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Research Article

Assessment of Risk Factors in Condominium Buildings Construction in Metro Manila using Analytic Hierarchy Process (AHP)

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ABSTRACT

The rapid urbanization of Metro Manila led to a surge in condominium construction projects, which, despite offering efficient housing solutions, faced significant challenges due to dense urban environment, susceptibility to natural disasters & the health and safety issues related to accidents, losses, injuries, damages, and/or delays arising during the execution of a project which may adversely affect its success. This study explored the efficacy of the Analytic Hierarchy Process (AHP) in assessing and prioritizing risks specific to Metro Manila's condominium construction projects, addressing a critical gap in current risk assessment methodologies. The study engaged mixed methods, integrating Meta-Analysis, Experts Consultation, and AHP, to identify and prioritize Risk Factors (RFs) in condominium construction projects. A systematic review through meta-analysis revealed nine critical RFs, including Technical/Design, Financial/Economic, Environmental, Regulatory/Legal, Socio-Political, Logistics/Supply Chain, Management/Supervision, Quality, and Health and Safety Risks. Inputs from experts from a diverse group of qualified professionals had been pooled to validate these findings. Through AHP analysis, risks specific to Metro Manila's condominium construction projects were revealed, with Health and Safety Risk (19.52%), Quality Risk (15.97%) and Management/Supervision Risk (15.77%) as the major concerns. An internal consistency of 0.71% attested to the reliability testing of the results. Given the complexity of condominium construction projects, this study responds to an important demand: a more systemic understanding of risk factors. Moreover, this study is relevant to further enhance and improve sustainability in condominium projects as well as performance of the construction industry.

Keywords: *Analytic Hierarchy Process (AHP), Condominium, Risk factors, Residential building*

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Introduction

An important component of the urban sector is the construction industry which has a significant increase in condominium construction projects in Metro Manila, Philippines. There has been a significant surge in the condominium sector. This boom is fuelled by different factors like rapid urbanization, population growth, and increased investment in real estate (Reyes, 2020; Ahmad & Nouban, 2023). While the expansion of the condominium market presents numerous economic advantages, it also introduces challenges and risks that can significantly impact the success and sustainability of construction projects (Akinola, 2023; Alamdari et al., 2021). Conceptualizing the construction of condominium buildings is a complex process that involves various risks and challenges. These risks can have implications for safety, cost, quality, time, and environmental impact (Božanić et al., 2023). Managing these risks are critical, not only for the project's potential clients but also for future occupants and the community especially in Metro Manila.

Methods

2.1 Research Design

In this study which aims to assess the risks in condominium construction in Metro Manila using AHP, the researcher used a mixed-methods approach. This approach employed both qualitative and quantitative research methods. The qualitative approach includes in-depth interviews with experts from construction industry, architects, engineers, and project managers to gain the challenges and risks associated with condominium construction in Manila (Reyes, 2020; Ahmad & Nouban, 2023). The Quantitative Approach included surveys conducted among professionals in the construction industry to extract numerical data on the perceived risks and the effectiveness of various risk assessment methods, utilizing AHP. This data was then analysed using statistical tools to draw meaningful conclusions.

2.2 Population and Sampling

Specifically, purposive sampling Nikolopoulou, K. (2022) will be used for the survey to measure and determine the critical risk factors of residential / condominium construction building projects. The population for this research encompassed all professionals and potential clients involved in the condominium construction industry in Manila. This includes the Project Managers, Construction Managers, Lead/Head Engineers, Architects, Contractors, Subcontractors, Real Estate Developers and Consultants.

2.3 Data Gathering Procedures

Before actual data collection, the research instruments (questionnaires, interview guides, AHP matrices, and observation checklists) were pilot tested with a small group of experts to ensure their validity and reliability (Alattyih et al., 2021). The study obtained necessary permissions and approvals from relevant authorities and participants. Informed consent was obtained from all respondents, ensuring their understanding of the study's purpose and their rights. The questionnaires were distributed to a diverse group of professionals in the condominium construction industry in Metro Manila. Depending on accessibility and feasibility, questionnaires were distributed in person, via email, or through online survey platforms. Respondents have filled out the questionnaires, providing quantitative data on perceived risks and the effectiveness of risk assessment methods.

The second phase of the research methodology involved expert consultation through the development and administration of a validated survey questionnaire. The questionnaire was designed and developed based on the results obtained from the Meta Analysis in condominium construction projects.

