Effect of Time Extension on Construction Projects in Pakistan: Comparison between Public and Private Projects in Khyber Pakhtunkhwa Pakistan

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Abstract

This research scrutinized the effect of time extension on construction projects which is pivotal for Pakistan. This research work identified the ten main factors, and the ninety-five sub delay factors applied to different techniques such as RII (Relative Importance Index) method, AI (Average Index) method, and the Pareto chart method. In this work, we have analyzed the data and delineated a questionnaire for the survey to collect the opinion in the different construction industries through 70 valid responses. We have also found the most effective reasons for delaying in the construction industry and recommended some key factors for the different construction industry groups to control or avoid the time extension. This work helps the construction industry to control delays in projects.

Keywords: construction projects; time extension; delaying causes: RII; AI

Introduction

A basic portion insinuates inside the headway contract it is the arrange period or the time of unsafe execution, which was made before the offer. Productive execution and improvement of wanders interior the evaluated taken a cost and plans depend on a strategy that required sound drawing examination. Anything here is imprisonments and in organize to settle these expansions. The time required to add up to building a gathering of people venture is routinely greater than the time appearing contract. The 'over rides' developments are consent for variables reasons, such as maker or blunders, change climate, and late conveyance. In any case,

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development delay could be a common issue that happens locally and all-inclusive. It has gotten to be a colossal issue confronted by development ventures over the world. (Karunakaran et al., 2019).

It also permits us to recognize existing crevices and show the current consider to fill in those gaps. This area audits past papers on the problem of venture administration in Oman. Particularly, the study presents the surveys concerning time delay and taken a cost to overwhelm venture administration in Oman (Amri & Marey-Pérez, 2020). The temporary worker plays a part within the plan subtle elements, nitty-gritty obtainment, hazard administration, handle and planning, efficiency, labor, hardware, environment, etc. Disappointment to meet any of these duties is an imperative reason for extending delays. (Banobi & Jung, 2019). The exchange of the assignment of the subcontractor to an afterward date may conclusion the address (may lead to contract break), or at slightest lead to downtime and extra costs. solid prepare due dates are too imperative for the temporary worker inside asset administration and arranging materials supplies and factory upkeep (Biruk & Jaśkowski, 2020).

Numerous development ventures have issues with advance since of numerous parameters. Venture changes happen due to alterations within the arranged grouping of work, changes in materials and strategies of development, and adjustments due to blunders or exclusions that are distinctive from the first arrangement. This comes about in a variety of work quality, extend varieties, and disarray that's all the development extend dubiously(Bitamba & An, 2020). Detention is characterized even as surpassing this period such after the agreement particular day or after the conveyance date concurred against each dissimilar team to the extend. In development ventures, interval occur for as well many causes (deviations, destitute efficiency, ingredients not accessible, etc.) and these explanations may change from one side to the another, etc. Delays also serve to different modification in a extend like deferrals, expanded costs, and indeed contract end. (Elhusseiny et al., 2021). A few of the most inside components influenced by the take a high and time of construction projects are changes within the venture plan, scope penetration and changes, off-base acquirement and conveyance approach, complexities in designing and development, unseemly gauges and contingencies, conflict among legally binding parties, organization and misconception within the contract archives (Paraskevopoulou & Boutsis, 2020).

Open division foundation ventures are seen as a financial and social driver for maintainable social improvement that upgrades the well-being of the populace. The reason for the government is to spend cash on open foundation ventures that improve the social and financial exercises of the

nation. In any case, an inadequately or immature framework is one of the greatest impediments to financial development and social improvement within the nation. To make strides the open foundation guidelines the government of KPK contributes tremendous sums of capital in many mega ventures. Be that as it may, a really common issue influencing all framework ventures is the disappointment to meet the arranged development plan and the anticipated taken a toll. Most of the ventures in KPK for illustration, street and railroad ventures, coordinates lodging advancement programs, sugar manufacturing plants, fertilizer industrial facilities, water system dams, monster control ventures, and others that have not been met venture objectives (Herrera et al., 2020)(Kassa & Ababa, 2018).

