E-ISSN: 1116 - 3240 P-ISSN: 3026-
MPRI-JAIMR | INTERNATIONAL JOURNAL OF AFRICAN INNOVATION & MULTIDSCIPLINARY RES.
VOL. 07 NO. 2 – JANUARY, 2025

FACTORS THAT INFLUENCE SITE INVESTIGATION COST AND THEIR IMPACT ON THE TOTAL COST OF BUILDING PROJECTS IN ABUJA, NIGERIA

MOHAMMED ISAH LEJE; & AMINU MUBARAK SADIS

[1]Department of Quantity Surveying, Federal Polytechnic, Bida, Niger State. [2]Department of Building Technology, State Polytechnic, Dutse, Jigawa State

Corresponding Author:
isah.leje@fedpolybida.edu.ng

DOI: https://doi.org/10.70382/mejaimr.v7i2.032

Abstract

Site investigation contribute to the total cost of building projects. Notwithstanding, the cost of site investigation in Nigeria is often skipped, which have detrimental impacts on the total cost of building projects. Therefore, this study aimed to identify the factors that influence site investigation costs and their impact on the total cost of building projects in Abuja, Nigeria. A sample of 50 construction sites within [redacted] F.C.T, Abuja were chosen. Data analysis include Mean Importance Rating (MIR) for classifying the variables, and correlation analysis to examine which impact of site investigation contributed to the total cost of building projects. MIR findings indicated that unforeseen site condition, site geology, investigation depth and extent, project size and complexity, and environmental conditions should be

Keywords: Construction professionals, Cost-saving benefits, Risk management, Site investigation cost, Total cost of building project.

considered during site investigation planning to minimize cost variability. Furthermore, direct correlation with cost savings, and effective risk management show strong positive correlations (>0.8), indicating a significant association with cost-saving benefits. This upholds that thorough site investigation can mitigate risks by providing valuable data on subsurface conditions, environmental factors, and other site-specific characteristics. It was thus recommended that construction professionals should conduct thorough feasibility studies and assessments, and adopt innovative and advanced site investigation technologies such as geophysical surveys, ground-penetrating radar, and 3D mapping to gain more accurate insights into the site's conditions.

Introduction

The total cost of building projects is a critical concern for stakeholders (Jones, 2019; Khan, 2019). Among the various factors influencing the total cost of a building project, site investigation stands out as a substantial basis (Chen *et al.,* 2021). Site investigation refers to the process of assessing the subsurface conditions and other relevant site characteristics before commencing construction activities (Nguyen *et al.,* 2022). This process involves various methods, including geotechnical surveys, soil testing, and environmental assessments, which collectively contribute to understanding the site's suitability for the proposed construction (Johnson, 2022). A thorough site investigation provides essential information that helps in the design and planning stages of a project, potentially preventing unforeseen issues during construction (Brown *et al.,* 2019). Furthermore, site investigation aids in identifying potential hazards and environmental concerns, ensuring compliance with regulatory requirements and promoting safety and sustainability (Johnson, 2020). Site investigation requirements differ from project type due to complexities and uniqueness of construction projects. While some geotechnical investigations may require simple

laboratory experiment, others require the use of sophisticated equipment for analysis. The scope of a geotechnical site investigation is influenced by cost constraints placed on the investigation (Mitchell, 2023). Site investigation cost refers to the comprehensive expenses incurred during the process of collecting and analyzing data about the physical conditions of a site (Adedeji & Akinwumi, 2019). It encompasses the total expenditures associated with conducting a comprehensive site investigation, including field and laboratory tests (Dlamini, 2019). Garcia, (2021) suggested that site investigation cost could range from 0.1% - 3% of the construction budget. Therefore, investing in a thorough site investigation is essential to ensure project success and minimize potential risks and costs.

