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Impact of Occupational Safety Compliance on Cost and Duration of Construction Projects in Pakistan

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Abstract

The construction industry significantly contributes to economic stability and employment generation globally. However, persistently high accident rates underscore widespread deficiencies in safety compliance. This study investigates the direct impact of occupational safety compliance on the cost and duration of construction projects. A quantitative research methodology was employed, utilizing a structured survey to collect data from safety compliance practitioners, including clients, consultants, and contractors, across eight large-scale construction projects in Pakistan. Data normality was confirmed, and Pearson correlation analysis was applied to evaluate relationships. The findings reveal a positive correlation between occupational safety compliance and both project duration and overall project cost. These results underscore the importance of integrating safety compliance with effective project management to achieve a balanced approach that enhances worker safety while optimizing project efficiency. This study provides valuable insights for stakeholders aiming to improve safety practices without compromising project objectives, contributing to the broader discourse on safety management in construction.

1. Introduction

It is acknowledged globally that the construction industry plays a paramount role in a country's economic and infrastructural development, particularly in developing countries [1]. However, substantial challenges are posed as well as opportunities arise due to the rapid development of urban areas [2].

The growth in construction work has been witnessed in various parts of the world and has led to the identification of diverse challenges. These diverse challenges include compliance with occupational safety standards during project execution [3]. The necessity of complying with occupational safety regulations shouldn't be overstated; nevertheless, it is frequently jeopardized to reduce costs and to expedite project completion [4]. The process of implementing safety measures on construction sites of large-scale projects poses unique challenges due to the intrinsic complexity of the projects and the large number of workers involved [5]. Nonetheless, occupational safety compliance has significant long-term benefits by minimizing the occurrences of accidents [6]. Conversely, neglecting security protocols can lead to costly repercussions in terms of loss of assets, legal issues, unscheduled delays, and fatalities [7]. Furthermore, implementing occupational safety has the potential to

strengthen employee morale and productivity, which tangentially benefits the company in terms of reputation and employee retention [6].

In Pakistan, there has been a visible growth in the construction industry, signifying its substantial contribution to the gross domestic product (GDP) and employment of the Pakistani workforce [8], [9]. Despite accelerated development, this industry is confronting challenges of integrating standards of workers' safety and project sustainability [10]. The main causes of these challenges are financial limitations and lack of time; therefore, the stakeholder is inclined towards cost cutting and time saving to enhance profitability [11]. Global studies suggest that safety is a shared responsibility of all the involved individuals and there are numerous benefits of implementing safety at the workplace. However, in Pakistan, it is perceived that occupational safety compliance in a construction project is the sole responsibility of the contractor and approved public construction projects do not allocate funds or extra duration for it, either in the Annual Development Plan (ADP) or the Public Sector Development Program (PSDP) [10], [11], [12]. The mindset reform is essential to transforming the way the industry perceives safety altering safety from a cost burden to a strategic investment [10]. The importance of integrating safety into project planning is emphasized with the growing demand for safer construction techniques [13].

2. Occupational Safety in Construction Industry

In the construction industry, occupational safety plays an important role in the construction management due to its ethical, practical, and financial significance in the project lifecycle [17]. In construction industry, the occupational safety is characterized by a comprehensive set of regulations, practices, and protocols, all designed to ascertain safety of individuals involved in construction [18]. In the construction industry, safety compliance is vital due to the numerous dangers and intricate tasks involved [19]. Construction companies have a moral obligation to protect workers from accidents, injuries, and fatalities. Neglecting safety measures can lead to significant disruptions, project delays, and cost overruns. Conversely, strict adherence to safety standards can enhance project efficiency and ultimately lead to improved profitability [20].

The global perspective on occupational safety within the construction industry underscores its crucial importance in the context of economic and infrastructural development [21]. Occupational safety catalyzes economic growth, generating employment opportunities, stimulating investment and contributing to the creation of essential infrastructure [11], [22]. The trend of rapid urbanization, marked by increasing migration from rural to urban areas, has led to a surge in the demand for housing, commercial spaces, and transportation systems impacting the construction industry on a global scale [23].

In the context of occupational safety, the construction industry faces a unique set of challenges and opportunities. One of the primary challenges in occupational safety compliance during construction is the persistent tension between cost reduction and safety compliance. Construction projects often operate under tight budgets and timelines, leading to a temptation to cut corners on safety measures to save time and money [24]. Such compromises can lead to inadequate safety training, subpar equipment, and insufficient safety protocols escalating the risk of workplace accidents [25]. Additionally, the imperative for speedy project completion can jeopardize safety, as accelerated schedules may pressure workers and contractors to prioritize speed over safety increasing the risk of accidents and injuries [26].

