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Pilot Study on Delay Factors and Solutions Strategies in Government Buildings Projects in Kuwait: Stakeholders' Perspectives Using Confirmatory Factor Analysis (CFA)

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Abstract

Construction delays are a repeated problem in government buildings projects in Kuwait, always leading to increased costs and schedule slippage. This pilot study investigates key delay factors and corresponding solutions strategies by analyzing the responses from 60 construction professionals representing project management consultants (PMCs), contractors, and consultants. Using a structured questionnaire and confirmatory factor analysis (CFA), the study identifies and validates critical delay constructs and explores useful solutions measures from stakeholders' perspectives. The findings provide foundational data to refine the main study and enhance model validity for structural equation modeling (SEM). The top of the delay factors are poor contractor monitoring, weakness of consultant project management team, and design faults. Recommended solutions strategies include establishing a monitoring system to track subcontractor progress and addressing potential delays proactively, ensuring timely approval for the required workforce, and establishing clear delivery schedules. The results validate the questionnaire's reliability (Cronbach's alpha = 0.920) and provide insights into urgency areas for delay mitigation in the Kuwaiti governmental building construction sector.

Keywords: construction delay; solution strategies; CFA; pilot study; Kuwait; government buildings; project management; SEM

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Academic Editor: Osama Abudayyeh

Received: 29 May 2025
Revised: 16 June 2025
Accepted: 8 July 2025
Published: 10 July 2025

Citation: Aldammak, M.M.; Hamzah, N.B.; Khoiry, M.A. Pilot Study on Delay Factors and Solutions Strategies in Government Buildings Projects in Kuwait: Stakeholders' Perspectives Using Confirmatory Factor Analysis (CFA). *Buildings* **2025**, *15*, 2420. https://doi.org/10.3390/buildings15142420

1. Introduction

Construction delays in public sector projects are a common and costly issue in Kuwait, particularly in government building construction [1]. These delays often stem from multifaceted problems involving project management, financial practices, and regulatory frameworks. This pilot study aims to assess the effectiveness and reliability of a structured questionnaire designed to assess the most significant delay factors [2] and identify potential solutions. Insights from this starting phase are critical to refining the questionnaire before full-scale data collection and SEM [3]. In Kuwait, many government building projects have faced substantial delays over the past decade, leading to public dissatisfaction and financial loss. The causes are often rooted in poor project planning, insufficient risk management, administrative bureaucracy, and a lack of qualified labor. To address these issues methodically, researchers have increasingly turned to structural modeling approaches such as CFA and SEM [4]. These tools allow for the proof of theoretical constructs and help in identifying the most critical delay factors through empirical data. This study assists as a starting step toward developing a strong framework by conducting a pilot CFA on a precise structured questionnaire [5].

2. Methodology

2.1. Questionnaire Design

The pilot questionnaire consisted of two main sections: (1) 27 construction delay factors and (2) 27 proposed solution strategies. Each item was rated on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The research stages are illustrated in the Figure 1.

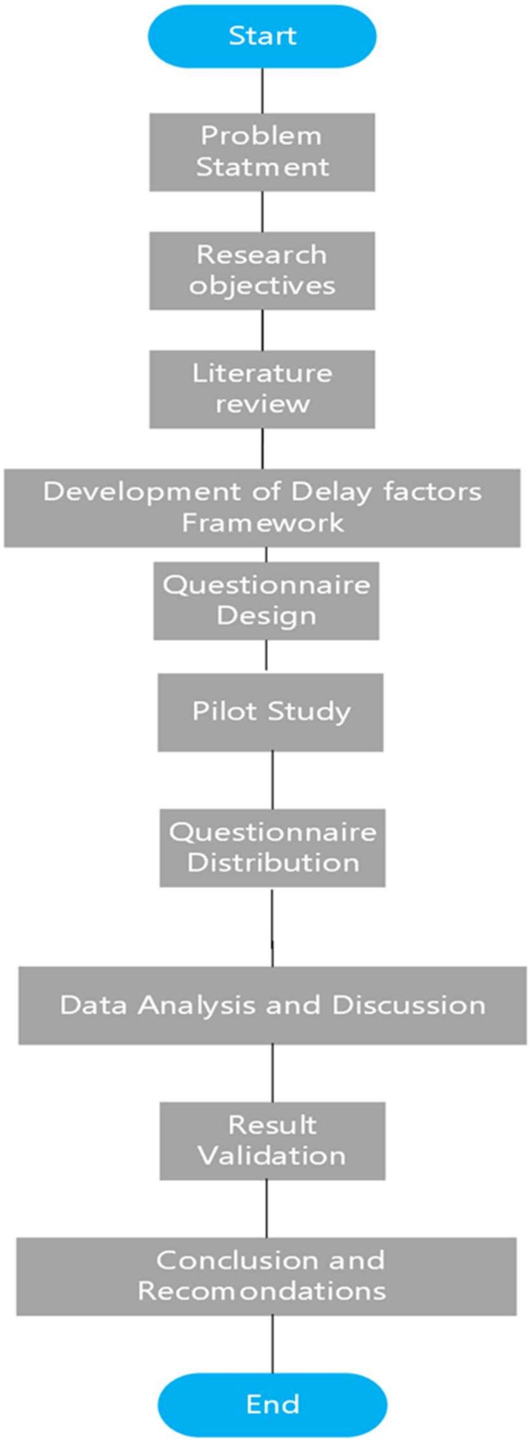

Figure 1. Research methodology flowchart.

Table 1 shows the input factors (such as resources, project design, and planning) which essentially serve as the starting point and the work base for construction projects. These components influence internal and external factors till project completion.

Table 1. The input, internal, and external delay factors and their overlap and influence on one another.

Reference	Input Factors	Internal Factors	External Factors	Methodology
[6]	Risk management processes, project scheduling	Organizational culture, team capabilities	Environmental regulations, political instability	Case study analysis, qualitative research
[7]	Material availability, labor resources	Workforce skills, management practices	Market fluctuations, economic conditions	Survey, literature review
[8]	Project design quality, planning	Communication within teams, leadership	Legal frameworks, governmental policies	Survey, exploratory research
[9]	Resource allocation, construction methods	Company structure, employee training	Market demand, country-specific regulations	Quantitative analysis, survey
[10]	Data collection, planning systems	Project management tools, process optimization	Technological innovations, global trends	Literature review, qualitative analysis
[11]	Cost estimation, resource allocation	Construction process, site management	Socio-economic factors, political environment	Critical review, case studies
[12]	Design plans, contractor qualifications	Team coordination, project control measures	Legal issues, cultural differences	Survey, descriptive research
[13]	Material handling, labor supply	Training programs, subcontractor performance	Market demand, inflation rates	Case study, qualitative research
[14]	Labor availability, safety measures	Labor productivity, task management	Local regulations, supply chain disruptions	Fuzzy fault tree analysis, qualitative analysis
[15]	Project complexity, technological requirements	Project schedule, resource optimization	External financial conditions, governmental regulations	Survey, regression analysis

Internal factors (team performance, communication, and project management) interact with both input and external factors. Internal factors often serve as moderators or mediators between input and external factors, involving how the project responds to external conditions.