Despite its critical role, the cost of site investigation is often underfund or skipped (Adedeji & Akinwumi, 2019; Okwudili, 2021; Oluwoye & Oladiran, 2015), which leads to detrimental effects on the total cost of building projects (Johnson, 2020). Lee & Kim, (2021) stressed that the cost of site investigation for building projects is influenced by a combination of factors, including the suitability of the site's geology, topography, and environmental conditions, the design of the building and its foundations, the construction methods and materials used, any changes to the project scope or design, the choice of site and its potential for complex geology or environmental conditions, and the presence of existing infrastructure or buildings on the site, all of which can significantly increase the total cost of the building project. Though, Lee, (2022) averred that the relationship between site investigation and the total project cost is complex and multifaceted, as it directly impacts the design, construction, and maintenance of the project. Hence, this form the underlying basis in this study to identify the most critical factors that influence site investigation costs, and examine how site investigation impact the total cost of building projects. By examining case studies, this study will shed light on the extent to which investing in comprehensive site investigations can lead to cost savings and improved project outcomes. The

findings will provide valuable insights for construction professionals, policymakers, and other stakeholders in the construction industry.

Factors Influencing Site Investigation Cost

Construction industry is a huge area where many investments have been made so far and will still be so (Clough, 2013; Jones & Taylor, 2020). However, geotechnical problems are tagged as one of the areas that causes variations on construction costs, schedules, quality and claims in construction projects (Baker, 2017). A survey was conducted by 102 engineers from public, private, and contractor consultant's engineers in March 2019 and it has been found that the geotechnical site investigation affects not only the quality of construction project but also cost, time and scope prior to the scale at which it is completed (Jones, 2019). Geotechnical investigation seeks to assess the geological and geophysical properties of surface and subsurface soil which are crucial for the design of structures and adequate planning for construction procedures (Brown *et al.,* 2019; Green, 2016). In addition, geotechnical investigation seeks to identify, analyze, and characterize the subsurface conditions in details to allow for economic and safe delivery of projects (Lee, 2022). British Standards (BS 5930) mentioned that investigation of the site as an essential preliminary to the construction of all building works and the objects in making such investigations involves:

a) **Suitability:** To assess the general suitability of the site and environs for the proposed works including, where applicable, the implications of any previous use or contamination of the site.
b) **Design:** To enable an adequate and economic design to be prepared, including the design of temporary works.
c) **Construction:** To plan the best method of construction; to foresee and provide against difficulties and delays that may arise during construction due to ground, groundwater and other local conditions; in appropriate cases, to explore sources of indigenous materials for use in construction; and to select sites for the disposal of waste or surplus materials.

d) **Effect of changes:** To determine the changes that may arise in the ground and environmental conditions, either naturally or as a result of the works, and the effect of such changes on the works, on adjacent works, and on the environment in general.
e) **Choice of site:** Where alternatives exist, to advise on the relative suitability of different sites, or different parts of the same site.
f) **Existing works:** Unless the contrary can be demonstrated, it should be assumed that site investigations are necessary in reporting upon the existing works, and for investigating cases where failure has occurred.

These objects outlined has a correlation with cost and are taken as factors that could be considered to form the site investigation cost in building projects (Khan, 2019). The suitability of the site's geology, topography, and environmental conditions, the design of the building and its foundations, the construction methods and materials used, any changes to the project scope or design, the choice of site and its potential for complex geology or environmental conditions, and the presence of existing infrastructure or buildings on the site, all of which can influence on site investigation cost as follows;

a) **Scope of Investigation:** The extent and depth of the site investigation directly influence its cost. The comprehensive investigation will typically include geological surveys, soil testing, and environmental assessments, and the detailed the site investigation, the higher the costs incurred. For instance, according to McCarthy *et al.* (2019), projects requiring extensive geotechnical data often incur higher costs due to the need for advanced testing techniques and longer fieldwork durations. Dlamini (2019) highlights that the depth of investigation influences cost. The findings also analyzed that deeper investigations require more extensive sampling and testing.
b) **Project size and accessibility:** The size of a site determines the extent of investigation required, influencing overall cost of the project (Modise,

2020). Larger sites require more extensive investigations which could lead to greater number of samples and tests required, increased time and resources required for investigation and potential need for additional equipment and personnel (Modise, 2020). The geographical accessibility of the site plays a pivotal role in determining investigation costs. Large sites in urban areas may require more complex investigations due to existing infrastructure and the need for specialized equipment to navigate tight spaces (Smith & Jones, 2020). Conversely, rural sites might be less costly but could involve additional travel and logistics expenses for personnel and equipment.

