equation modeling.

Only 140 of the 250 construction professionals who were given survey forms responded positively. As a result, 131 of these forms were subjected to data analysis, with nine forms being disregarded due to incompleteness or lack of information. In the data analysis questionnaire forms, 46 responses came from contractor organizations, 44 from consultants, and 41 from client organizations. As shown in Figure 2, the participants have several years of experience managing construction projects and have gained technical knowledge.



(**a**) Academic Qualification (**b**) Working Experience of the Respondent

Figure 2. Demographic information of the respondents.

The vast majority of survey respondents have engineering degrees, according to Figure 2. Furthermore, these respondents have a long history of working in the construction industry. The participants hold a variety of positions within the projects, including director, project manager, and engineer.

6. Assessment of Measurement Model

The measurement model and the structural model are the two stages of the PLS model assessment. To guarantee the validity of the measurement model and the appropriateness of the link between the latent variables and the indicators being measured [65,66]. The measurement model specifies how closely the indicators and the associated latent variable are correlated. Additionally, the measurement tools' correctness is verified [67]. The two forms of validity testing for the measuring model are model discriminant validity and individual item reliability [52,68].

Some parameters must be examined to confirm the measurement mode's converging validity. Composite reliability (CR), average variance extracted (AVE), and attribute item loading are the most commonly used parameters for confirming convergent validity. Typically, latent variables should explain at least half of the variance in the observed variable (i.e., the square of the loadings). As a result, indicators with outer loadings greater than 0.7 are permitted to be used [69–71]. Negative loading values should not be included in the analysis [72,73].

Convergent validity tests employ an iterative process in which constructs with negative loading or attributes with loading less than 0.7 are eliminated. In a single iteration, only one attribute can be removed from each construct. The Composite Reliability (CR) and Average Variance Extracted (AVE) metrics [74,75] can be used to reach this conclusion. The CR value must be at least 0.7 to validate the construct and its associated indicators [76]. In this study, the model was run through 12 iterations to achieve the required convergent validity. Table 2 shows the results of running the measurement model with the PLS algorithm.

Table 2. Convergent validity of the model.

Construct	Item Code	Loading	CR	AVE	Loading	CR	AVE
Contract Management	CM01T	0.464	0.874	0.321	Omitted	0.82	0.532
	CM02T	0.59			Omitted		
	CM03T	0.572			Omitted		
	CM04T	0.518			Omitted		
	CM05T	0.386			Omitted		
	CM06T	0.517			Omitted		
	CM07T	0.685			0.734		
	CM08T	0.548			Omitted		
	CM09T	0.612			0.691		
	CM10T	0.585			Omitted		
	CM11T	0.584			Omitted		
	CM12T	0.674			0.769		
	CM13T	0.603			0.723		
	CM14T	0.588			Omitted		
	CM15T	0.493			Omitted		

Table 2. *Cont.*

Construct	Item Code	Loading	CR	AVE	Loading	CR	AVE
Client Responsibilities	CR01T	0.638	0.798	0.405	0.668	0.826	0.544
	CR02T	0.712			0.744		
	CR03T	0.775			0.806		
	CR04T	0.68			0.727		
	CR05T	0.456			Omitted		
	CR06T	0.494			Omitted		
Design and Project Management	DPM01T	0.558	0.825	0.372	Omitted	0.796	0.565
	DPM02T	0.656			0.709		
	DPM03T	0.62			Omitted		
	DPM04T	0.549			Omitted		
	DPM05T	0.578			Omitted		
	DPM06T	0.592			Omitted		
	DPM07T	0.693			0.744		
	DPM08T	0.616			0.8		
Information and Communication	ICT01T	0.87	0.845	0.647	0.87	0.845	0.647
	ICT02T	0.811			0.812		
	ICT03T	0.725			0.724		
Resource Management	RM01T	0.56	0.795	0.251	0.755	0.743	0.5
	RM02T	0.519			Omitted		
	RM03T	0.447			Omitted		
	RM04T	0.323			Omitted		
	RM05T	0.256			Omitted		
	RM06T	0.538			Omitted		
	RM07T	0.578			0.69		
	RM08T	0.527			0.714		
	RM09T	0.541			Omitted		
	RM10T	0.509			Omitted		
	RM11T	0.604			Omitted		
	RM12T	0.498			Omitted		
Site Management	SM01T	0.599	0.836	0.32	Omitted	0.818	0.6
	SM02T	0.529			Omitted		
	SM03T	0.547			0.724		
	SM04T	0.657			0.744		
	SM05T	0.458			Omitted		
	SM06T	0.535			Omitted		
	SM07T	0.522			Omitted		
	SM08T	0.733			0.85		
	SM09T	0.536			Omitted		
	SM10T	0.539			Omitted		
	SM11T	0.513			Omitted		