External factors (such as political, economic, and environmental conditions) endlessly influence the project's development and can magnify or mitigate the impact of input and internal factors.

These factors often overlap and influence each other, creating a complicated environment where changes in one aspect can significantly impact the others. Each research emphasizes the importance of considering these factors in delay, project planning, and performing evaluation to ensure successful project results.

We recommend that future researchers conduct further studies on building construction delays based on the findings from the reviewed studies. Several paths for future research are proposed to Increase our knowledge understanding of construction delays and their mitigation strategies. For example, the authors [16] discuss the financial and project management problems in Egypt. Future studies could increase the dataset to include a broader range of projects across different regions in Egypt, allowing for comparative analyses of urban and rural construction projects. In addition, applying advanced methodologies, such as machine learning models, could assist in predicting delays and improve planning precisely.

Ref. [17] focused on contractor-related issues and stakeholder communication in Saudi Arabia. Upcoming research could investigate the integration of emerging digital technologies, like artificial intelligence and blockchain, to enhance collaboration and resource allocation. Additionally, studying how cultural and organizational factors influence stakeholder coordination could provide valuable insights into improving communication practices in the Saudi construction sector.

Finally, Ref. [18] highlighted the challenges presented by political instability and economic needs in Yemen. Future studies could explore the role of public–private partnerships in mitigating these challenges, working on how innovative financing models could guarantee project continuity. In addition, further research could analyze the helpfulness of governance reforms and capacity-building programs in generating a sustainable construction environment in unstable economies.

This study focused on the key factors that cause delays for buildings construction, aiming to interaction between input, internal, and external delay factors. However, the reliance on secondary data and a lack of site works limits the depth and applicability of the findings. To overcome these limitations, upcoming research should incorporate primary data collection methods, such as stakeholder interviews and surveys from different areas, to validate and extend the study's insights and enhance its applied relevance.

2.2. Sample and Data Collection

A total of 60 responses were collected, evenly distributed among three professional groups:

- Twenty project management consultants (PMCs);
- Twenty contractors;
- Twenty consultants.

The participants were selected based on their active involvement in government building projects in Kuwait (see Table 2).

Table 2. Participant information.

Variable	Category	Frequency
Age	<20 years	1
	20–29 years	5
	30–39 years	18
	40–49 years	19
	50 years and above	17
	Total	60
Sex	Male	38
	Female	22
	Total	60
Education	Upper Secondary	2
	Diploma Holder	3
	Bachelor's Degree Holder	50
	Master's Degree Holder	5
	Total	60

Table 2. *Cont.*

Variable	Category	Frequency
Type of Organization	Contractor	20
	Consultant	20
	Project Management Consultant (PMC)	20
	Total	60
Occupational Level	Managerial	10
	Non-Executive	44
	Executive	6
	Total	60
Job Title	Project Manager	11
	Project Engineer	12
	Construction Supervisor	8
	Other	29
	Total	60
Work Experience	Less than 2 years	1
	2 to 5 years	7
	6 to 10 years	10
	11 years and above	42
	Total	60
Field of Specialization	Structural	22
	Mechanical	9
	Electrical	8
	Architectural	12
	Other	9
	Total	60

2.3. Data Analysis

Confirmatory factor analysis (CFA) is a statistical method used to test the validity of hypothesized factor structures by investigating the relationships between observed variables and their underlying latent constructs. Unlike exploratory factor analysis (EFA), which identifies potential factor groupings without prior assumptions, CFA is theory-driven and needs the researcher to define the number and nature of latent variables in advance, based on the literature or theoretical models.

In this research, CFA was applied to assess the construct validity of a questionnaire designed to assess the key delay factors and corresponding mitigation strategies in government buildings projects. The model fit was assessed using standard goodness-of-fit indices, including the Chi-square/df ratio, the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). Factor loadings were examined to confirm whether each observed item significantly contributed to its intended latent construct, with loadings above 0.5 considered acceptable. This procedure helped verify the internal structure of the survey instrument and ensured its suitability for upcoming, large-scale applications.

Descriptive statistics such as reliability testing (Cronbach's alpha), and the Relative Importance Index (RII) were used to analyze the responses. Confirmatory factor analysis was employed to confirm the underlying factor structure and assess construct validity before full-scale [19] SEM. Confirmatory factor analysis was performed using SmartPLS (https://smartpls.com/) to evaluate the factor structure of the survey constructs. The CFA assessed the model fit using indices such as Chi-square/df, RMSEA, CFI, and TLI. The standardized factor loadings were tested to ensure convergent validity (all > 0.60), and

Average Variance Extracted (AVE) was calculated to confirm construct validity. Discriminant validity was also assessed by comparing the square root of AVE with inter-construct correlations. The model exhibited acceptable fit (Chi-square/df < 3.0, RMSEA < 0.08, CFI > 0.90, and TLI > 0.90), justifying the inclusion of the constructs in the full SEM.

3. Results and Discussion

3.1. Reliability Analysis

Measuring the internal consistency of survey instruments using multi-item scales is vital, and a key method is Cronbach's alpha test [20]. This test, also known as the coefficient alpha, assesses the reliability of a dataset by evaluating whether all items within a scale reliably measure the same underlying construct [21]. In essence, reliability refers to the degree to which a test consistently measures what it intends to [22]. Therefore, for researchers using multi-item scales, employing Cronbach's alpha is an essential step to ensuring that the instrument's data holds up to scrutiny. Assessing data reliability for research, Cronbach's alpha helps gauge internal consistency. Typically, values above 0.70 suggest reliable data. Lower values could indicate a lack of questions, weak item connections, or mixed underlying concepts.

Hence, in this study, this test was used to determine whether the scales used are reliable.

Table 3 shows that the values of Cronbach's alpha test ranged between 0.762 and 0.961, that indicates good internal consistency. Indeed, Ref. [20] established that an alpha (α) of 0.70 or above provides evidence for the internal consistency and reliability of a scale's items.

Table 3. Reliability statistic: Cronbach's alpha (N = 60).