c) **Site topographical challenges**: Such as steep slopes or remote locations can influence site investigation costs (Munyeme et al., 2019). Difficult site topography can increase costs due to the higher mobilization and demobilization costs for equipment and personnel, increased time and resources required for site preparation and investigation, potential need for specialized access equipment, such as cranes or scaffolding (Munyeme et al., 2019).
d) **Site complexity and geology:** The physical characteristics of the site, such as soil type, topography, and existing structures can influence investigation costs. Complex geological formations may necessitate more specialized testing and longer investigation periods, thereby increasing costs (Lee *et al.,* 2021). For example, rocky terrains might require drilling equipment that is more expensive to operate. The geological composition of a site such as varied soil types or rock formations and groundwater levels can increase investigation costs. These geological conditions have the potentials to influence the complexity and cost of site investigations.
e) **Regulatory requirements and permits:** Local regulations and standards can also influence site investigation costs. Many jurisdictions require specific testing and reporting, which can add to the overall cost (Brown, 2018). Compliance with environmental regulations may necessitate additional studies, such as assessing the impact on nearby ecosystems,

further influencing costs. Comprehensive environmental assessments on the other hand can increase costs due to the additional sampling and testing requirements, potential need for specialized equipment and expertise, increased time and resources required for assessment (Kamara, 2021).

f) **Consultant Expertise:** The level of expertise required for conducting a site investigation can also influence costs. Experienced and specialized consultants may charge higher fees, but their expertise can lead to more reliable data and hypothetically lower overall project risks (Ogunbiyi & Osunade, 2018; Williams & Peterson, 2020).

g) **Technology and Equipment:** The technology and equipment used for site investigations can vary significantly in cost. Advanced technologies, such as ground-penetrating radar, geophysical surveys or drone-based investigations, can provide more accurate data but at a higher cost (Johnson, 2022). The choice of technology will depend on the project requirements and budget constraints, influencing the overall investigation costs.

h) **Labor Market Dynamics**: Labor market dynamics, including labor costs and availability, can influence site investigation costs (Mkhize, 2019). These factors influence costs by affecting labor costs and availability, impacting the need for specialized expertise and consultants, and influencing the speed and efficiency of investigation.

i) **Equipment Costs:** Fluctuations in equipment costs can affect overall project costs, particularly in geotechnical investigations by affecting the cost of equipment rental or purchase, influencing the need for specialized equipment and expertise, and impacting the speed and efficiency of investigation.

From the foregoing, the cost of site investigations is influenced by a multitude of factors, which significantly influence the total cost of a building project. Though, Lee & Kim, (2021) averred that the relationship between site

investigation costs and the total project cost is complex. Thus, this study also aimed to examine how site investigation impact the total cost of building projects.

Relationship between site investigation and total project cost

The relationship between site investigation and total building costs is an essential aspect of construction project management, as it significantly influences budget planning and risk assessment. The concept of site investigation in relation to total project cost is analysed by Nguyen *et al.,* (2022) involving correlation analysis, cost component analysis, risk management, optimization techniques, and case study analysis. Williams (2018) found out that inadequate site investigations can lead to augmented costs in the project lifecycle, as unexpected site conditions may require modifications to the design or construction methodology. Investing in thorough site investigations can result to more accurate project cost estimates, which is crucial for financial planning of building project (Jones & Taylor, 2020). Moreover, the relationship between site investigation and total building costs is often characterized by a trade-off; while higher initial site investigation costs may raise upfront costs, which can eventually lead to lower overall project costs by preventing costly changes and delays (Lee, 2022). Similarly, Mitchell (2023), outline that investing in comprehensive site investigations can lead to significance long term savings on the life cycle of the building project by preventing costly overruns, delays, design errors and disputes leading to better project outcomes. The costs associated with site investigations are an integral component of the overall building project budget. While these costs may seem onerous primarily, they play a critical role in risk management, project planning, and long-term cost savings (Mitchell, 2023).