The researcher deliberately selected experts from the project team, including individuals involved in condominium construction projects such as project managers and project heads, to participate as respondents for the survey questionnaires. These selected experts were anticipated to possess the necessary competence and reliability in managing construction projects. The experts were required to meet the following qualifications, be at least 30 years old and possess more than 10 years of professional experience. The survey questionnaire comprised three (3) sections. The initial part served as an invitation to participate in the survey. The second part focused on collecting profile information from the experts. This profiling was considered crucial to validate the expertise of the respondents and ensure their alignment with the specified criteria for experts. The demographic details included gender, age, educational level, years of professional experience, job title, and employment status. The final segment of the survey questionnaire involved the multi-criteria analysis for Critical Risk Factor (CRF) evaluation. This analysis utilized the priority scale proposed by Saaty (1980), as detailed in Table 1. The scale ranged from 1 to 9, facilitating comparisons to aid in achieving the research objective of establishing priority criteria or alternatives. Through these comparisons, the relative importance of elements and the frequency with which an element was deemed more important than others were determined.

Table 1. Pairwise Comparison Scale for AHP Preferences (Suner et al., 2012)

Importance	Definition
1	Equally
2	Equally to moderately
3	Moderately
4	Moderately to strongly
5	Strongly
6	Strongly to very strongly
7	Very strongly
8	Very strongly to extremely
9	Extremely

2.4 Data Analysis Procedures

Following the completion of expert consultation to determine the prioritized Risk Factors in the previous phase of the research methodology, the researcher proceeded to implement the Analytic Hierarchy Process (AHP). First, the research methodology employed Meta-Analysis to identify and ascertain all critical risk factors relevant to the construction of condominium projects in Manila. Meta-analysis involves a comprehensive and systematic review, combined with a statistical procedure, to gather data from various existing studies (Reyes, 2020; Ahmad & Nouban, 2023). The researcher chose to conduct a meta-analysis to collect and consolidate all critical risk factors relevant to the construction phase of condominium projects.

2.4.1. Meta Analysis

The researcher applied essential concepts of Meta-Analysis, including the identification of research keywords, searching across various platforms such as ScienceDirect, Academia.edu, Google Scholar, ASCE, etc., for relevant articles and journals, and screening and synthesizing the abstracts and titles of the literature researched.

2.4.2. Experts' Consultation

The researcher crafted a survey questionnaire encompassing the respondents' profiles and pairwise comparisons for the nine RFs identified in the Meta-Analysis. The survey questionnaire was structured into three (3) parts. The first part invited participation in the survey and gathered demographic information about the experts, including gender, age, educational level, years of professional experience, job title, and employment status. The subsequent pilot testing phase involved evaluating the clarity, relevance, and effectiveness of the questionnaire with a select group of individuals, a critical step in refining the survey instrument before wider distribution. To check the validity and effectiveness of the questionnaire, a diverse group of pilot test participants, including experts, professionals, or individuals with pertinent experience, was selected.

2.4.3. Analytic Hierarchy Process

The research study utilized the Analytic Hierarchy Process (AHP) to calculate priority weights in multi-attribute decision-making scenarios, with the aim of achieving the research objectives. According to Saaty (2008), to set priorities systematically, it is necessary to break the decision down into the following parts. Thus, the following were the step-by-step procedures for implementing AHP in the research:

1. Identified the problem and the relevant information required.
2. Constructed a decision hierarchy, shown in Figure 1, or organized the topics by starting at the top with the research's objective and moved down through the numerous criteria making it a one-level framework.
3. Generated a group of pairwise comparison matrices; every pairwise comparison includes automatic reciprocals allocation, as demonstrated in Table 2.