Table 2 shows that after twelve PLS algorithm iterations, some items were excluded from each iteration because factor loading values fell below the model evaluation cutoff points [52]. During this process, 28 of the 55 elements were eliminated, leaving 20 important factors. Following the evaluation of the model, a discriminant validity test was performed. A discriminant validity test was performed to determine how each construct differed from the others [77,78]. Discriminant validity is determined by examining the correlations between measures or any potential overlaps between the constructs [2]. The sign that a latent variable explains more of its variance than another latent variable controlled by the square root of its average variance (AVE) is used to measure variable correlation [72]. In this study, cross-loading analysis with generated construct scores and average variance analysis with latent variable correlations were both used to assess discriminant validity. Table 3 shows the results of the cross-loading analysis.

Table 3. Analysis of cross-loadings of factors.

Item Code	Construct					
	Contract Management	Client Responsibilities	Design and Project Management	Information and Communication	Resource Management	Site Management
CM07T	0.734	0.404	0.435	0.284	0.391	0.404
CM09T	0.691	0.368	0.451	0.372	0.369	0.298
CM12T	0.769	0.531	0.423	0.359	0.433	0.469
CM13T	0.723	0.366	0.322	0.372	0.354	0.389
CR01T	0.411	0.668	0.389	0.285	0.367	0.429
CR02T	0.404	0.744	0.356	0.264	0.398	0.476
CR03T	0.483	0.806	0.441	0.38	0.359	0.521
CR04T	0.39	0.727	0.439	0.242	0.308	0.481
DPM02T	0.385	0.269	0.709	0.354	0.381	0.41
DPM07T	0.482	0.448	0.744	0.441	0.352	0.569
DPM08T	0.4	0.506	0.8	0.329	0.256	0.424
ICT01T	0.424	0.419	0.395	0.87	0.519	0.437
ICT02T	0.369	0.261	0.356	0.812	0.394	0.265
ICT03T	0.367	0.256	0.451	0.724	0.402	0.412
RM01T	0.314	0.143	0.175	0.428	0.755	0.233
RM07T	0.435	0.543	0.44	0.333	0.63	0.449
RM08T	0.412	0.437	0.363	0.393	0.714	0.377
SM03T	0.406	0.454	0.465	0.402	0.34	0.724
SM04T	0.356	0.423	0.398	0.207	0.305	0.744
SM08T	0.473	0.609	0.543	0.447	0.435	0.85

In Table 3, bold variables indicate the loading values of the variables with respect to their relative construct. It shows that variables in one construct have a higher loading than variables in other constructs. Since all of these variables are consistent with their respective constructs, this is a resounding endorsement. The square root of each construct's AVE must be larger than the correlation between the two constructs to guarantee full discriminant validity. Table 4 displays the value of the square root of the AVE in place of the diagonal correlation matrix in this case.

Table 4. Latent variable correlations (Fornell–Larker criteria).

Construct	AVE's Square Root					
Client Responsibilities	0.738					
Contract Management	0.574	0.73				
Design and Project Management	0.55	0.554	0.752			
Information and Communication	0.404	0.481	0.488	0.804		
Resource Management	0.479	0.53	0.427	0.553	0.701	
Site Management	0.648	0.535	0.61	0.465	0.47	0.775

The latent variable correlations for all four constructs in Table 4 emphasize the square root of AVE. The diagonal bold values represent the AVE value of constructs with parent construct. This illustrates the discriminant validity of Hulland's concept, which claims that items in rows and columns that are diagonal are greater than those that are off-diagonal [47]. In the next stage, the overall structural equation model is presented.

7. Structural Model Assessment

After the measurement has been proven to be accurate, the structural model is tested. Figure 2 depicts the outcomes of the Smart-PLS-created structural model.

Endogenous R^2 of 0.26 or higher is considered significant. If R^2 is less than or equal to 0.02 and greater than or equal to 0.13, but less than or equal to 0.26 [79], it is considered weak. Figure 3 shows that R^2 for the endogenous variable, time overrun, is 0.484, indicating that the model's ability to explain events is significant. Furthermore, the model demonstrates that communication and information issues are the primary causes of time overruns. The second most important factor contributing to time overruns in Pakistani construction projects is contract management. Contract management is critical to the success of construction projects. The detailed challenge categories and key challenges are shown in Table 5.