The engineer's survey of the plan may bring almost changes to progress or optimize the plan and hence the operation of the venture. Advance, blunders, and omissions in designing or development may drive a alter. These and other components require changes that are expensive and generally un-welcomed by all parties(Khalifa & Mahamid, 2019). The slightest visit basic variables are fragmented documents, delay in performing review and testing, intemperate bureaucracy in the project–owner organization, frequent intrusions from open (nearby individuals, weight benches, etc.), need of clarity in venture scope, land seizure, division of the West Bank, sources of data, and works in strife with existing utilities, which have been specified as it were in one think about with a delay calculate file rise to one (Khatib et al., 2018). The Development delay may be characterized while duration overwhelm either past the accomplishment time indicated in agreement, or behind the extended conveyance particular day as concurred by team characterized the detention as an alternatives or occasion which specifically needed time to execute or total role of the agreement shows on its own as extra days of work(Kumar, 2020)

In Turkey, for case, where the speculation in development includes up to 50% of the whole speculations, a few major causes of delay were recognized to be a requirement of cash stream, resources, arrange delay, and changes within the organization, which happen as frequently as conceivable, not because it was the causes of a delay is imperative, but so, as well, are the factors that cover the delay. In Nigeria, the most cause of venture taken a price overwhelms was distinguished to be related to the deficiency of materials and the insufficiency within the funding, and a suggestion to subdue that was to decrease the botch of managing with human resources and materials (Abdullatif & Alshibani, 2019)(Okpala & Aniekwu, 1988). To measure the execution, a test is tried to see in case the

concrete can bear the most extreme stack it should be able to stand up. Results based on manual testing can be influenced by outside or natural components such as human botches, blunders in test details, and issues with stacking setups and setting(Hamooni et al., 2020)(Pall et al., 2019).

Moreover, the United Nation Countries person arrangement program or UN-Habitat expressed as lodging is a main component in correlates tangible and financial improvement, natural supportability, and the production of riches; and it collisions the wellbeing, public manner, and common well-being populations(Ali et al., 2021). Any delay in the activity plan could outcome in taken a price to invade which routs the reason for depleting the project with little amount. While most motives of giving Low-Cost Housing (LCH) are to bolster impoverished isolated/households, fetching the ventures on time is basic to avoiding fetched overwhelms. In 2014, executed a ponder that establish the inaccessibility of accommodation credits, elevated adding costs or intrigued brief credit reimbursement terms, and low-quality materials as the foremost critical delay measures in lodging projects(Safapour et al., 2019).

Delay components within the development industry have been talked about by numerous analysts in a few ways. A few analysts have emphasized major delay components and a few extended categories, whereas others think about have talked about strategies for analyzing delays and proposed ways to decrease these delays. Delays for the most part happen since of inappropriate management of several variables that are related to key partners such as client, temporary worker, experts, labor and equipment's, and materials required for ventures(Rashid, 2020). The assets and performance of auction-goers ought to be confirmed meticulously for decreasing plan delays in open development ventures. For a prosperous public suspended metropolis venture, it is basic for administration to manage fetched overruns and assess a practical allowance(Rivera et al., 2020). Depend on the introductory survey of the continuing trials within the writing, a set of succession was created to choose the ultimate look criteria. The search series was chosen as "delay overwhelm" or "time overwhelm" and "construction sector" or "public work" and connected to the bibliographic. The explore was restricted to apprenticeship exploring reasons and impacts within the past ten a long time, from 2009 to 2018. Hence, "cause" and "effect" were moreover contained within the pursue standards. Utilizing the guideline developed in creating the postponed tactics database within the development(Sepasgozar et al., 2019).

By utilizing the (RII) relative importance index five causes of time

overwhelm were distinguished which were destitute supervision at location and location management, delay in making choices, proprietor obstructions in the extend, ground conditions, and essential changes from the owner. Author recognized 16 causes of time invade, the top 5 creatures: budgetary issues confronted by the temporary worker, destitute contract administration, location supervision, need of arranging, and delay in material supply. The main causes of time overwhelm were destitute checking, destitute project administration and monetary issues confronted by the proprietor(Soomro et al., 2019).

Optimization

The investigation technique applicable in this study is an evaluative review. The evaluative changes dissimilar from conventional dissertation reviews by employing a straightforward system reproducible, methodical and translucent, by what sort of results can be ascertained Analyze the audit method used to collect and analyze evidence. Hence, organized modifies permit attaining conclusions with highest recommendations of dependability on particular exploration content. Given that strategy enhancement act as led in a distinct inquiry issue, which are based on the mechanism about assessment development over definition terms various criteria for instance investigation selection guideline, procedures of affirmation accumulation or also evaluation, characteristics record conclusions, and so forth. In Khyber Pakhtunkhwa we distributed 90 questionnaires in different well-reputed public and private construction sectors at the close of this successful survey we received 70 questionnaires and apply on Statistical package for the social sciences (SPSS) Software to obtained accurate results about the extension of time factors and also predict the RII (Relative Importance Index), AI (Average Index) method and Pareto chart method.