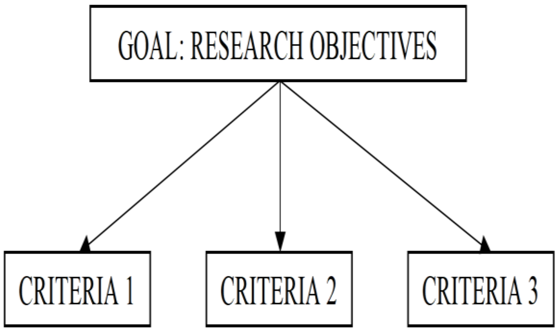

Figure 1. Decision Hierarchy of Research

Table 2. Template for the Pairwise Comparison Matrix

Criteria	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5
Criteria 1	1	$\frac{\text{Criteria 1}}{\text{Criteria 2}}$	$\frac{\text{Criteria 1}}{\text{Criteria 3}}$	$\frac{\text{Criteria 1}}{\text{Criteria 4}}$	$\frac{\text{Criteria 1}}{\text{Criteria 5}}$
Criteria 2	$\frac{\text{Criteria 2}}{\text{Criteria 1}}$	1	$\frac{\text{Criteria 2}}{\text{Criteria 3}}$	$\frac{\text{Criteria 2}}{\text{Criteria 4}}$	$\frac{\text{Criteria 2}}{\text{Criteria 5}}$
Criteria 3	$\frac{\text{Criteria 3}}{\text{Criteria 1}}$	$\frac{\text{Criteria 3}}{\text{Criteria 2}}$	1	$\frac{\text{Criteria 3}}{\text{Criteria 4}}$	$\frac{\text{Criteria 3}}{\text{Criteria 5}}$
Criteria 4	$\frac{\text{Criteria 4}}{\text{Criteria 1}}$	$\frac{\text{Criteria 4}}{\text{Criteria 2}}$	$\frac{\text{Criteria 4}}{\text{Criteria 3}}$	1	$\frac{\text{Criteria 4}}{\text{Criteria 5}}$
Criteria 5	$\frac{\text{Criteria 5}}{\text{Criteria 1}}$	$\frac{\text{Criteria 5}}{\text{Criteria 2}}$	$\frac{\text{Criteria 5}}{\text{Criteria 3}}$	$\frac{\text{Criteria 5}}{\text{Criteria 4}}$	1
	$\sum$ (col 1)	$\sum$ (col 2)	$\sum$ (col 3)	$\sum$ (col 4)	$\sum$ (col 5)

Each element at a higher level was used to evaluate the components at the lower level using the AHP pairwise comparison scale from Table 3. The pairwise comparison was conducted in terms of which one element outweighs another.

Table 3. AHP Fundamental Scale (Saaty, 2008)

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the object
3	Moderate importance of one over another	Experience & judgement moderately favor one activity over another

Intensity of Importance	Definition	Explanation
3	Essential or Strong Importance	Experience & judgement strongly favor one activity over another
7	Very Strong Importance	An activity is very strongly favored its dominance is demonstrated in practice
9	Extreme Importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate Values	When compromise is needed
Reciprocals	If activity *i* has one of the above numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	

4. Created a normalized pairwise comparison matrix which is depicted in Table 4. Moreover, the ratio of the sum of the specific row over the total number of criteria has been determined to solve for the criteria weights using the values acquired from the comparisons. This process must be applied to every row.

Table 4. Template for the Normalized Pairwise Comparison Matrix

Criteria	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Criteria Weights
Criteria 1	1	$\frac{\text{Criteria } 1/2}{\Sigma(\text{col } 2)}$	$\frac{\text{Criteria } 1/3}{\Sigma(\text{col } 3)}$	$\frac{\text{Criteria } 1/4}{\Sigma(\text{col } 4)}$	$\frac{\text{Criteria } 1/5}{\Sigma(\text{col } 5)}$	$\frac{\Sigma(\text{row } 1)}{n}$
Criteria 2	$\frac{\text{Criteria } 2/1}{\Sigma(\text{col } 1)}$	1	$\frac{\text{Criteria } 2/3}{\Sigma(\text{col } 3)}$	$\frac{\text{Criteria } 2/4}{\Sigma(\text{col } 4)}$	$\frac{\text{Criteria } 2/5}{\Sigma(\text{col } 5)}$	$\frac{\Sigma(\text{row } 2)}{n}$
Criteria 3	$\frac{\text{Criteria } 3/1}{\Sigma(\text{col } 1)}$	$\frac{\text{Criteria } 3/2}{\Sigma(\text{col } 2)}$	1	$\frac{\text{Criteria } 3/4}{\Sigma(\text{col } 4)}$	$\frac{\text{Criteria } 3/5}{\Sigma(\text{col } 5)}$	$\frac{\Sigma(\text{row } 3)}{n}$
Criteria 4	$\frac{\text{Criteria } 4/1}{\Sigma(\text{col } 1)}$	$\frac{\text{Criteria } 4/2}{\Sigma(\text{col } 2)}$	$\frac{\text{Criteria } 4/3}{\Sigma(\text{col } 3)}$	1	$\frac{\text{Criteria } 4/5}{\Sigma(\text{col } 5)}$	$\frac{\Sigma(\text{row } 4)}{n}$
Criteria 5	$\frac{\text{Criteria } 5/1}{\Sigma(\text{col } 1)}$	$\frac{\text{Criteria } 5/2}{\Sigma(\text{col } 2)}$	$\frac{\text{Criteria } 5/3}{\Sigma(\text{col } 3)}$	$\frac{\text{Criteria } 5/4}{\Sigma(\text{col } 4)}$	1	$\frac{\Sigma(\text{row } 5)}{n}$
	Σ(col 1)	Σ(col 2)	Σ(col 3)	Σ(col 4)	Σ(col 5)	