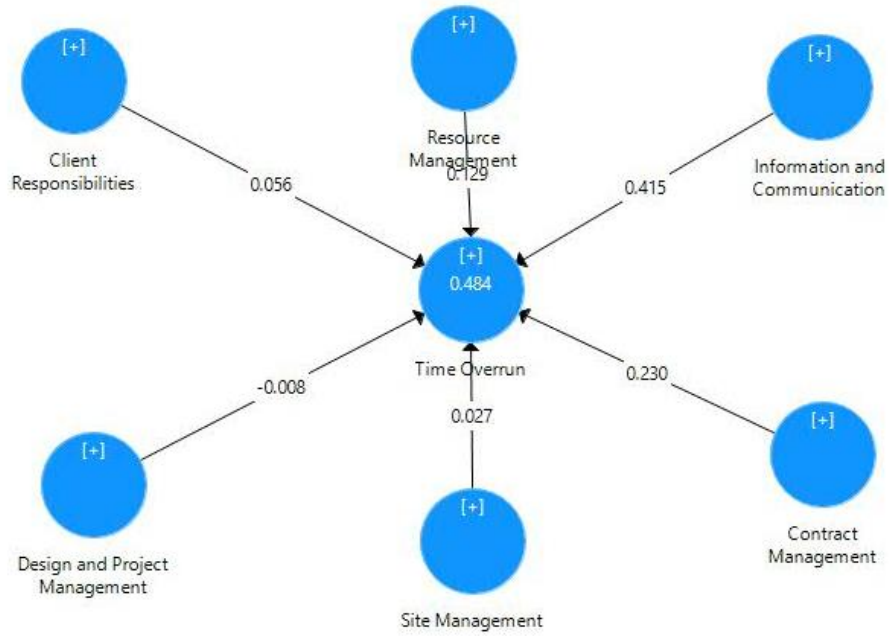


Figure 3. Result of structural model.

Table 5. Key challenges to delay in construction projects.

Challenge Category	Key Challenges	Rank
Contract Management	Lack of constructability (0.769)	6
	Inadequate monitoring and control (0.734)	9
	Delay in obtaining permits from governmental agencies (0.723)	12
	Mode of financing, bonds and payments (0.691)	15
Client Responsibilities	Delay in progress payment by the owner (0.806)	4
	Financial difficulties of the owner (0.744)	8
	Slow decision-making by owners (0.727)	10
	Unnecessary interface by the owner (0.668)	16
Design and Project Management	Poor financial control on site (0.8)	5
	Poor project management on site (0.744)	8
	Delay in inspection and approval of completed works by consultant (0.709)	14
Information and Communication	Lack of coordination between parties (0.87)	1
	Lack of communication between parties (0.812)	3
	Slow information flow between parties (0.724)	11
Resource Management	Shortages of materials (0.755)	7
	Relationship between management and labour (0.714)	13
	Shortage of technical personnel (skilled labour) (0.63)	17
Site Management	Delay payment to supplier/subcontractor (0.85)	2
	Incompetency of subcontractors (0.744)	8
	Mistakes during the execution of works (0.724)	11

8. Assessment of the Overall Model

The overall validity and explanatory power of the model were evaluated using the Goodness of Fit (GoF) index. The geometric mean of the average communality of all endogenous constructs and R^2 are used to get the GoF value [80]. This technique is used to determine the model's overall predictive power [81]. There is a GoF value between 0 and 1 [82]. Akter et al. [83] proposed GoF cut-off values determined by using 0.50 as the communality value and plotting the various R^2 effect sizes as GoFsmall (0.10), GoFmedium (0.25), and GoFLarge (0.36). The current study's GoF was calculated using the equation proposed by Akter et al. [83].

GoF = $\sqrt{}$AVE × RSquare (Source: [83])
GoF = $\sqrt{}$(0.563 × 0.0.484)
GoF = 0.522

According to the equation, the GoF value of the developed model, 0.522, is greater than the GoF value required for a large effect, as presented above. This suggests that the developed model has a high level of explanatory power. The findings of this study will enable Pakistani construction professionals to take appropriate action to resolve issues and complete projects on time.

9. Contribution of Findings to United Nations Strategic Development Goals

The findings of this paper contribute to SDG9 (Industry, Innovation and Infrastructure) and SDG11 (Sustainable Cities and Communities) of the United Nations' long-term plans as shown in Figure 4.