Design and Data Collection Analysis

We analyzed and survey different Public and private firms for collecting the data about the extension of time factors depicted in the charts below. Firstly, we designed 10 delay factors groups about Client, Contractor, Consultant, Design, Material, Labor, Equipment, Externality, Owner and Project these 10 delay factors having 95 statements and we also designed respondent scores “Very High”, “High”, “Moderate”, “Low”, “Very Low”.

For statistical analysis and ranking factors causing delay use RII (Relative Importance Index), AI (Average Index) and Pareto chart method. From these Relative Importance Index, Average Index and Pareto chart

graph method we analyzed the most important delay factors and least important delay factors.

1. RII (Relative Importance Index) Method

RII Method for determining the relative importance of various causes from the delay. The identical technique was achieved in this research.

$$\mathrm{RII} = \frac{\sum W}{A * N}$$

Where RII = Relative Importance Index; W = weighting given to each factor is answered by respondents (ranging from 1 to 5); a = higher Weight (for example, 5 in this case); N = the total number of respondents. RII has a range from 0 to 1 (0 not included); highest and RII, and most importantly, the cause of the delay. RIIs were then rank, and the results are shown below:

Assessment scales for a large level evaluation used in this study are as follows:

1: (VL) Very Low 2: (L) Low 3: (M) Moderate 4: (H) High 5: (VH) Very High

After generating the questionnaires format then survey and distributed in different departments both public and private, obtained highly field experienced views and counsel about delay factors and respondent score analyzed with RII (Relative Importance Index) value and gradation of delay components depicted in following tables

Respondent Scores

Factor group	Factors Causing Delays	1:VL	2: L	3:M	4: H	5: VH	RII	Rank
Client Related Factors Respondent Scores.	Lack of incentives for contractor to finish ahead of schedule	5	11	23	19	12	0.66	1
	Slowness in decision making	3	14	20	27	6	0.65	2
	Change orders	5	11	30	12	12	0.64	3
	Delay in site possession	6	13	20	20	11	0.64	3
	Delay in approving design documents	4	17	19	23	7	0.63	5
	Improper project feasibility study	5	16	22	19	8	0.62	6
	Lack of capable representative	6	19	20	11	14	0.62	6
	Lack of experience of Client in construction project	9	12	22	16	11	0.62	6
	Delay in payment	8	18	15	18	11	0.61	9
	Poor communication and coordination with other parties	9	17	15	22	7	0.60	10
	Suspension of work by Client	9	17	24	14	7	0.58	11
	Conflicts between joint ownership	11	15	22	13	9	0.58	12

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	RII	Rank
Consultant Related Factors Respondent Scores.	Late in looking into and favoring plan reports	4	15	20	16	14	0.65	1
	Destitute communication and coordination with other parties	4	14	20	22	9	0.64	2
	Inadequate project management assistance	4	15	23	20	8	0.63	3
	Stoppage in payment	8	18	15	18	11	0.61	4
	Clashes between Expert and Plan Design	6	24	21	15	4	0.56	5
	Inaccurate site investigation	8	16	22	17	7	0.59	6

	Delay in endorsing major changes in the scope of work by specialist	9	16	21	18	6	0.58	7
	Delay in performing review and testing	7	24	19	10	10	0.57	8

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	RII	Rank
Contractor Related Factors Respondent Scores	Destitute communication and coordination with other parties	5	10	21	25	9	0.67	1
	Inept extend group	8	11	21	16	14	0.65	2
	Out of date innovation	8	6	29	15	12	0.65	2
	Visit alter of subcontractors	8	10	22	20	10	0.64	4
	Insufficient Temporary worker encounter	8	13	17	20	12	0.64	4
	Inappropriate construction methods	6	12	24	23	5	0.63	6
	Incapable venture arranging and planning	7	11	22	20	9	0.63	6
	Unreliable subcontractors	5	16	20	20	9	0.63	6
	Poor site management and supervision	7	13	24	17	9	0.62	9
	Rework due to errors	5	22	15	20	8	0.61	10

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	RII	Rank
Design Related Factors Respondent Scores	Deficiently information and collection and overview some time recently plan	3	12	20	24	11	0.68	1
	Plan changes by the proprietor or his specialist amid development	5	14	17	21	13	0.67	2
	Unclear and inadequate details in drawings	7	12	17	21	13	0.66	3
	Lack of experience of design team in construction projects	5	16	17	19	11	0.63	4
	Destitute utilize of development building plan program	4	17	21	14	12	0.62	5
	Design errors made by designer	9	13	22	17	9	0.61	6
	The misconception of the owner's prerequisites by the	6	16	24	16	8	0.61	6

plan design							
Complexity of project design	8	16	28	12	6	0.58	8
Mistakes and delays in producing design documents	7	13	24	16	7	0.58	8