Delay Factors/Solution	No. of Items	Cronbach's Alpha
Input Delay Factors	16	0.878
Internal Delay Factors	56	0.955
External Delay Factors	12	0.762
Solution of Input Delay Factors	16	0.861
Solution of Internal Delay Factors	56	0.961
Solution of External Delay Factors	12	0.794

3.2. The Result of Stakeholder Comparison and Delay Factors Ranking

- Cronbach's Alpha: 0.86 for delay factors;
- Cronbach's Alpha: 0.87 for mitigation strategies.

3.2.1. Ranking of Delay Factors—RII

1. Poor contractor monitoring—0.783;
2. Weakness of consultant project management team—0.780;
3. Design faults—0.760;
4. Owner experience—0.753.

3.2.2. Ranking of Mitigation Strategies—RII

1. Establish a monitoring system to track subcontractor progress and address potential delays proactively—0.754;
2. Ensure timely approval for the required workforce—0.753;
3. Establish clear delivery schedules—0.741;
4. Initiate the authorization process early in the project timeline—0.740.

3.2.3. Stakeholder Comparison

- PMCs highlight of poor consultant monitoring and suggested the establishment of clear evaluation criteria to ensure fair competition.
- Contractors confirm of the poor contractor monitoring and proposed the consideration of temporary off-site storage to manage limited space effectively.
- Consultants recommend that the delay of subcontractor works may mitigated by implementing rigorous quality control measures, conducting regular inspections, and enforcing contractual agreements with suppliers.

This differentiation emphasizes the importance of stakeholder-specific strategies.

3.3. Confirmatory Factors Analysis Results

3.3.1. Input Factors

Table 4 and Figure 2 presents the confirmatory factor analysis results which demonstrate the structural validity of the measurement model examining construction input delay factors. The model identifies four main latent variables (labor, material, financial, and machinery) [23] with their respective indicators. The standardized factor loadings range from 0.405 to 0.654, indicating moderate-to-strong relationships between the observed variables and their corresponding factors. Labor skills (B1_4) show the strongest connection to the labor factor (0.630), while late payments (B3_2) has the strongest association with the financial factor (0.654). The analysis also reveals significant intercorrelations between factors, with particularly strong relationships between financial and machinery (0.775) and between material and financial (0.836). The model demonstrates adequate convergent validity across all constructs, with most indicators exceeding the recommended threshold of 0.5, although labor shortage (B1_1) and strike (B1_2) [24] show slightly lower loadings.

Table 4. Standardized loadings of CFA for input delay factors (N = 60).

Factors	No.	Items	Loadings (Standardized)
Labor	B1.1	labor shortage	0.405
	B1.2	strike	0.482
	B1.3	labor productivity	0.596
	B1.4	labor skills	0.630
Material	B2.1	lack of materials in market	0.563
	B2.2	delay in receiving materials on site	0.546
	B2.3	materials do not follow contract specifications	0.537
	B2.4	defect in materials which is accepted	0.551
Financial	B3.1	project owner financial problems	0.579
	B3.2	late payments—work done	0.654
	B3.3	project cost estimate—low	0.573
	B3.4	owner problem—get bank loan	0.619
Machinery	B4.1	machinery allocation problem	0.636
	B4.2	machinery failure	0.650
	B4.3	wrong selection of machinery	0.623
	B4.4	lack of modern machinery	0.494

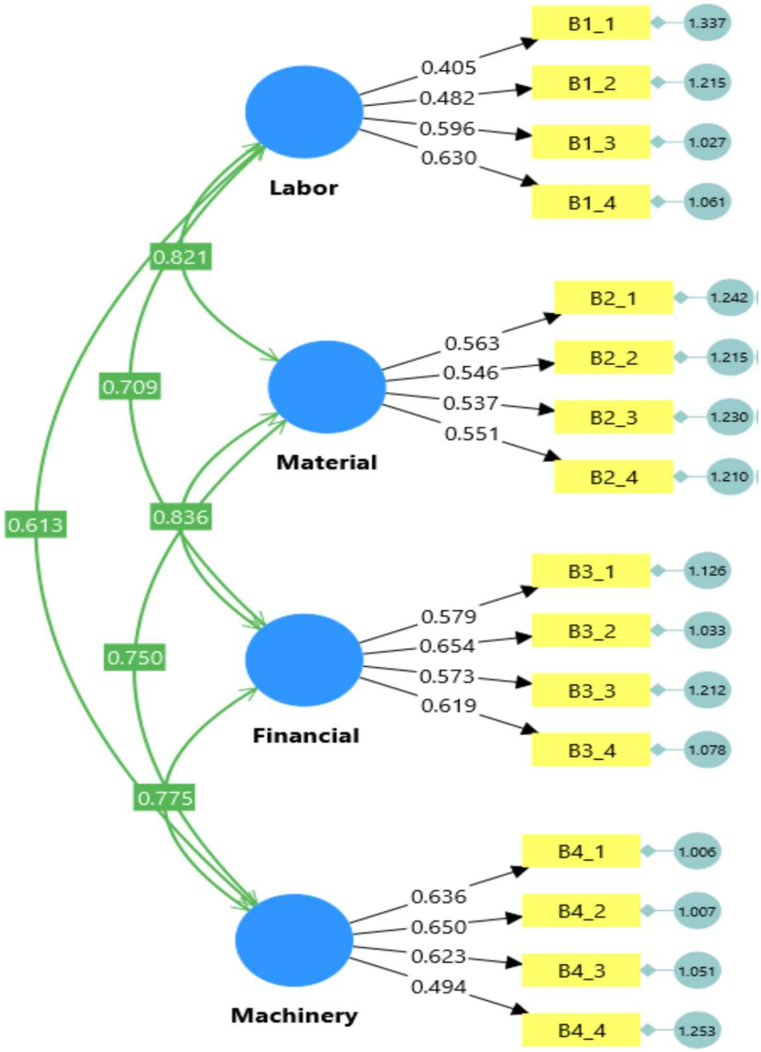

Figure 2. CFA for input delay factors.

3.3.2. Internal Factors

Table 5 and Figure 3 presents the CFA for internal delay factors in construction projects (N = 60) across 18 categories including administration, job change, disputes, quality, and others [25]. The model illustrates how various factors interconnect through standardized loading coefficients, with values ranging from 0.412 to 0.746. Notable findings include the particularly strong impact of unclear consultant drawing details (0.746), poor contractor monitoring (0.714), and work interruption (0.678) [9].

Table 5. Standardized loadings of CFA for internal delay factors (N = 60).