Studies have indicated that compliance with safety standards enhances project efficiency and cost-effectiveness. These studies present alarming data on the frequency and consequences of construction-related accidents, such as falls, machinery mishaps, and exposure to hazardous materials. The resultant injuries, disabilities, and fatalities represent not only human tragedies but also financial burdens in terms of medical costs, legal liabilities, and project delays. Ensuring occupational safety compliance in construction projects is a formidable task, fraught with significant challenges that require careful consideration [27]. Safety measures not only protect workers but also impact project outcomes directly. These measures, while potentially involving initial costs, offer long-term benefits in terms of reduced expenses, increased productivity, and accident prevention presenting compelling reasons for their adoption.

2.1 The Effect of Occupational Safety Measures in Construction Practices

Failure in adhering to safety regulations and standards can result in costly legal battles, fines, and penalties [28]. Operational consequences are also significant. Neglecting safety can lead to work stoppages, delays, and disruptions in project timelines. Inadequate safety measures can also result in damage to equipment, materials, and property incurring additional costs and delays [29]. Improved safety practices in construction projects, on the other hand, have a substantial positive impact on workers' morale and productivity, which, in turn, has indirect but significant effects on project timelines and costs. The impact of workers' morale and productivity on project timelines and costs is indirect but significant. When workers are motivated and engaged, they tend to work more efficiently, make fewer errors, and complete tasks on time. This leads to smoother project progression, reduced work stoppages, and minimized delays. Moreover, a motivated and productive workforce can help optimize

resource utilization [30]. It is important to note that the positive effects of safety on workers' morale and productivity extend beyond the construction phase. Construction workers who experience a safe and supportive work environment are more likely to stay longer with the company reducing turnover and recruitment costs [31].

2.2 Dynamics of Pakistan's Construction Industry

The construction industry in Pakistan has undergone significant growth and development in recent years encompassing various activities such as residential and commercial construction, infrastructure development, and public works projects. Factors such as urbanization, population growth, and government investments in infrastructure have contributed to the industry's expansion. This growth not only generates substantial revenue but also provides employment opportunities for a diverse workforce, including skilled and unskilled labor, consequently impacting poverty reduction and economic development in Pakistan [32].

In the context of Pakistan's construction and infrastructure development, Karachi, as the largest and most populous city in the country, plays a crucial and central role. Being an economic and industrial hub, Karachi is a focal point for numerous construction activities. The city's growing population is a significant driver of its importance in the construction industry. Urbanization in Karachi has resulted in a higher demand for housing, commercial spaces, and transportation networks making it an attractive destination for real estate developers and construction companies seeking to meet the escalating demand for infrastructure and housing [12].

Furthermore, Karachi's strategic location as a major port city enhances its significance in infrastructure development. The city's port facilitate international trade and commerce necessitating the expansion and maintenance of transportation and logistics infrastructure, including roads, highways, and the port itself [33].

2.3 Challenges in Occupational Safety Compliance in Pakistan's Construction Industry

The construction industry in Pakistan faces specific safety challenges that can be exacerbated by inconsistent enforcement of safety standards. While regulations and guidelines exist to ensure safe working conditions, their implementation can be inconsistent due to factors such as corruption, inadequate regulatory oversight and a lack of awareness among construction companies and workers [34]. Additionally, many workers in Pakistan's construction industry lack adequate training and awareness regarding safety practices. Some construction sites in Pakistan may inherently possess unsafe work environments due to factors such as inadequate safety equipment, poorly maintained machinery, and substandard construction materials. Moreover, the densely populated urban areas make effective implementation of safety measures challenging, especially when construction projects are situated near residential neighborhoods and commercial zones [35].

Research on workplace accidents and project delays in Pakistan's construction industry highlights significant concerns. Nevertheless, recent years have seen a transformation in the construction industry in Pakistan, marked by an increasing recognition of safety as an essential component of sustainability and reputation [11]. This shift in perspective reflects a growing understanding of the need to balance rapid development with safety imperatives in the construction industry [36], [37].