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	RII	Rank
Material Related Factors Respondent Scores	Change in Material types and specifications during construction	5	13	21	18	14	0.67	1
	Deficiency of development Materials	2	15	24	19	10	0.66	2
	Poor procurement of construction Materials	5	12	21	23	8	0.64	3
	Destitute quality of development Materials	9	9	22	18	12	0.64	3
	Damage of sorted Material	5	14	23	25	3	0.62	5
	Acceleration of material costs	7	13	21	20	8	0.62	5
	Unreliable suppliers	5	16	28	8	12	0.61	7
	Late conveyance of Materials	8	13	26	16	7	0.60	8
	Delay in manufacturing Materials	7	17	24	13	8	0.59	9

2. AI (Average Index) Method

In this method, average of price relative of commodity is calculated. Find price relative for each commodity for the current year using the formula $R = (P_1 / P_0) \times 100$. Add all price relatives of all the commodities. Divide sum obtained in step 2 by the number of commodities (N).

$$P_{01} = \frac{\sum \left(\frac{P_1}{P_0} \times 100\right)}{N}$$

Assessment scales for a large level evaluation used in this study are as follows:

1: (VL) Very Low 2: (L) Low 3: (M) Moderate 4: (H) High 5: (VH) Very High

We evaluated for more accurate and most important causing delay factors which have been used in every construction site area, so implement and find out the average index method values and it's ranking briefly discussed in table below.

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	AI	Rank
Client Related Factors Respondent Scores.	Need of motivations for a temporary worker to wrap up ahead of plan	5	11	23	19	12	3.31	1
	Gradualness in choice making	3	14	20	27	6	3.27	2
	Delay in location ownership	6	13	20	20	11	3.24	3
	Change orders	5	11	30	12	12	3.21	4
	Delay in favoring plan archives	4	17	19	23	7	3.17	5
	Inappropriate venture achievability study	5	16	22	19	8	3.13	6
	Lack of competent agent	6	19	20	11	14	3.11	7
	Need of experience of Client in a development venture	9	12	22	16	11	3.11	7

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4:H	5: VH	AI	Rank
Consultant Related Factors Respondent Scores.	Late in investigating and endorsing plan reports	4	15	20	16	14	3.26	1
	Destitute communication and coordination with other parties	4	14	20	22	9	3.21	2
	Inadequate project management assistance	4	15	23	20	8	3.19	3
	Delay in payment	8	18	15	18	11	3.09	4
	Wrong-site investigation	8	16	22	17	7	2.99	5
	Delay in favoring major changes in the scope of work by expert	9	16	21	18	6	2.94	6
	Delay in performing an assessment and testing	7	24	19	10	10	2.89	7
	Conflicts amongst Consultant and Design Engineer	6	24	21	15	4	2.81	8

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	AI	Rank
Contractor Related Factors Respondent Scores	Poor communication and coordination with other parties	5	10	21	25	9	3.33	1
	Incompetent project team	8	11	21	16	14	3.24	2
	Obsolete technology	8	6	29	15	12	3.24	2
	Inadequate Contractor experience	8	13	17	20	12	3.21	4
	Frequent change of subcontractors	8	10	22	20	10	3.20	5
	Unreliable subcontractors	5	16	20	20	9	3.17	6
	Ineffective project planning and scheduling	7	11	22	20	9	3.14	7
	Inappropriate construction methods	6	12	24	23	5	3.13	8
	Destitute location administration and supervision	7	13	24	17	9	3.11	9
	Rework due to mistakes	5	22	15	20	8	3.06	10

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	AI	Rank
Design Related Factors Respondent Scores	Insufficient data and collection and survey before design	3	12	20	24	11	3.40	1
	Design changes by the proprietor or his specialist amid development	5	14	17	21	13	3.33	2
	Vague and lacking points of interest in drawings	7	12	17	21	13	3.30	3
	Design blunders made by architect	9	13	22	17	9	3.15	4
	Destitute utilize of development the designing design software	4	17	21	14	12	3.10	5
	Need of involvement of the planning group in	5	16	17	19	11	3.13	6