Factors	No.	Items	Loadings (Standardized)
Administration	C1.1	disturbances of project owner	0.599
	C1.2	internal administration problems	0.633
	C1.3	unskilled PMC	0.634
Job change	C2.1	design changes	0.568
	C2.2	changes in the type or specification of the materials	0.629
	C2.3	materials work change	0.563

Table 5. *Cont.*

Factors	No.	Items	Loadings (Standardized)
Disputes	C3.1	contract disputes and specifications	0.620
	C3.2	environmental disputes	0.563
	C3.3	financial disputes	0.615
	C3.4	negotiation of other major disputes	0.638
Quality	C4.1	too much quality-related documentation	0.593
	C4.2	application of quality control based on specifications	0.557
Work drawing	C5.1	delay in preparation of work drawings	0.526
	C5.2	delay in confirming work drawings	0.547
Safety	C6.1	accidents during construction	0.578
	C6.2	lack of application of safety aspect	0.533
Tests and inspections	C7.1	lack of competent inspectors	0.568
	C7.2	slow confirmation of testing and inspection	0.605
	C7.3	slow results from project owner	0.527
Decision	C8.1	late results from consultant	0.678
	C8.2	late decision from contractor	0.638
	C8.3	approval process	0.512
Motivation	C9.1	incentive of early work completion	0.537
	C9.2	late fines	0.531
Lack of experience	C10.1	consultant experience	0.561
	C10.2	owner experience	0.504
	C10.3	contractor experience	0.587
Coordination	C11.1	mismanagement of construction site	0.624
	C11.2	Coordination between parties are weak	0.555
	C11.3	late mobilization of construction site	0.569
	C11.4	contractor poor monitoring	0.714
	C11.5	Consultant poor monitoring	0.570
Communication	C12.1	Lack of constant communication that effective construction party	0.412
	C12.2	issuing instruction delay between construction parties	0.650
	C12.3	personnel problem among construction workers	0.645
Construction Site Management	C13.1	weakness of material procurement planning	0.605
	C13.2	late issuing of document approvals	0.547
	C13.3	inaccuracy in documenting work quantity	0.538
	C13.4	weakness of consultant project management team	0.587
Contract	C14.1	types of bidding and award	0.641
	C14.2	late contract awarding	0.585
	C14.3	high competition between bidders	0.627
Construction	C15.1	delay in drawing preparation by contractor	0.554
	C15.2	unclear drawing details by the consultant	0.746
Operation	C16.1	work suspension	0.594
	C16.2	error during construction	0.612
	C16.3	delay in subcontractor works	0.667
	C16.4	incorrect construction method	0.609
	C16.5	work interruption	0.678
Design	C17.1	complex design	0.606
	C17.2	poor design	0.567
	C17.3	design faults	0.605
Schedule	C18.1	project construction period	0.561
	C18.2	work program	0.596
	C18.3	working plan	0.606

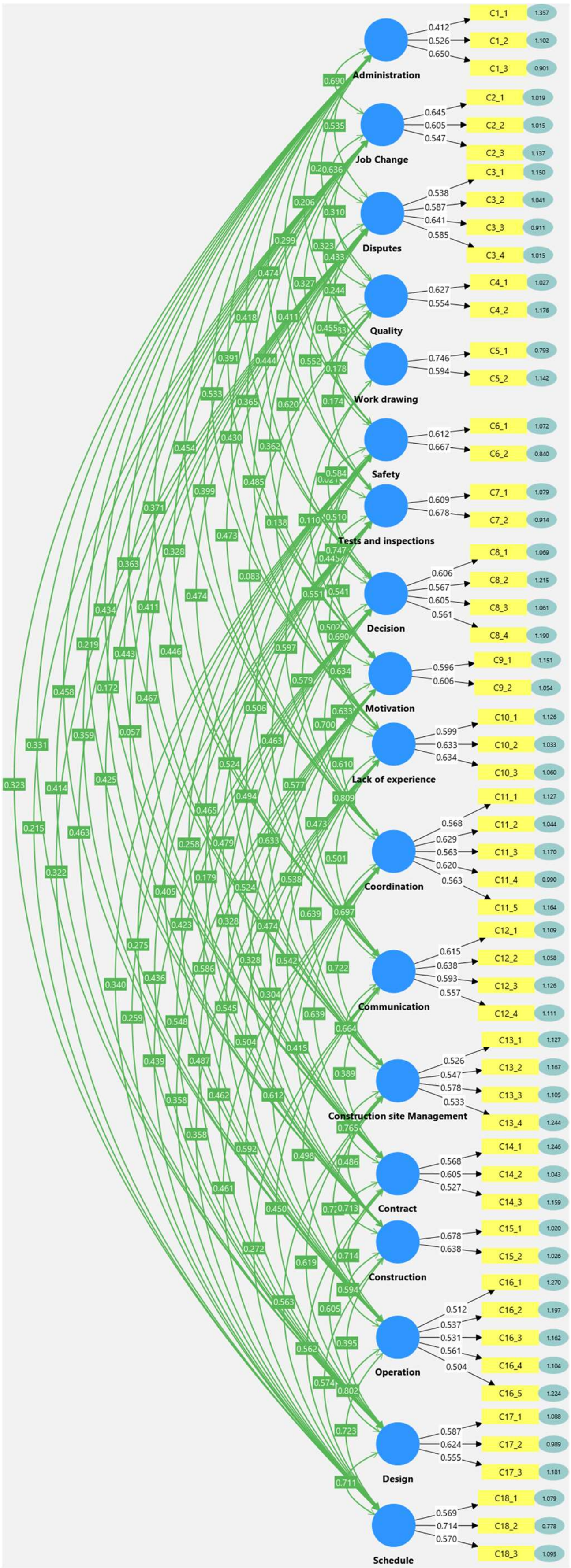

Figure 3. CFA for internal delay factors.

3.3.3. External Factors

Table 6 and Figure 4 shows The confirmatory factor analysis (CFA) for external delay factors in construction projects illustrates a complex network of five interconnected primary factors: weather, condition, economy, general, and authorities. These factors demonstrate significant correlations, with particularly strong relationships observed between authorities and general (0.721), economy and general (0.690), and weather and condition (0.627) [26]. Each primary factor links to specific indicator variables with varying strengths of association, notably the robust connection between condition and indicator D2.1 (0.802) and between authorities and indicator D5.2 (0.764) [13]. This structural equation model effectively maps how external elements beyond the control of construction teams—including environmental conditions [27], economic circumstances, and regulatory requirements—form an interconnected system that significantly impacts project timelines and contributes to construction delays [28].