To address these challenges, construction firms must adhere to and even exceed safety regulations. Implementing robust safety protocols, and training programs and leveraging modern technology can minimize accidents and injuries without slowing down projects. Emphasis should be placed on proactive risk assessment and mitigation. Achieving a balance between rapid development and safety necessitates a holistic approach that prioritizes safety standards, preventive measures, worker empowerment, and collaboration among stakeholders.

2.4 Cost, Duration and Safety in Construction

The construction industry requires a delicate balance between project cost, duration, and employee well-being to ensure a safer work environment [38]. Efficient management is crucial to understanding the relationship between project cost, duration, and occupational safety [39]. Financial limitations with cost-cutting can compromise safety measures impacting safety protocols and equipment quality [40]. Insufficient funding for safety training increases accident risks in construction work; however, investing in safety programs and innovative technologies can significantly decrease workplace accidents and injuries [41]. Project deadlines, with expedited schedules, can impact safety practices and results leading to faster work, increased worker fatigue, and compromised safety rules [42]. Conversely, realistic schedules with time for safety training and adequate breaks can improve safety outcomes [41], [42]. The integration of cost and duration management for the implementation of occupational safety in construction settings is essential [43]. This initiative involves allocating funds, prioritizing safety in scheduling, and fostering a safety-focused culture. Further, this approach ensures safety as a fundamental aspect of project success and helps align with industry morale and ethical standards, which ultimately contribute to long-term sustainability and success [13].

The available literature presents two different perspectives on how safety compliance (SC) influence project cost (PC) and project duration (PD). The studies suggest that higher SC increases both cost and duration due to

the need for additional training, safety equipment, inspections, and procedural adherence, which may slow work progress [3], [6], [26], [41]. However, other studies discusses that strong SC improves productivity and reduces long-term costs by preventing accidents, minimizing disruptions, and enhancing worker morale and performance [4], [19], [20], [34], [44]. These both perspectives support the relationship among SC, PC and PD and existing literature provides theoretical grounding for examining SC, PC, and PD as distinct but interrelated dimensions in this research.

The literature on occupational safety within the construction industry has yielded extensive insights into various aspects of safety regulations, their enforcement, and practices. The latest studies have significantly contributed to understanding occupational safety within the construction industry by focusing on individual elements such as accident analysis, adherence to safety regulations, safety culture, and compliance statistics [45]. These investigations have laid a solid foundation by highlighting various aspects of safety management. However, a notable gap remains in the context of Pakistan and there exists an opportunity to expand this body of knowledge. The regulatory framework governing occupational safety compliance in Pakistan, namely the "Pakistan Occupational Health and Safety Act of 2018," provides a general guideline for occupational health and safety. It emphasizes the need for a balanced and nationally consistent approach to secure the health and safety of workers [46].

3. Research Methodology

The study evaluates the immediate impact of occupational safety compliance on the cost and timeline of large-scale residential building construction projects in Karachi, Pakistan. The rationale for selecting Karachi as the focus of our study is that the city accounts for a significant share of national economic activity and many of the country's large-scale building construction projects are executed in Karachi [14]. It accommodates a diverse portfolio of project types, including high-rise complexes, transportation networks, and industrial facilities [15]. Furthermore, the statistics presented on official website of Pakistan Engineering Council (PEC) validate that Karachi has 93 head office of leading contractor firms that operate across the country and are authorized by PEC to undertake projects without cost limitations [16]. This establishes that Karachi is also among the earliest locations where national development policies and safety regulations are implemented at scale, making it a reliable substitute for assessing national-level trends.

This study is particularly relevant to clients, consultants, contractors, and regulatory authorities who need to integrate safety compliance with project cost and schedule management. The findings offer evidence to support informed decision-making on safety protocols and project planning in Pakistan's construction industry.

In this research, a quantitative method was adopted to measure and analyze specific variables, including occupational safety compliance, project cost, and project duration, using structured instruments and statistical techniques. Variables are measurable elements of interest that allow researchers to examine relationships and test hypotheses. [47]. To evaluate the impact of occupational safety compliance on project cost and project duration in large-scale residential building construction projects in Karachi, a structured questionnaire was developed based on an extensive review of relevant literature. The questionnaire was refined through feedback from experts, including senior safety managers and academic researchers specializing in construction management. These experts assessed the questionnaire for content relevance, clarity, and comprehensiveness, ensuring that each item accurately represented the intended construct. The final instrument comprised three constructs corresponding to the three variables under study, namely adherence to safety standards, project cost, and project duration. The subsequent sections provide a detailed discussion of the development, validation, and reliability testing of the questionnaire, as well as the procedures for sample selection, data collection, and data analysis.