* where "n" is the number of criteria

5. To solve for the eigenvalue (λmax.), the weights of the criteria were now applied to the eigenvectors (priority vector) using hierarchical synthesis, and the summation of all weighted eigenvector entries corresponding to those at the next lower level of the hierarchy is determined which is shown in Table 5.

Table 5. Template for Computing the Eigenvalue (λmax)

Criteria	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Criteria Weights	Weighted Sum Value
Criteria 1	$1x\frac{\Sigma(row1)}{n}$	$Crit\frac{1}{2}x\frac{\Sigma(row}{n}$	$Crit\frac{1}{3}x\frac{\Sigma(row3}{n}$	$Crit\frac{1}{4}x\frac{\Sigma(row}{n}$	$Crit\frac{1}{5}x\frac{\Sigma(row}{n}$	$\frac{\Sigma(row1)}{n}$	Σ (row1
Criteria 2	$Crit\frac{2}{1}x\frac{\Sigma(row1}{n}$	$1x\frac{\Sigma(row2)}{n}$	$Crit\frac{2}{3}x\frac{\Sigma(row1}{n}$	$Crit\frac{2}{4}x\frac{\Sigma(row}{n}$	$Crit\frac{2}{5}x\frac{\Sigma(row}{n}$	$\frac{\Sigma(row\ 2)}{n}$	Σ (row2)
Criteria 3	$Crit\frac{3}{1}x\frac{\Sigma(row1}{n}$	$Crit\frac{3}{2}x\frac{\Sigma(row}{n}$	$1x\frac{\Sigma(row3)}{n}$	$Crit\frac{3}{4}x\frac{\Sigma(row}{n}$	$Crit\frac{3}{5}x\frac{\Sigma(row}{n}$	$\frac{\Sigma(row\ 3)}{n}$	Σ (row3)
Criteria 4	$Crit\frac{4}{1}x\frac{\Sigma(row1}{n}$	$Crit\frac{4}{2}x\frac{\Sigma(row}{n}$	$Crit\frac{4}{3}x\frac{\Sigma(row1}{n}$	$1x\frac{\Sigma(row4)}{n}$	$Crit\frac{4}{5}x\frac{\Sigma(row}{n}$	$\frac{\Sigma(row\ 4)}{n}$	Σ (row4)
Criteria 5	$Crit\frac{5}{1}x\frac{\Sigma(row1}{n}$	$Crit\frac{5}{2}x\frac{\Sigma(row}{n}$	$Crit\frac{5}{3}x\frac{\Sigma(row1}{n}$	$Crit\frac{5}{4}x\frac{\Sigma(row}{n}$	$1x\frac{\Sigma(row5)}{n}$	$\frac{\Sigma(row\ 5)}{n}$	Σ (row5)

$$\lambda max = \frac{\frac{\Sigma(row\ 1)}{\frac{\Sigma(row\ 1)}{n}} + \frac{\Sigma(row\ 2)}{\frac{\Sigma(row\ 2)}{n}} + \frac{\Sigma(row\ 3)}{\frac{\Sigma(row\ 3)}{n}} + \frac{\Sigma(row\ 4)}{\frac{\Sigma(row\ 4)}{n}} + \frac{\Sigma(row\ 5)}{\frac{\Sigma(row\ 5)}{n}}}{n} \quad \text{Eq.1}$$

$$\lambda max = \frac{\Sigma\ (\text{Weighted Sum Value/Criteria weights})}{n} \quad \text{Eq. 2}$$

6. After all the pairwise comparisons are performed, the eigenvalue (max) was used to determine the consistency of comparisons. The eigenvalue was used to calculate a consistency index (CI) using Equation 3.

$$\text{Consistency Index (C.I.)} = \frac{\lambda max - n}{n-1} \quad \text{Eq. 3}$$

where: n is the matrix size.
λmax = computed eigenvalue

7. Through the consistency ratio (C.R.) of the consistency index (C.I.) with the proper value of the random consistency index (R.I.), the consistency judgment was proven. Table 3G indicates the random consistency index (R.I.) suitable for the size of the matrix.