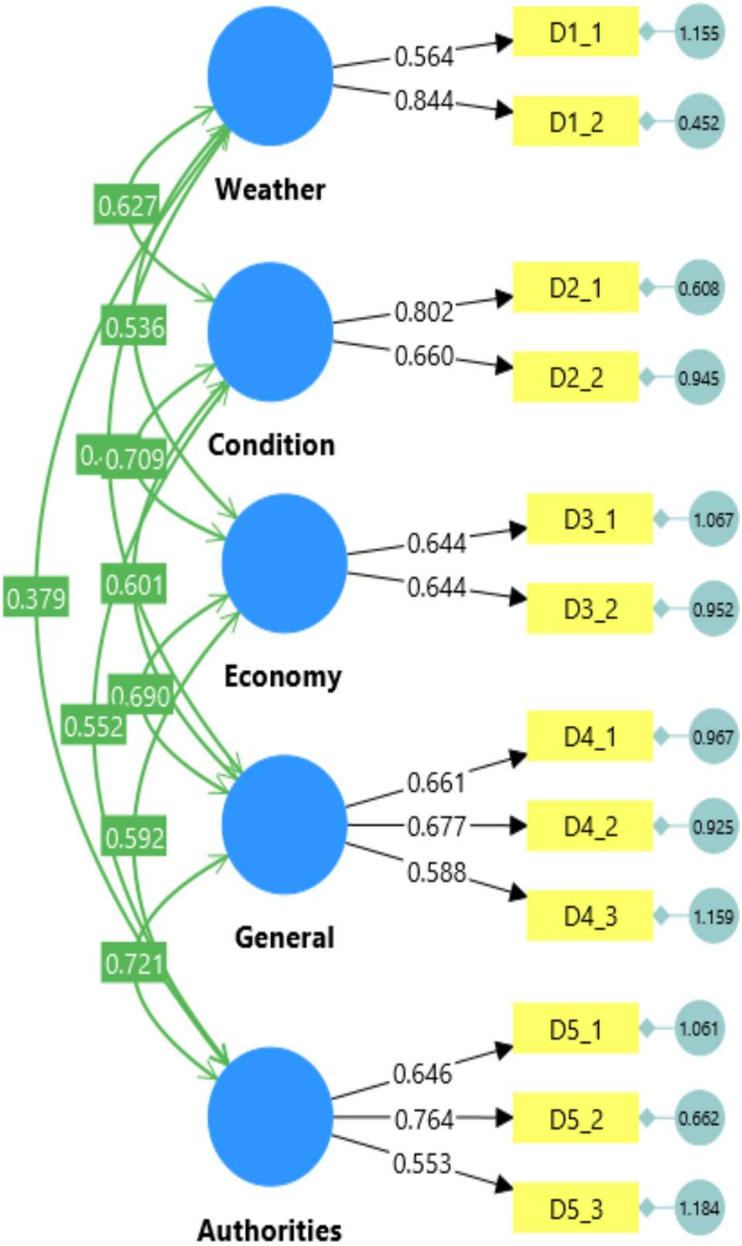

Figure 4. CFA for external delay factors.

Table 6. Standardized loadings of CFA for external delay factors (N = 60).

Factors	No.	Items	Loadings (Standardized)
Weather	D1.1	bad weather	0.564
	D1.2	natural disaster	0.844
Site condition	D2.1	soil condition	0.802
	D2.1	demolition of old buildings	0.660
Economy	D3.1	material price increase	0.644
	D3.2	labor salary increase	0.644
General	D4.1	activity delay due to construction public activity	0.661
	D4.2	force majeure	0.677
	D4.3	limited construction area	0.588
Authorities	D5.1	government policy and law changes	0.646
	D5.2	municipality authorization delay	0.764
	D5.3	manpower authorization delay	0.553

3.3.4. Potential Key Solutions for Input Factors

Table 7 and Figure 5 shows the standardized loadings of the CFA for potential key solutions for construction delay factors [29], identifying the most significant interventions across the four input factors. For labor, providing incentives to enhance worker motivation (0.685) and investing in training programs (0.635) demonstrated the strongest impact. Within the material factor, establishing clear delivery schedules (0.632), implementing quality control measures (0.583), and maintaining strategic reserves (0.580) proved most effective. Financial solutions showed consistent effectiveness across all options (0.565–0.591), with periodic budget reviews (0.591) and defining clear payment schedules (0.588) slightly outperforming others. The machinery factor revealed the strongest overall solutions [30], particularly regular equipment maintenance (0.695), thorough pre-selection research (0.689), and comprehensive machinery allocation planning (0.617).

Table 7. Standardized loadings of CFA for potential key solutions for input factors that contribute to delaying building construction (N = 60).

Factors	No.	Items	Solution	Loadings (Standardized)
Labor	EB1.1	labor shortage	increase recruitment efforts	0.410
	EB1.2	strike	establish contingency plans to minimize the effect of strikes	0.529
	EB1.3	labor productivity	provide incentives to enhance worker motivation and productivity	0.685
	EB1.4	labor skills	invest in training programs to upgrade the skills of the workforce	0.635
Material	B2.1	lack of materials in market	maintain strategic material reserves	0.580
	EB2.2	delay in receiving materials on site	establish clear delivery schedules	0.632
	EB2.3	materials do not follow contract specifications	implement rigorous quality control measures, conduct regular inspections, and enforce contractual agreements with suppliers	0.583
	EB2.4	defect in materials which is accepted	only accept materials that meet the specified standards	0.576

Table 7. *Cont.*

Factors	No.	Items	Solution	Loadings (Standardized)
Financial	EB3.1	financial problems of project owner	explore financing options to address financial constraints	0.565
	EB3.2	late payments—work done	clearly define payment schedules in contracts	0.588
	EB3.3	project cost estimate—low	periodically review and adjust the budget as needed	0.591
	EB3.4	owner problem—get bank loan	explore alternative financing options	0.574
Machinery	EB4.1	machinery allocation problem	develop a comprehensive machinery allocation plan	0.617 0.695
	EB4.2 EB4.3 EB4.4	machinery failure wrong selection of machinery lack of modern machinery	conduct regular equipment maintenance conduct thorough research before selecting machinery continuously upgrade equipment to improve project efficiency	0.689 0.495