3.1 Development of the Questionnaire

The development of the questionnaire was initiated through a comprehensive review of the relevant literature. In addition to peer-reviewed publications were used as sources from government reports [48], industry publications [49], and professional safety guidelines [16]. Based on these studies [50], [51], the questions assessed various aspects of safety compliance encompassing adherence to safety practices [52], the frequency of training, and the use of safety equipment. The aggregated findings from the various sources served as the foundation to develop the questionnaire. The questions that could gauge or perceive impacts on project costs and duration and address issues such as budget overruns, delays, and their reasons were crafted. This approach ensured the development of a comprehensive and relevant questionnaire [53]. The questionnaire, developed with strict adherence to established guidelines and methodological frameworks, comprised two separate sections. The first section was structured to encompass demographic inquiries. The second section includes questions related to safety compliance, project cost, and project duration.

3.2 Validity and Reliability of the Questionnaire

In this study, a comprehensively developed questionnaire was adapted to assess the impact of safety compliance on project cost and duration. This questionnaire, containing 13 items, employed a five-point Likert scale (1 = Strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly agree) to offer a quantitative measure for gauging respondents' perspectives. The questionnaire was validated for its content and construct by two academicians and three senior safety managers, respectively. This validity ensured that the questionnaire measured all aspects of the construct being studied.

Moreover, the reliability of the modified scale demonstrates that internal reliability ranging from 0.81 to 0.91 is considered acceptable [54]. The data acquired by this tool was tested to ascertain its reliability. The value of Cronbach Alpha obtained from the test was in the acceptable range of 0.81 to 0.91 indicating good reliability. Although numerous studies have addressed safety compliance, there has been a lack of recent literature assessing its direct impact on project cost and duration, particularly in the context of Pakistan. Therefore, conducting this study in this context was deemed highly necessary.

3.3 Population, Sample Size and Sampling Technique

This research sourced data from eight distinct construction sites involved in a large-scale residential-building project in Karachi. These specific sites were chosen due to their project profiles, which included an approved budget for occupational safety and a dedicated time allocation to implement safety measures within the construction schedule. To achieve focused insights, purposive sampling was applied targeting manager-level respondents who were directly involved in procuring safety equipment and overseeing the training and development of construction workers. Additionally, it was ensured that all the respondents had a minimum of three to six years range of experience in the construction industry as safety professional. Data collection was conducted through structured questionnaire surveys administered to this targeted group resulting in responses from 116 safety professionals. For quantitative research, a sample size of at least 100 participants from the relevant population is generally deemed adequate for statistical validity [53], [55].

3.4 Data Collection

The data collection approach in this study was characterized by a structured quantitative survey methodology, as outlined by [53]. This methodology facilitated the collection of data on variables specifically focusing on the impact of safety compliance on project cost and duration. The researcher personally conducted in-person data collection targeting a carefully selected sample from the population. The selection criteria for suitable respondents included the type of organization they belong to, job responsibility, working experience and academic qualification. These criteria were established to ensure a comprehensive representation of perspectives of occupational safety within the construction industry.

The survey participants included safety managers, supervisors, engineers, and consultant safety practitioners, all of whom participated voluntarily. Data collection was carried out across eight different construction sites of large-scale residential buildings in Karachi, Pakistan. The demographics of these participants are detailed in Table 1.

Table 1 *Demographics of survey respondents*

Description	Characteristic	Responses	Description	Characteristic	Responses
Type of Organization	Contractors	64	Working Experience	3-6 years	79
	Consultants	44		7-9 years	23
	Clients	8		10-12 years	14
Job Responsibilities	HSE Manager	28	Highest Qualification	Professional Course	66
	Safety Engineer	23		Master	15
	HSE Supervisor	51		Bachelor	31
	Other	14		Other	4

3.5 Data Analysis

The data collected were systematically organized and entered into the Statistical Package for Social Sciences (SPSS) software, version 27.0. To describe the variables such as Occupational Safety Compliance, Project Cost, and Project Duration, descriptive statistics were employed wherein the mean and the standard deviation were

computed. Additionally, correlational statistical analysis was applied. Specifically, Pearson correlation analysis was utilized to determine the relationship between Safety Compliance and Project Cost, as well as Safety Compliance and Project Duration, within the context of Karachi, Pakistan.