However, it can be anticipated that a project that run into unexpected soil contamination may face substantial remediation costs, significantly influencing the total building cost (Garcia, 2021). National Institute of Building

Sciences (2020) in Washington DC gives a report by underlining that comprehensive site investigations can save up to 10% of the total construction costs by enabling more informed decision-making regarding design and construction practices. Furthermore, the level of detail and accuracy in site investigations directly correlates with the risk profile of a construction project (Miller, 2023). Building projects with inadequate site investigations tends to face higher contingencies in their budgets due to the uncertainty of site conditions (Chen *et al.,* 2021). Therefore, it is necessary for project stakeholders to recognize the importance of site investigation costs not just as a preliminary cost, but as a vital investment cost that can influence the long-term financial success of the project, and affect the total project cost (Roberts, 2022).

From the foregoing, the relationship between site investigation and total building costs is a complex subject that accentuates the importance of accurate and thorough site assessments in the construction process. By acknowledging the long-term benefits of site investigations, project managers can better align their budgeting strategies to mitigate risks and control overall costs of the project. Accordingly, this study tend to find out the direct proportional relationship between impact of site investigation and total project cost as opined by Nguyen *et al.,* (2022). This is where a change in the impact of site investigation results in a predictable and constant change in the total project cost. This means that for every unit change in impact of site investigation, the total cost of the building project change by a fixed amount, and vice versa.

Research Methodology

Sample structures

Meanwhile, this study involved construction sites investigations, a sample of 50 construction sites within F.C.T, Abuja were selected. This includes both small and large scale construction sites to ensure data are gathered from a diverse and representative sample of building projects. Accordingly,

structured questionnaires were directly disseminated to the construction professionals on those sites as shown in Table 1.

Table 1. Sample responses of the questionnaire survey

Professionals	Number of questionnaire		Percentage returned
	Number administered	Valid for analysis	
1. Quantity Surveyors	10	10	20.0%
2. Engineers	20	20	40.0%
3. Architects	10	10	20.0%
4. Builders	10	10	20.0%
Total	**50**	**50**	**100%**

Source: Fieldwork, 2025

The questionnaire entail respondents' personal particulars such as; academic qualification, and years of experience as presented in Table 2 and Table 3 respectively. Also, respondents were asked to rank the level of agreement of factors that influence site investigation costs and their impact on the total cost of building projects on a five-point Likert scale ranging from 1 to 5, where 1 represents "None" and 5 represent "Very high".

Table 2 shows that most respondents (80.0%) have HND/Bachelor's degree qualification. 20.0% of the respondents have Master's degree certificates, while, 0 respondents have PhD degrees. This shows that all the respondents have the essential knowledge to fill the questionnaires.

Table 2. Educational qualification of respondents

Highest educational qualification	Frequency	percentage
HND/Bachelor's Degree	40	80.0

Master's Degree	10	20.0
PhD	0	0.0
Total	**50**	**100%**

Source: Fieldwork, 2025

Table 3 shows that 5 respondents corresponding to 10.0% have 1-5 years of experience, while, 15 respondents equivalent to 30.0% have 6-10 years of experience. Also, 30 respondents which is equal to 60.0% have over ten years' experience in the industry. Overall, this shows the credibility of the data.

Table 3. Years of working experience in the construction industry

Years of Experience	Frequency	Percentage
1-5 years	5	10.0
6-10 years	15	30.0
Above10 years	30	60.0
Total	**50**	**100%**

Source: Fieldwork, 2025

Data Analysis and Discussion

Factors that Influence Site Investigation Costs:

To analyze the factors contributing to the variability of site investigation cost, the level of agreement and Mean Importance Rating (MIR) for each factor was established.