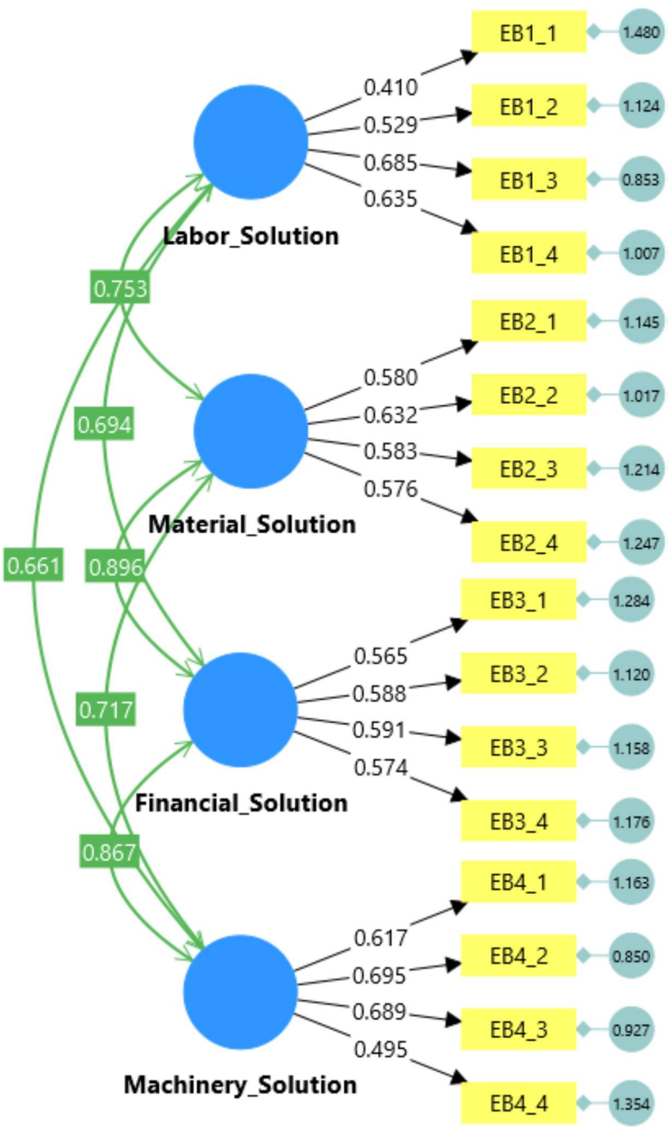

Figure 5. CFA of potential key solutions for input delay factors.

3.3.5. Potential Key Solution for Internal Factors

Table 8 and Figure 6 shows the confirmatory factor analysis (CFA) of potential key solutions for internal delay factors in building construction which reveals an interconnected network of 18 solution categories with varying levels of effectiveness. The standardized loadings indicate that the most impactful interventions include [29] management (0.738), administrative measures (0.742), decision-making processes (0.707, 0.708), quality control (0.749 [31]), and safety protocols (0.726). Additionally, tests and inspections (0.686), contract management (0.698) [32], and work drawing solutions (0.674) demonstrate strong potential for reducing delays. The extensive green network connections in the diagram emphasize that these solutions function as an integrated system rather than isolated interventions, suggesting that a comprehensive approach addressing multiple internal factors simultaneously would be most effective in mitigating construction delays, with particular attention to the highest-loading solutions identified across the various categories.

Table 8. Standardized loadings of CFA for potential key solutions for internal factors that contribute to delaying building construction (N = 60).

Factors	No.	Items	Solution	Loadings (Standardized)
Administration	EC1.1	disturbances of project owner	regularly update the owner on project progress	0.611
	EC1.2	internal administration problems	implement efficient project management systems	0.653
	EC1.3	unskilled PMC	ensure that the project management consultant (PMC) has the necessary skills for the project	0.647
Job change	EC2.1	design changes	develop a robust design review process at the project's outset	0.573
	EC2.2	changes in the type or specification of the materials	establish a detailed material specification document early in the project	0.585
	EC2.3	work materials changes	maintain a comprehensive inventory of materials required for the project	0.605
Disputes	EC3.1	contract disputes and specifications	establish a dispute resolution mechanism to resolve issues efficiently	0.642
	EC3.2	environmental disputes	conduct a thorough environmental impact assessment before the project begins	0.601
	EC3.3	financial disputes	engage in proactive communication to address financial concerns before they escalate into disputes	0.585
	EC3.4	negotiation of other major disputes	engage in proactive mediation to resolve disputes before they escalate	0.662
Quality	EC4.1	too much quality-related documentation	focus on essential documentation and implement a digital system for easy tracking and accessibility	0.630
	EC4.2	application of quality control based on specifications	clearly define quality control criteria in the project specifications	0.520
Work drawing	EC5.1	delay in preparation of work drawings	regularly monitor the progress of drawing preparation	0.581
	EC5.2	delay in confirming work drawings	set clear timelines for confirmation	0.657
Safety	EC6.1	accidents during construction	investigate and address any safety concerns promptly to prevent accidents	0.634
	EC6.2	lack of application of safety aspect	foster a safety-first culture on the construction site	0.585
Tests and inspections	EC7.1	lack of competent inspectors	invest in training programs for inspectors to enhance their competency	0.609
	EC7.2	slow confirmation of testing and inspection	provide adequate resources to testing and inspection teams	0.698
Decision	EC8.1	slow results from project owner	regularly communicate the impact of delayed decisions on the project	0.649
	EC8.2	late results from consultant	set expectations for timely deliverables and updates	0.678
	EC8.3	late decision from contractor	establish a project schedule that includes clear deadlines for decisions from the contractor	0.600
	EC8.4	approval process	use digital platforms to facilitate the review and approval of documents	0.588
Motivation	EC9.1	incentive of early work completion	implement an incentive program that rewards contractors and project teams for completing work ahead of schedule	0.625
	EC9.2	late fines	enforce penalties consistently to motivate timely project completion	0.665