4. Results

The results obtained from both the descriptive and correlation analyses are comprehensively presented. To evaluate the influence of safety compliance on the total cost and duration of large-scale building construction projects in Karachi, a thorough investigation was conducted. This involved calculating the mean and standard deviation and also applying Pearson's correlation method. These statistical approaches were essential to thoroughly understand and quantify the relationship between safety adherence and key project metrics such as overall cost and completion time in these significant construction projects.

4.1 Perception Relating to Project Cost and Duration in Safety Compliance

Descriptive statistics represents the average value of a dataset, providing a typical measure of the data. The mean value of the questionnaire data helps summarize the overall response of the respondents to a construct of project cost and project duration [56].

The data presented in table 2 summarize respondents' perceptions of safety compliance with respect to project cost and duration. The respondents were asked about safety practices and their implications for project cost and duration in Pakistan. The results of project cost, the mean value of 2.61 (on a scale where 1 = Strongly Disagree, 3 = Neutral, and 5 = Strongly Agree) falls between “Disagree” and “Neutral,” suggesting that respondents slightly leaned toward disagreement, though not entirely. The relatively low standard deviation of 0.29 indicates that responses were consistent across the sample. For project duration, the mean value of 2.39 suggests an inclination toward disagreement with the idea that safety compliance extends timelines, while the higher standard deviation of 0.60 reflects greater variation in opinions. Because these means are positioned near the midpoint of the scale, they are best understood as indicative of weak disagreement and possibly mixed or context-specific perceptions rather than firm conclusions. Overall, these descriptive statistics reflect general patterns in perceptions rather than evidence of statistical relationships, which are explored further in the correlation analysis.

Table 2 *Statistical perception of safety practitioners*

		Statistics	
		Av. Project Cost	Av. Project Duration
N	Valid	116	116
	Missing	0	0
Mean		2.6131	2.3984
Std. Deviation		.29761	.60057

4.2 Assessing the Impact of Safety Compliance on Project Cost

The study used Pearson correlation analysis; a statistical method commonly employed to measure the strength of a linear relationship between two variables. The dataset included 116 responses regarding both the Safety Compliance and the Overall Project Cost. This sample size is considered robust for such an analysis, providing a solid foundation for the findings. The Pearson correlation coefficient was found to be 0.647 with a p-value of .000 (two-tailed) as illustrated in table 3.

Table 3 *Pearson correlation results safety compliance and project cost*

		S.C	P.C
S.C	Pearson Correlation	1	.647
	Sig. (2-tailed)		.000
P.C	Pearson Correlation	.647	1
	Sig. (2-tailed)	.000	

The coefficient of 0.647 is significant and suggests a moderately strong positive correlation. This means that as one variable increases, the other tends to increase as well. The p-value of .000 indicates that the results are statistically significant, meaning the likelihood that this correlation is due to chance is extremely low. The positive

correlation suggests that higher safety compliance is associated with increased overall project cost. This could be interpreted to mean that as more resources are invested in ensuring safety compliance, the overall cost of the project rises proportionally. These findings highlight the impact of safety compliance on project costs in the construction industry. It underscores the importance of integrating safety compliance into project management practices, not as an extra but as a key factor influencing overall costs.

4.3 Assessing the Impact of Safety Compliance on Project Duration

The Pearson correlation coefficient for correlation between Safety Compliance and Project Duration was found to be 0.541, with a p-value of .000 (two-tailed) as shown table 4. A coefficient of 0.541 indicates a moderate positive correlation. This suggests that there is a consistent, though not exceptionally strong, relationship between the two variables. The statistical significance of this correlation is affirmed by the p-value of .000, which is well below the typical threshold of 0.05, suggesting that the correlation is unlikely to be random. This moderate positive correlation implies that as Safety Compliance increases, there is a corresponding increase in the Project Duration.

It can be interpreted that higher levels of safety compliance may require more time for effective implementation, thus extending the duration of the project. Alternatively, it may also suggest that projects with longer durations have more comprehensive safety-compliance measures in place, possibly due to the extended timeframe allowing for more thorough implementation of safety protocols.