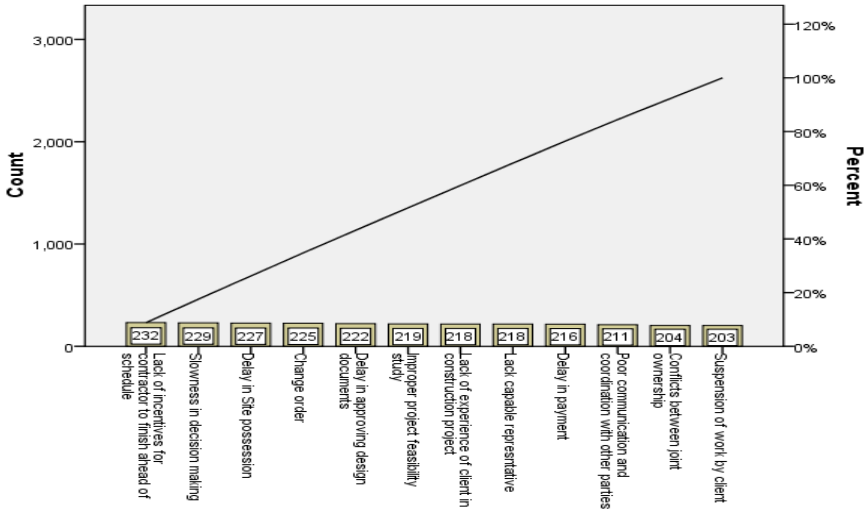
development projects							
The misconception of the owner's necessities by the design engineer	6	16	24	16	8	3.06	7
Botches and delays in creating design archives	7	13	24	16	7	2.91	8
Complexity of project design	8	16	28	12	6	2.89	9

Respondent Scores

Factor group	Factors Causing Delays	1: VL	2: L	3:M	4: H	5: VH	AI	Rank
Material Related Factors Respondent Scores	Alter in material sorts and details amid development	5	13	21	18	14	3.37	1
	Deficiency of development materials	2	15	24	19	10	3.29	2
	Destitute quality of development Materials	9	9	22	18	12	3.21	3
	Poor acquirement of development materials	5	12	21	23	8	3.20	4
	Damage of sorted material	5	14	23	25	3	3.10	5
	Acceleration of material costs	7	13	21	20	8	3.09	6
	Unreliable suppliers	5	16	28	8	12	3.04	7
	Late delivery of materials	8	13	26	16	7	3.01	8
	Delay in manufacturing materials	7	17	24	13	8	2.93	9

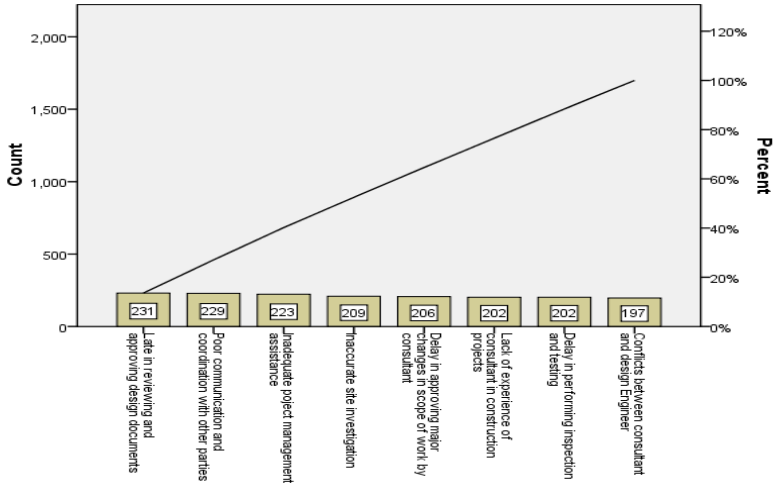
3. Pareto Chart procedure

The most important plan for determining the different significant circumstances is a Pareto chart graph plan. When we execute the Pareto plan for statistics analysis of development projects incidental and another significant constituent it will show its project importance in the factory. First, bring the data from different origins and install the data in software then we take the data which is analyzed in SPSS software to draw the 80/20 rule(Blackman & Chan, 2013) (Adegoke et al., 2017) (Ali et al., 2019)From this strategy analyzed and discovered the important and unimportant factors. It is very convenient and has no difficult understanding.



In client-related factors the respondent scores according to Pareto chart graph when we put causing factor delays and respondent scores then we obtained the most important causing delay factors from Pareto chart graph, so the most important and least important factor delays are discussed below.