Table 8. *Cont.*

Factors	No.	Items	Solution	Loadings (Standardized)
Lack of experience	EC10.1	consultant experience	select experienced consultants with a proven track record in similar projects	0.583
	EC10.2	owner experience	provide support and guidance to less experienced project owners	0.494
	EC10.3	contractor experience	select contractors with a history of successful project completions	0.552
Coordination	EC11.1	mismanagement of construction site	address issues promptly to maintain effective site management	0.707
	EC11.2	weak coordination between parties	establish regular coordination meetings to discuss progress	0.708
	EC11.3	late mobilization of construction site	ensure that all necessary resources and permits are obtained well in advance to avoid delays	0.660
	EC11.4	contractor poor monitoring	regularly review and assess the contractor's monitoring activities to ensure compliance with project requirements	0.738
	EC11.5	consultant poor monitoring	conduct regular performance evaluations of consultants regarding monitoring activities	0.534
Communication	EC12.1	Lack of constant effective communication between construction party	encourage an open and transparent communication culture among all project stakeholders	0.628
	EC12.2	Delay of issuing instructions between the construction parties	implement a digital platform for issuing instructions and tracking their status	0.742
	EC12.3	personnel problem among construction workers	address personnel issues promptly and fairly to maintain a harmonious construction site	0.666
Construction site Management	EC13.1	weakness of materials procurement planning	regularly update the plan based on project progress and changes	0.650
	EC13.2	late issuing of document approval	regularly monitor and enforce the document approval schedule to prevent delays	0.541
	EC13.3	inaccuracy in documenting work quantity	regularly audit and review the accuracy of documented quantities to prevent discrepancies and delays.	0.586
	EC13.4	weakness of consultant project management team	evaluate the competence of the consultant's project management team during the selection process	0.608
Contract	EC14.1	types of bidding and award	select an appropriate bidding and award process based on the project's complexity and requirements	0.596
	EC14.2	late contract awarding	develop a realistic timeline for the awarding of contracts	0.581
	EC14.3	high competition between bidders	establish clear evaluation criteria to ensure fair competition	0.620
Construction	EC15.1	delay in drawing preparation by contractor	clearly define drawing preparation milestones in the contract	0.749
	EC15.2	unclear drawing details of the consultant	facilitate clear communication between the consultant and the contractor regarding drawing details	0.674
Operation	EC16.1	work suspension	clearly define the conditions under which work suspension may occur in the contract	0.612
	EC16.2	error during construction	implement quality control measures to identify and address errors during construction	0.557
	EC16.3	delay in subcontractor works	establish a monitoring system to track subcontractor progress and address potential delays proactively	0.726
	EC16.4 EC16.5	incorrect construction method work interruption	ensure that the chosen construction methods align with project requirements and industry standards develop contingency plans to mitigate the impact of interruptions	0.686 0.631 0.669
Design	EC17.1	complex design	engage in thorough planning and feasibility studies to assess the complexity of the design	0.597
	EC17.2	poor design	consider involving experienced design consultants for critical project components	0.567
	EC17.3	design faults	implement a formalized process for revising designs as needed	0.631
Schedule	EC18.1	project construction period	develop a realistic and well-planned construction schedule	0.657
	EC18.2	work program	create a detailed work program that outlines tasks, milestones, and dependencies	0.618
	EC18.3	working plan	communicate the working plan to all stakeholders and regularly assess its effectiveness; make adjustments as needed to ensure alignment with project goals	0.665

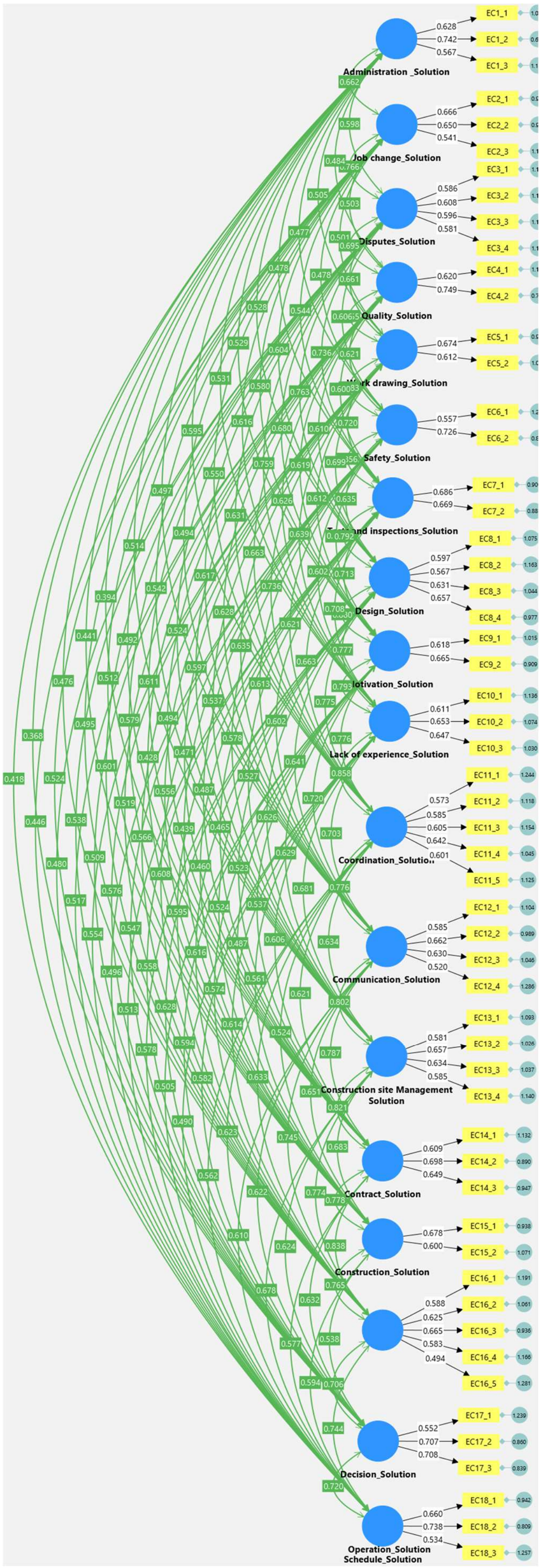

Figure 6. CFA of the potential key solution for internal delay factors.

3.3.6. Potential Key Solutions for External Factors

Table 9 and Figure 7 show The CFA of potential solutions for external factors contributing to construction delays reveals several effective interventions across five key categories [33]. For weather-related factors, ensuring that construction design adheres to resilient building codes and standards (0.807) stands out as particularly impactful, showing the highest loading among all solutions. In addressing site conditions, efficient demolition methods and phased demolition (0.673) proved more effective than soil investigations (0.601). Economic factors are best mitigated by negotiating fixed-price contracts with suppliers (0.719), which outperformed strategies to reduce labor needs (0.649). For general external factors, including force majeure clauses in contracts (0.657) and coordinating with local authorities (0.620) showed strong potential, while temporary off-site storage (0.570) had comparatively less impact. Regarding authority-related delays, initiating authorization processes early (0.679) demonstrated the highest loading, followed by staying informed about policy changes (0.620) [34] and ensuring timely workforce approvals (0.565). Overall, the strongest solutions focus on resilient design standards, contract provisions [35], and proactive engagement with authorities and scheduling processes.