Table 4 *Pearson correlation results safety compliance and project duration*

		S.C	P.D
S.C	Pearson Correlation	1	.541
	Sig. (2-tailed)		.000
P.D	Pearson Correlation	.541	1
	Sig. (2-tailed)	.000	

These findings are significant for project management, especially in industries where safety is a critical concern, such as construction or manufacturing. The correlation between increased Safety Compliance and longer Project Duration highlights the need for careful planning and resource allocation. Projects aiming for high safety standards might need additional time to meet these standards without compromising project timelines. This insight can guide project managers to balance safety compliance with efficient project delivery understanding that enhancing safety measures might extend the project timeline.

5. Discussion

This study questioned the impact of compliance with occupational safety on the cost and duration of construction project projects in Pakistan. The results of the study reveal that increased compliance with occupational safety standards often leads to increased project costs. The previous studies suggest that although initial compliance with safety standards may seem costly, it yields substantial long-term benefits for project management and sustainable construction practices, including reduced accidents, enhanced company reputation, and improved employee retention [57]. The increase in cost is attributed to factors such as the initial capital investment required for safety equipment and training [44]. Maintaining safety standards and keeping both the equipment and workers updated with the latest safety practices also contribute directly to the project's cost [56], [58]. Furthermore, the administrative aspects of safety compliance, such as documentation, audits, and inspections, also add to the overall cost of the project [59]. Although these factors increase project costs, they also contribute to creating a safer work environment, which can reduce long-term costs associated with accidents and legal liabilities [60].

This study further illustrates that occupational safety compliance can directly extend the duration of construction projects. Previous studies suggest that safety compliance needs strict adherence to safety standards, which require thorough planning, additional inspections, and quality-control measures [61]. These activities can prolong the time needed to complete various construction stages and slow the progression of work to meet safety standards [62]. Regular safety inspections, essential for a safe working environment, may cause work stoppages or slowdowns if immediate attention or rectification is required [63]. Safety programs typically entail significant training for the workforce and engaging workers in meetings, discussions, and quality circles takes time potentially extending the project's initial duration [64]. Adapting to new systems and safety practices can slow the pace of construction work. Additionally, managing both technical and non-technical safety-related risks involves a complex process of assessment, planning, and execution further adding to project duration [65].

In that case, safety is paramount. The relationship between occupational health and safety (OHS) management and project management in construction is complex. However, it is essential to implement measures that

effectively manage safety, cost, and time, ensuring their optimum utilization and balance in construction projects. The effective management and integration of OHS practices are essential for long-term project success and workforce safety.

6. Conclusion and Recommendation

This study investigates the impact of occupational safety compliance on the cost and duration of large-scale construction projects in Karachi, Pakistan. The findings substantiate prior research by establishing a moderate increase in project cost while complying with safety measures. Additionally, the analysis indicates a low yet positive increase in the duration of the construction project while complying with safety measures.

In terms of project cost, the study's results indicate that increased attention to safety compliance tends to elevate the overall cost of a construction project. This increase is likely attributed to investment in safety equipment, training and potentially more meticulous planning and execution of construction activities that comply with stringent safety standards. However, this added cost should not be viewed merely as an expense but rather as a critical investment in ensuring the safety and well-being of construction workers and the quality of the construction process. By prioritizing safety, construction projects can potentially avoid costly accidents and legal issues, which can have far-reaching financial implications.

Regarding project duration, the positive correlation found in this study suggests that projects with higher levels of safety compliance may experience extended timelines. This extension could be due to the additional time required to implement comprehensive safety measures, including training, safety checks, and adherence to safety protocols. However, it is essential to recognize that while this may extend project timelines, it also contributes to creating a safer working environment. Ensuring the safety of workers is not only a moral imperative but also a contributor to the overall efficiency and quality of the construction process since it potentially reduces the frequency of work-related accidents and the consequent disruptions.

Overall, this research provides valuable insights into the construction industry, emphasizing the importance of safety compliance as a critical component of project planning and execution. It calls for a nuanced understanding of the interplay between safety, cost, and duration in construction projects. The findings advocate a strategic approach where safety compliance is integrated into the project lifecycle recognizing its influence on both the cost and the duration. By doing so, construction projects can achieve dual goals of operational efficiency and safety excellence ultimately leading to more sustainable and responsible construction practices in the industry.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Mujtaba Hassan, Nor Haslinda Abas;* ***data collection:*** *Mujtaba Hassan, Nor Haslinda Abas;* ***analysis and interpretation of results:*** *Samiullah Sohu, Muhammad Mujtaba Asad;* ***draft manuscript preparation:*** *Mujtaba Hassan, Nor Haslinda Abas. All authors reviewed the results and approved the final version of the manuscript.*

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