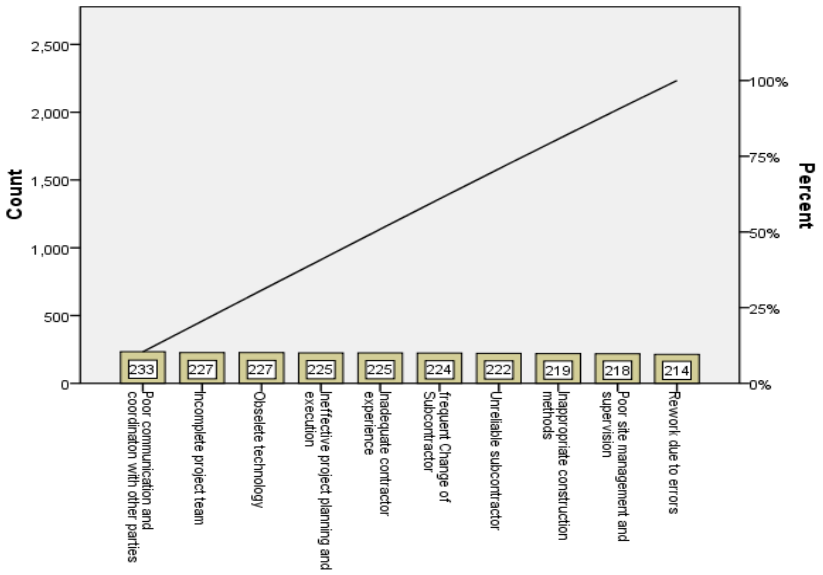
Most Pivotal Factors	Least Pivotal Factors
Delay in payment	Suspension of work by Client
Lack of capable representative	Conflicts between joint ownership
Lack of involvement of Client in construction project	Poor communication and coordination with other parties
Inappropriate venture possibility study	
Delay in favoring design documents	
Change orders.	
Delay in site possession	
Dumbness in decision making	
Need of motivations for the temporary worker to wrap up ahead of schedule	



Consultant Related Factors Respondent Scores:

In consultant-related factors the respondent scores according to Pareto chart graph when we put causing factor delays and respondent scores then we obtained the most important causing delay factors from Pareto chart graph, so the most important and least important factor delays are discussed below.

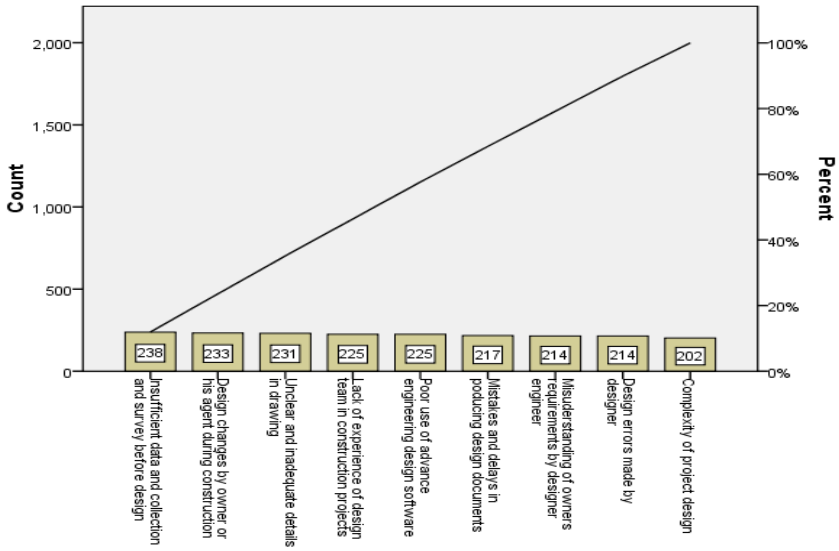
Most Pivotal Factors	Least Pivotal Factors
Need of involvement as an expert in development ventures	Clashes between Expert and Design Engineer
Delay in favoring major changes within the scope of work by expert	Delay in performing review and testing
Wrong location examination	
Lacking project administration help	
Destitute communication and coordination with other parties	
Late in investigating and favoring design reports	



Contractor Related Factors Respondent Scores

In contractor-related factors the respondent scores according to Pareto chart graph when we put causing factor delays and respondent scores then we obtained the most important causing delay factors from Pareto chart graph, so the most important and least important factor delays are discussed below.

Most Pivotal Factors	Least Pivotal Factors
Inappropriate construction methods	Revamp due to blunders
Unreliable subcontractors.	Destitute site administration and supervision
Frequent alter of subcontractors	
Insufficient Temporary worker involvement	
Incapable venture arranging and planning	
Out of date innovation.	
Incompetent project team.	
Destitute communication and coordination with other parties.	