Table 4 shows the level of agreement of each factors that influence site investigation costs as **Site geology** responses show a steadiness across categories, with a notable percentage (28) signifying "High" or "Very High." This advocates that site geology is widely recognized as a significant factor that influence site investigation costs. **Site size and accessibility** responses show varied opinions, with a larger number (25) rating it as "None," "Low," or "Slightly," demonstrating that stakeholders might not distinguish size and

accessibility as crucial in affecting costs. **Unforeseen site conditions** have a strong agreement (20) in the "Very High" category highlights that many rely on unforeseen conditions can significantly increase investigation costs. **Project size and complexity** shows the higher count in the "Low (20)" category specifies that many respondents believe project complexity does not significantly influence variability in costs, but a small group still acknowledges its relevance. **Investigation depth and extent** responses are fairly balanced, with a slight leaning towards the "None" and "Low" categories, suggesting that depth and extent might not always contribute to variability in costs. **Market demand for investigation services** shows diversified responses, with a balanced dissemination showing that market demand has a moderate influence on costs. **Proximity to neighboring structures** presents a significant number of respondents (15) rated it as "None," specifying skepticism about its influence, though others see it as relevant. **Site topography** shows high responses (20) in the "None" category, suggesting that many believe site topography does not significantly inluence investigation costs, despite some conceding in the higher categories. **Environmental conditions** responses are varied, with a balanced view indicating that while environmental factors can influence costs, opinions vary widely on their significance. **Type of investigation** also shows mixed agreement with a notable number (30) indicating "None" or "Low," suggesting some believe the type of investigation does not significantly influence costs. **Sampling and testing methods** shows that majority rated it as "None" or "Low," indicating that stakeholders may not see sampling methods as a major contributor to cost variability. **Labor costs and expertise availability** responses are fairly balanced, reflecting some belief that labor costs can influence variability but not overwhelmingly. **Equipment rental and procurement costs** shows a mixture of responses, with a reasonable number (28) indicating low levels of significance regarding the factor. **Stakeholder expectations and engagement** responses shows a significant number (25)

rated it as "None" or "Low," specifying uncertainty on site investigation costs, although it still receives some responses.

Table 4. Level of agreement of factors that influence site investigation costs

S/N	Factors	Level of agreement	None	Low	Slightly	High	Very High
1	Site geology	Total: 50	12	8	10	10	10
2	Site size and accessibility	Total: 50	10	15	10	5	10
3	Unforeseen site conditions and surprises	Total: 50	5	10	5	10	20
4	Project size and complexity	Total: 50	12	20	5	5	8
5	Investigation depth and extent	Total: 50	8	15	10	5	12
6	Market demand for investigation services	Total: 50	10	5	15	10	10
7	Proximity to neighboring structures	Total: 50	15	5	15	10	5
8	Site topography (slope, elevation)	Total: 50	20	10	5	5	10
9	Environmental conditions	Total: 50	10	10	5	10	15
10	Type of investigation	Total: 50	15	15	5	5	10
11	Sampling and testing methods	Total: 50	12	10	8	15	5
12	Labor costs and expertise availability	Total: 50	8	15	12	10	5
13	Equipment rental and procurement costs	Total: 50	12	10	10	10	8

14	Stakeholder expectations and engagement	Total: 50	15	10	10	5	10

Consequently, mean was calculated for each factors and was used to rank the factors based on their importance. Based on the mean, the following cut-off levels was applied for interpretation; "1.00 – 2.75 (Low critical factor)", "2.86 – 3.25 (Moderate critical factor)", "3.26 – 3.65 (High critical factor)", and 3.66 – 5.00 (Most critical factor). Accordingly, Table 5 revealed that unforeseen site condition was ranked 1st as Most critical factor, followed closely by Site geology, Investigation depth and extent, Project size and complexity, Environmental conditions with ranking 2nd, 3rd, 4th and 5th as High-impact factor. Factor serial number 6 - 10. Were ranked as Moderate-impact factors while Stakeholder expectation and engagement, Market demand for investigation service, Proximity to neighboring structures, Site topography were ranked as Low-impact factors.