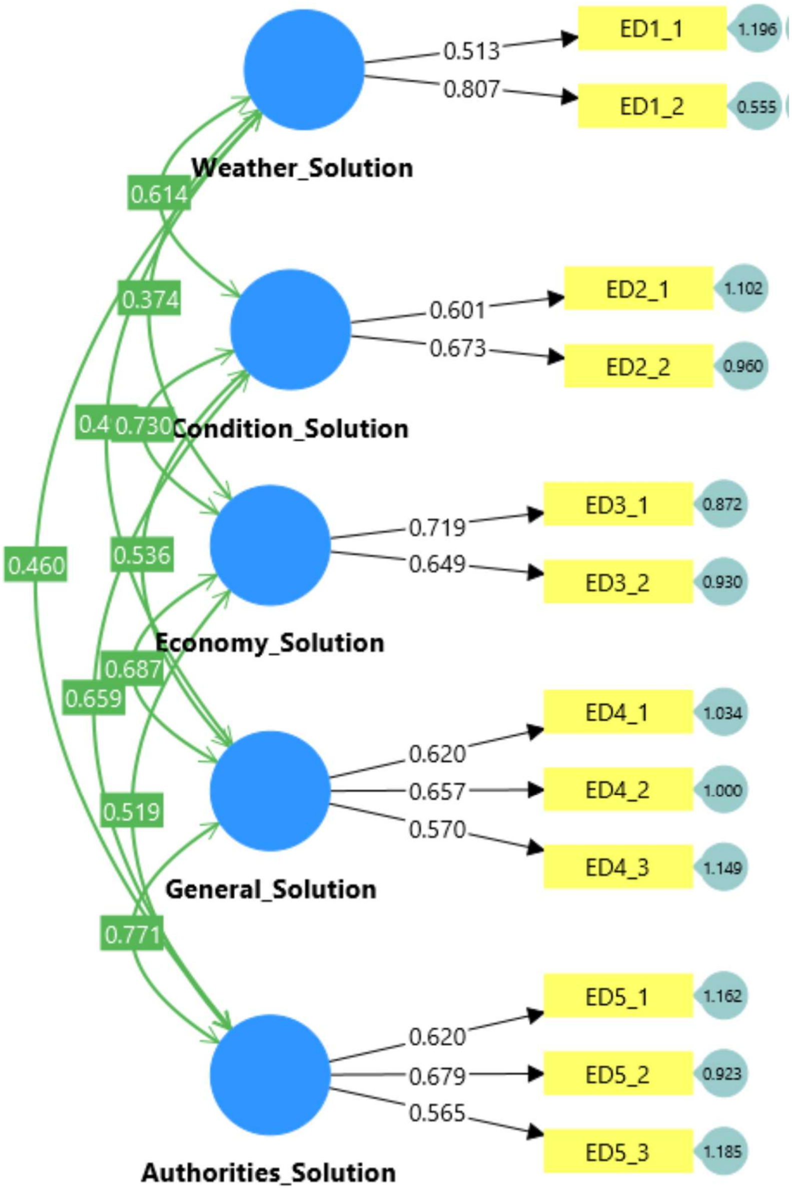

Figure 7. CFA of potential key solutions for external delay factors.

Table 9. Standardized loadings of CFA for potential key solutions for external factors that contribute to delaying building construction (N = 60).

Factors	No.	Items	Solution	Loadings (Standardized)
Weather	ED1.1	bad weather	incorporate weather contingencies in the project schedule	0.513
	ED1.2	natural disaster	ensure that the construction design adheres to resilient building codes and standards to minimize the impact of natural disasters	0.807
Site condition	ED2.1	soil condition	conduct thorough soil investigations before the construction begins	0.601
	ED2.1	demolition of old buildings	use efficient demolition methods and consider phased demolition to allow for simultaneous construction in cleared areas	0.673
Economy	ED3.1	material price increase	negotiate fixed-price contracts with suppliers	0.719
	ED3.2	labor salary increase	reducing the need for additional labor	0.649
General	ED4.1	activity delay due to construction public activity	coordinate construction activities with local authorities	0.620
	ED4.2	force majeure	include force majeure clauses in contracts	0.657
	ED4.3	limited construction area	consider temporary off-site storage to manage limited space effectively	0.570
Authorities	ED5.1	government policy and law changes	stay informed about potential changes in government policies and laws	0.620
	ED5.2	municipality authorization delay	initiate the authorization process early in the project timeline	0.679
	ED5.3	manpower authorization delay	ensure timely approval for the required workforce	0.565

4. Conclusions

This pilot study confirms the reliability and effectiveness of the proposed questionnaire in capturing key construction delay factors and solutions strategies in Kuwait’s public sector. The results highlight critical focus areas for reducing project delays and form the basis for full-scale data collection and structural equation modeling. Future research will expand this analysis to a larger sample and develop a comprehensive delay solutions framework. The successful application of CFA enhances the statistical accuracy of the research and ensures that subsequent SEM analysis will be based on validated constructs.

The analysis identified numerous critical factors contributing to construction delays. The highest-ranked delay factor was poor monitoring by contractors, followed closely by the weakness of the consultant’s project management team. Other noted factors included design faults and the owner’s limited experience, all of which significantly impact project timelines.

In terms of mitigation strategies, stakeholders agreed on key interventions to reduce delays. The highest-ranked strategy was to establish a monitoring system to track subcontractor progress and proactively address potential delays. This was followed by the need to ensure timely workforce approvals, set clear delivery schedules, and initiate authorization processes early in the project timeline.

A comparative analysis across different stakeholder groups discovered varying perspectives. Project management consultants (PMCs) highlight of poor consultant monitoring and suggested the establishment of clear evaluation criteria to ensure fair competition. Contractors highlighted their own challenges with monitoring and proposed temporary off-site storage solutions to overcome space limitations. Meanwhile, consultants focused on subcontractor delays and suggested comprehensive strategies including rigorous quality control, regular inspections, and the enforcement of contractual obligations with suppliers.

These differences underscore the importance of tailored mitigation strategies that reflect the unique responsibilities and challenges of each stakeholder group involved in construction projects.

In addition to confirming the questionnaire structure, this research contributes to a deeper understanding of interrelated delay factors and suggests targeted strategies that align with empirical data. Policymakers, project managers, contractors, and consultants can benefit from these data to reduce inefficiencies in future government projects.

5. Limitations

This study acknowledges a key limitation linked to the sample size. The data were collected from a total of 60 respondents—20 project management consultants, 20 contractors, and 20 consultants. While this sample allowed for the application of confirmatory factor analysis (CFA) to test the structure and reliability of the developed questionnaire, it remains modest in size and scope. Accordingly, the findings should be interpreted as preliminary and exploratory in nature.

It is significant to note that the aim of this study was to conduct a pilot analysis to evaluate the conceptual framework and assess the suitability of the instrument for future large-scale research. Given the exploratory design, the current sample size is considered sufficient for CFA, but it does limit the generalizability of the outcomes across the broader construction sector in Kuwait. As a result, conclusions regarding the relative importance of delay factors and the use of mitigation strategies should be drawn with caution.

Upcoming research will aim to overcome this limitation by administering the revised and validated questionnaire to a larger and more various population, including different regions, project types, and levels of stakeholder responsibility. This expanded dataset will allow for more comprehensive statistical modeling, including structural equation modeling (SEM), and will offer stronger empirical support for the relationships identified in this research.

Author Contributions: Conceptualization, M.M.A.; methodology, N.B.H.; validation, M.A.K.; formal analysis, M.M.A.; writing—original draft preparation, M.M.A.; writing—review and editing, M.M.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Data is available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

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