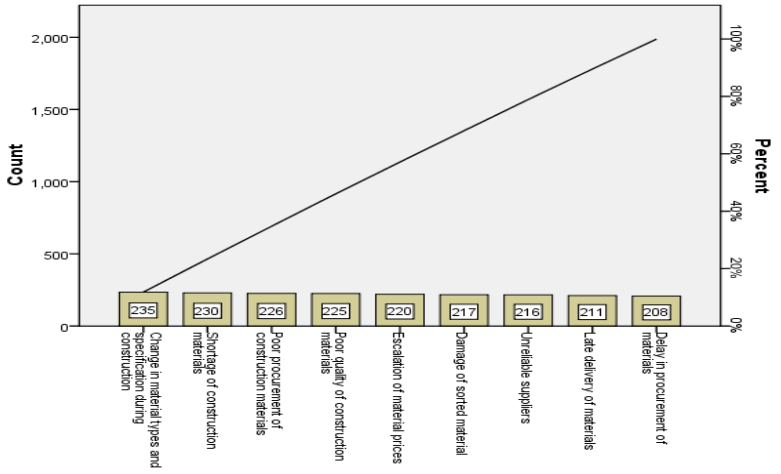


Design Related Factors Respondent Scores

In design-related factors the respondent scores according to Pareto chart graph when we put causing factor delays and respondent scores then we obtained the most important causing delay factors from Pareto chart graph, so the most important and least important factor delays are discussed below.

Most Pivotal Factors	**Least Pivotal Factors**
The misconception of owner's prerequisites by a design engineer	The complexity of venture design
Mistakes and delays in producing design documents	Design errors made by designer
Destitute utilize of progressed engineering design software	
Lack of experience of a design team in construction projects	
Undetermined and inadequate details in drawings	
Design changes by the proprietor or his specialist amid development	
Insufficient data and collection and survey	

before the design	



Material Related Factors Respondent Scores

In material-related factors the respondent scores according to Pareto chart graph when we put causing factor delays and respondent scores then we obtained the most important causing delay factors from Pareto chart graph, so the most important and least important factor delays are discussed below.

Most Pivotal Factors	Least Pivotal Factors
Unreliable suppliers	Delay in manufacturing Materials
Damage of sorted Material	Late conveyance of Materials
Escalation of Material prices	
Destitute quality of development Materials	
Destitute obtainment of development materials	
Deficiency of development Materials	
Alter in Material sorts and determinations amid development	

Conclusion

We have found a major and most important causing delay factor which is occurring in every project. This extension of time could be stopped by adopting the following factors and methods.

The most important delay factors in a client which we have been found from RII methods is the "Lack of motivations for the temporary worker to wrap up ahead of schedule". The most important delay factors in consultant which we have been found from RII methods is the "Late in checking on and endorsing design documents". The most important delay factors in contractors which we have been found from RII methods is: "Poor communication and coordination with other parties". The most important delay factors in design which we have been found from RII methods is the "Insufficient information and collection and study some time recently design". The utmost important delay factors in the material which we have been found from RII methods is the "Change in Material sorts and details amid construction".

Moreover, the great significant delay factor in client which we have been found from AI methods is the "Gradualness in choice- making". The uttermost fundamental delay factors in consultant which we have been found from AI methods is the "Poor communication and coordination with others parties". The most important delay factors in Contractor which we have been found from AI methods is the "Obsolete technology". The most significant delay factors in design which we have been found from AI methods is the "Design changes by the proprietor or his specialist amid construction". The great significant delay factors in material which we have been found from AI methods are the "Shortage of construction Materials".

Furthermore, we have analyzed the design related factors from Pareto Chart method. The most pivotal factors are the Inappropriate construction methods, Unreliable subcontractors, Frequent change of subcontractors, Incapable extend arranging and planning. And the least pivotal factors are Design errors made by designer, Complexity of project design.

References

Abdellatif, H., & Alshibani, A. (2019). Major Factors Causing Delay in the Delivery of Manufacturing and Building Projects in Saudi Arabia. *Buildings 9*(4), 93.

Adegoke, B. F., Babatunde, L. A., Apata, C. O., & Ogunyemi. (2017). *The Use of 80:20 Pareto Rule: A Guide in Testing Accuracy of Cost Estimating of Residential Buildings in Nigeria*. *2*(43), 330–340.

Ali, W., Shao, J., Khan, A. A., & Tumrani, S. (2019). Context-Aware

Recommender Systems: Challenges and Opportunities. *Dianzi Keji Daxue Xuebao/Journal of the University of Electronic Science and Technology of China*, *48*(5), 655–673.

Ali, W., Tian, W., Din, S. U., Iradukunda, D., & Khan, A. A. (2021). Classical and modern face recognition approaches: a complete review. *Multimedia Tools and Applications*, *80*(3), 4825–4880.