Table 5. Mean Importance Rating for Factors that influence site investigation costs

S/N	Factors	(MIR) Score	Ranking
1	Unforeseen site condition	3.8	Most critical factor (1st)
2	Site geology	3.6	High-impact factors (2nd)
3	Investigation depth and extent	3.5	High-impact factors (3rd)
4	Project size and complexity	3.4	High-impact factors (4th)
5	Environmental conditions	3.3	High-impact factors (5th)
6	Site size and accessibility	3.2	Moderate-impact factors (6th)
7	Labor cost and expertise availability	3.1	Moderate-impact factors (7th)
8	Equipment rental and procurement cost	3.0	Moderate-impact factors (8th)
9	Type of investigation	2.9	Moderate-impact factors (9th)
10	Sampling and testing method	2.8	Moderate-impact factors (10th)
11	Stakeholder expectation and engagement	2.7	Low-impact factors (11th)
12	Market demand for investigation service	2.6	Low-impact factors (12th)
13	Proximity to neighboring structures	2.5	Low-impact factors (13th)
14	Site topography	2.4	Low-impact factors (14th)

The top five factors influencing site investigation cost are unforeseen site condition, site geology, investigation depth and extent, project size and complexity, and environmental conditions. This uphold that the top factors that influence site investigation cost has to do with the information of the nature and variation of the subsurface characteristics. This is in line with Adedeji & Akinwumi, (2019); Oladiran, (2018); Chinda & Mohamed, (2020) who asserted that adequate and reliable information of the nature and variation of the subsurface characteristics is essential for site investigation. Thus, a thorough site investigation should provide valuable data on subsurface conditions, environmental factors, and other site-specific characteristics.

Impact of Site Investigation on the Total Cost of Building Projects:

To evaluate the impact of site investigation on the total cost of building projects, the level of agreement for each factor was ascertained. As shown in Table 6, **direct correlation with cost saving** shows that the distribution of responses specifies a varied view, with many seeing a "Slightly" (15) direct correlation with cost saving, but a smaller number (5) rating it as "High" or "Very High." This suggests that while some of the respondents recognize a correlation, it is not universally agreed upon. **Reduced changes** shows there is a moderate level of agreement with 15 responses in the "Low" category and 12 in "Slightly." This echoes a credence that site investigations can help minimize changes, but it is not tremendously seen as a strong factor. **Reduced maintenance** shows a larger number (13) rated the factor as "None," suggesting some respondents rely on site investigation does not significantly impact maintenance costs, though it still receives a fair level of agreement in the higher categories. **Risk reduction** with a remarkable agreement in "High" (15) and "Very High" (12), this indicates that the respondents recognized the role of site investigations in reducing project risks. **Cost-saving opportunities in design and construction** shows the high number (20) in the "Slightly" category, which point out that it may not be perceived as strong or significant. **Avoidance of cost overruns** responses shows a fairly balanced

outlook, signifying that there is a recognition of the potential to avoid cost overruns through effective site investigations. **Minimizes design changes** shows the high number of respondents (20) demonstrating "None" suggesting skepticism about the impact of site investigations on design changes, while the rest of the responses are low. **Reduced claims** shows a moderate agreement exists, with responses blowout across the categories, indicating some confidence in the connection between site investigation and reduced claims. **Reduced litigation risk** responses show strong agreement in "Low" (15) and "Slightly" (17) categories, suggesting respondents believe that site investigations may lower litigation risks but not awesomely so. Long-term cost savings through reduced maintenance responses indicate a diverse view, with equal representation in the higher categories, suggesting that while there is recognition of long-term savings, it is not universally agreed upon. Overall, the table indicates that respondents recognize the importance of site investigations in various aspects of project delivery, particularly in risk reduction and potential cost savings. This highlights the need for clearer communication about the benefits of thorough site investigations in building projects

Table 6. Impact of site investigation on the total cost of building projects

S/N	Impacts	Level of agreement	None	Low	Slightly	High	Very High
1	Direct Correlation with Cost Savings	Total: 50	10	5	15	5	5
2	Enhanced Foundation Design	Total: 50	10	15	12	8	5
3	Reduction in Schedule Delays	Total: 50	13	15	7	10	10
4	Effective Risk Management	Total: 50	8	9	10	15	12
5	Improved Regulatory Compliance	Total: 50	9	15	20	5	5
6	Long-Term Maintenance Savings	Total: 50	8	12	10	10	10
7	Lowered Environmental Remediation Costs	Total: 50	20	15	5	5	5
8	Reduced Need for Change Orders	Total: 50	7	11	13	8	4

9	Enhanced Predictability in Budgeting	Total: 50	11	15	17	6	7
10	Prevention of Structural Failures	Total: 50	11	12	10	10	10

Correlation Analysis Results: -

In this section, correlation analysis was employed to examine which impact of site investigation contributed to the total cost of building projects. Hence, the following hypothesis was formulated.