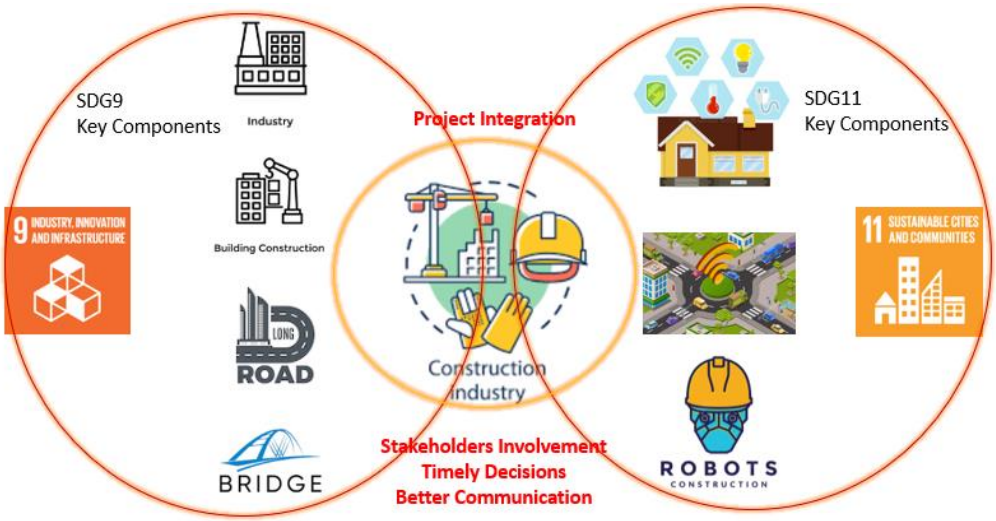


Figure 4. Contribution to UN-SDG's.

The findings of the study contribute to two key elements, which are industrial innovation and sustainable projects. This industry has witnessed various projects which suffer delays due to highlighted challenges in this study. The projects are getting complex and designs are being innovative. Thus, traditional construction practices do not meet the challenges of the current construction industry revolution. New approaches, methods, materials, and equipments are required to meet the current challenges to attain sustainability in this important industry [59,60]. Industries are changing, their design requirements are shifting from traditional processes to new optimized processes. Similarly, the building and infrastructure methods are also changing in the current informative revolutionized world. Therefore, in the future, machines will be smart and robots will replace workers. Further, 3D printing, robots, artificial intelligence, and virtual reality will bring a major impact, so it is very important to explore the key challenges towards the timely completion of construction projects [84]. Thus, the findings of this research can assist planners and decision-makers to make informed decisions and design new guidelines and policies accordingly.

10. Limitations and Implications

This research work was carried out based on a survey gathered from the respondents via structured questionnaires to identify and assess the significant challenges causing a delay in construction projects in Pakistan. The majority of the respondents belonged to the Sindh province. The contribution of practitioners from other provinces could also be extended, as well as a case study should be carried out to understand the behavior of these challenges. This study, however, fills in the knowledge gap concerning the examination of project delays in the construction sector. As a result, it presents a document that acts as a standard for research on project delays and construction management, particularly in developing countries. Future researchers can validate their findings by using the useful findings of this study to further investigate areas related to delay in other regions or other nations. Further, to reduce or avert the potential effects of construction project delays on the industry, the findings of this study will be helpful for policymakers, project developers, and other key stakeholders in guiding regarding the most important factors that influence delays in Pakistan. These identified challenges could also serve as a guide for creating the short- and long-term evidence-based strategies and measures needed to reduce or completely eradicate the effects of construction project delays.

11. Conclusions and Discussion

Numerous challenges and obstacles have hampered the construction industry worldwide. The construction industry has been struggling with the problem of persistent

delay [85]. Through exploratory and investigative studies, researchers have attempted to address the issue and identify the primary causes of construction delay [9,85–89]. The first step in offering potential solutions is identifying the causes of construction delay, but further research is needed to provide prescriptive tools to mitigate delay [90]. A detailed literature review identified 55 common factors that were divided into six categories that delay construction projects. The six key areas of concern observed were contract management, site management, design and project management, resource management, client obligations, and information and communication. This research investigated the relationship between these constructs and delay challenges using the PLS-SEM method. The study discovered that information and communication have a significant impact on the timely completion of projects in the construction industry. Fashina et al. [91] also reported that poor communication is one of the most significant causes of project delays in Hargeisa. Further, it is crucial that consultants ensure proper communication and coordination among project stakeholders because they act as a liaison between the client and contractors [92]. Proper communication will be helpful to prevent delays [93]. Furthermore, contact management has a significant impact on project time. Contract management plays an essential role in the timely completion of projects [90,94]. The highlighted serious challenge can be managed by establishing an efficient and effective communication protocol among contractual parties during both the design and supervision stages. The construction sector's electronic communication culture should be improved and encouraged while maintaining a high level of transparency and clarity. For improving communication and information systems, it is essential to promote team-building communication processes. Additionally, establishing rules and regulations for communication among construction parties as well as adopting a clear information and communication channels will be helpful in reducing time delays. Regular meetings should also be arranged for improving communication. To avoid the issue due to poor contact management, the contracts should be clear, well presented, and signed among parties. An effective process should be designed or adopted by this industry to manage the resources of projects.

This study can be extended to cost overrun challenges to the construction industry as it has been observed that it is also one of the key challenges this substantial industry is suffering. A general combined model can also be designed to analyze a bigger picture of time and cost delay challenges in construction projects.

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