Amri, T. Al, & Marey-Pérez, M. (2020). Towards a sustainable construction industry: Delays and cost overrun causes in construction projects of Oman. *Journal of Project Management*, 87–102.

Banobi, E. T., & Jung, W. (2019). Causes and Mitigation Strategies of Delay in Power Construction Projects: Gaps between Owners and Contractors in Successful and Unsuccessful Projects. *Sustainability*, *11*(21), 1–16.

Biruk, S., & Jaśkowski, P. (2020). Selection of the Optimal Actions for Crashing Processes Duration to Increase the Robustness of Construction Schedules. *Applied Sciences*,*10*(22), 8028.

Bitamba, B. F., & An, S.-H. (2020). Construction Project Change Management in the Democratic Republic of the Congo: Status, Causes, and Impacts. *Sustainability 2020, Vol. 12, Page 9766*, *12*(22), 9766.

Blackman, I., & Chan, E. (2013). *Using Pareto Principle plus statistic methodology in establishing a cost estimating model*.

Elhusseiny, H. O., Nosair, I., & Ezeldin, A. S. (2021). Systematic processing framework for analyzing the factors of construction projects' delays in Egypt. *Ain Shams Engineering Journal*, *12*(2), 1501–1511.

Hamooni, M., Maghrebi, M., Sardroud, J. M., & Kim, S. (2020). Extending BIM Interoperability for Real-Time Concrete Formwork Process Monitoring. *Applied Sciences 2020, Vol. 10, Page 1085*, *10*(3), 1085.

Herrera, R. F., Sánchez, O., Castañeda, K., & Porras, H. (2020). Cost Overrun Causative Factors in Road Infrastructure Projects: A Frequency and Importance Analysis. *Applied Sciences*,*10*(16), 5506.

Karunakaran, S., Malek, M. A., & Ramli, M. Z. (2019). Causes of Delay in Construction of Highway Projects: a Review. *International Journal of Civil Engineering and Technology*, *10*(02), 2374–2386.

Kassa, Y. F., & Ababa, A. (2018). *Department of Public Administration and Development Management Determinants of Infrastructure Project Delays and Cost Escalations. The Case of Road and Rail Construction Projects in Ethiopia*. *63*(1), 102–136.

Khalifa, W. M. A., & Mahamid, I. (2019). Causes of Change Orders in

Construction Projects. *Engineering, Technology & Applied Science Research*, *9*(6), 4956–4961.

Khatib, B. Al, Poh, Y. S., & El-Shafie, A. (2018). Delay Factors in Reconstruction Projects: A Case Study of Mataf Expansion Project. *Sustainability 10*(12), 4772.

Kumar, V. (2020). Delay in Construction of Highway and Expressway Projects. *International Research Journal of Engineering and Technology*, *7*(6), 2136–2142.

Okpala, D. C., & Aniekwu, A. N. (1988). Causes of High Costs of Construction in Nigeria. *Journal of Construction Engineering and Management*, *114*(2), 233–244.

Pall, G. K., Bridge, A. J., Gray, J., & Skitmore, M. (2019). Causes of delay in power transmission projects: An empirical study. *Energies*, *13*(1).

Paraskevopoulou, C., & Boutsis, G. (2020). Cost Overruns in Tunnelling Projects: Investigating the Impact of Geological and Geotechnical Uncertainty Using Case Studies. *Infrastructures 2020, Vol. 5, Page 73*, *5*(9), 73.

Rashid, Y. (2020). Analysis of delay factors and their effects on construction projects. *Management Science Letters*, *10*(6), 1197–1204.

Rivera, L., Baguec, H., & Yeom, C. (2020). A Study on Causes of Delay in Road Construction Projects across 25 Developing Countries. *Infrastructures 2020, Vol. 5, Page 84*, *5*(10), 84.

Safapour, E., Kermanshachi, S., Alfasi, B., & Akhavian, R. (2019). Identification of Schedule-Performance Indicators and Delay-Recovery Strategies for Low-Cost Housing Projects. *Sustainability*, *11*(21), 1–13.

Sepasgozar, S. M. E., Karimi, R., Shirowzhan, S., Mojtahedi, M., Ebrahimzadeh, S., & McCarthy, D. (2019). Delay Causes and Emerging Digital Tools: A Novel Model of Delay Analysis, Including Integrated Project Delivery and PMBOK. *Buildings 2019, Vol. 9, Page 191*, *9*(9), 191.

Soomro, F. A., Memon, M. J., Chandio, A. F., Sohu, S., & Soomro, R. (2019). Causes of Time Overrun in Construction of Building Projects in Pakistan. *Engineering, Technology & Applied Science Research*, *9*(1), 3762–3764.