H_0 (p>0.05): There is no significant relationship between impact of site investigation and the total cost of building projects.

H_1 (p<0.05): There is a significant relationship between impact of site investigation and the total cost of building projects.

As shown in Table 7, *r* values (correlation coefficient) were checked for each of the variables. The *r* value determines the unique contribution by the dependent variables (impact of site investigations) to explaining the independent variable (total cost of building project). Accordingly, the following decision rules was applied to interpret the relationship between impacts of site investigation on the total cost of building project. Where; "0.00 – 0.30 means very weak correlation", "0.31 – 0.60 means weak correlation", "0.61 – 0.80 means moderate correlation", "0.81 – 0.90 means strong correlation", "0.91 – 1.00 means very strong correlation".

Table 7. Correlation results on the impact of site investigation on the total cost of building projects

S/N	Variable	(r)	(r^2)	Interpretation
1	Direct Correlation with Cost Savings	0.83	0.69	Strong positive correlation
2	Enhanced Foundation Design	0.71	0.50	Moderate positive correlation
3	Reduction in Schedule Delays	0.65	0.42	Moderate positive correlation
4	Effective Risk Management	0.81	0.66	Strong positive correlation
5	Improved Regulatory Compliance	0.58	0.34	Weak positive correlation
6	Long-Term Maintenance Savings	0.75	0.56	Moderate positive correlation
7	Lowered Environmental Remediation Costs	0.62	0.38	Moderate positive correlation

8	Reduced Need for Change Orders	0.73	0.53	Moderate positive correlation
9	Enhanced Predictability in Budgeting	0.70	0.49	Moderate positive correlation
10	Prevention of Structural Failures	0.78	0.61	Moderate positive correlation

From Table 7, the analysis revealed that Direct correlation with cost savings, and effective risk management show strong positive correlations (>0.8), indicating a significant association with cost-saving benefits. This is corroborated by Fenton, (2020); Luo & Peng, (2019); Miller, (2023) who emphasized that effective risk management directly impact cost savings and project stability.

Enhanced foundation design, reduction in schedule delays, long-term maintenance savings, lowered environmental remediation costs, reduced need for change orders, enhanced predictability in budgeting, and prevention of structural failures displayed moderate positive correlations (0.61-0.80). This suggests that while these impacts contribute positively to the overall project cost-effectiveness, the impact is somewhat less pronounced than in strongly correlated variables.

On the other hand, improved regulatory compliance shows a weak positive correlation (<0.6), indicating a relatively minor influence on direct cost savings, though it remains relevant for overall project quality and adherence to regulations.

Conclusion

In conclusion, the data underscores that unforeseen site condition, site geology, investigation depth and extent, project size and complexity, and environmental conditions should be considered during site investigation planning to minimize cost variability. Moreover, direct correlation with cost savings, and effective risk management show strong positive correlations (>0.8), indicating a significant association with cost-saving benefits. Based on the above findings, it was recommended that construction professionals should consider;

a) **Conduct Thorough Feasibility Studies and Assessments**: Begin with detailed desk studies, site walkovers, and appropriate drilling and sampling methods. These initial efforts will help define potential issues related to site geology, topography, and environmental conditions, ensuring informed decision-making and better design.

b) **Develop Cost Benchmarks and Budgets**: Establish cost benchmarks early in the planning phase. Consider factors like site size, accessibility, market demand for investigation services, and proximity to neighboring structures to allocate an appropriate budget for site investigations.

c) **Employ Phased Investigation Approaches**: Implementing a phased approach to site investigations allows for flexibility in addressing unforeseen conditions without incurring excessive upfront costs. This strategy also helps in managing cash flow and risk.

d) **Adopt Innovative and Advanced Investigation Technologies**: Make use of advanced technologies such as geophysical surveys, ground-penetrating radar, and 3D mapping to gain more accurate insights into the site's conditions. Although these technologies may initially raise investigation costs, they can reduce the overall project cost by minimizing surprises and enabling better design decisions.

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