However, based on Saaty (1987), the consistency ratio (Equation 4) is acceptable when CR ≤ 0.10. When CR > 0.10, the judgment matrix should be considered inconsistent. Examining and repeating the decision to formulate a consistent matrix is recommended.

$$\text{Consistency Ratio} = \frac{\text{Consistency Index (C.I.)}}{\text{Random Index (R.I.)}} \quad \text{Eq. 4}$$

Table 6. Average Random Consistency (Suner et al., 2012)

Size of Matrix	Random Consistency
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12

Size of Matrix	Random Consistency
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

RESULTS AND DISCUSSION

This explained the outcomes of the methodological process employed in the study. It encompassed the discussion of results derived from the Meta-Analysis, findings from the survey, data analysis utilizing the Analytic Hierarchy Process (AHP), evaluation of risk factors, and the formulation and proposal of effective mitigating strategies for managing risk factors associated with condominium construction projects.

3.1 Meta-Analysis

The researcher identified a multitude of specific risk factors within the context of the study but opted to categorize them into distinct groups for a more systematic and comprehensive analysis. After doing this, there are a total of 57 risk factors (as shown in Table 7) associated with condominium construction project, manually listed or tallied using a Microsoft Excel Sheet to record all the variables, which are the risk factors, the corresponding authors, and the respective frequencies.

Table 7. Comprehensive List of Risk Factors Text

Risk Factors Category	Risk Factors
RF1- Technical / Design Risk	1. Technical risks
	2. Lack of Design and Consultancy Clarity and Timeliness
	3. Low quality equipment (Design Deficiency)
	4. Learning New Communication Tools / WFH Arrangements
	5. Complexity
	6. Consultant Expertise and Information Deficiency
RF2- Financial / Economic Risk	7. Delay/Suspension of Projects
	8. Price Escalations
	9. Financial risks
	10. Lack of Financial Stability and Resource Management
	11. Lack of Labor Resources and Workforce Management
	12. Extension of Time
	13. Inflation
	14. Payment Delays
	15. Loss of Revenue
	16. Economic losses
	17. Bank Loans
	18. Late Economic Support from Government
	19. Additional Costs for Technology
RF3- Environmental / Natural Risk	20. Force Majeure
RF4- Regulatory / Legal Risk	21. Lack of External Stability and Regulatory Compliance
	22. Land acquisition
	23. Legal Risks

Risk Factors Category	Risk Factors
	24. Insurance/Legal Issues
	25. Delays due to Public Agencies/Government
RF5- Socio-Political / Cultural Risk	26. Fear of Virus/Contamination
	27. Political risks
	28. Social Impact Assessment (public opposition, traffic)
	29. Travel Restrictions
	30. Work Life Balance
RF6- Logistics / Supply Chain Risk	31. Shortage of Materials / Equipment
	32. Shortage of Workers/ Skilled Workers
	33. Challenges in Material and Equipment Management
RF7- Management / Supervision Risk	34. Efficiency/Psychological
	35. Lack of Operational Efficiency and Management
	36. Lack of Stability in Project Scope and Procurement Strategy
	37. Lack of Client Engagement and Project Leadership
	38. Site Challenges and Location Management
	39. Lack of Stability in Project Duration and Schedule
	40. Inadequate Communication and Coordination
	41. Lack of expertise/experience (workers, managers, surveyor, contractors)
	42. Poor planning /decision making
	43. Lack of site management
	44. Lack of Effective Planning and Control Processes
	45. Poor coordination/ communication between stakeholders
	46. Lack of Management Commitment
	47. Lack of Timely Work Completion and Increased Workload
	48. Time Overrun (operation & billing, documents, poor scheduling)
	49. Lack of Attention/ Delayed Instructions
	50. Time Break Management
RF8- Quality Risk	51. Poor site investigation
	52. Inspection Lags
	53. Poor Quality
RF9- Health and Safety Risk	54. Additional Costs for Safety Hazards
	55. Safety Requirements
	56. Poor Engineering Practices and Safety Protocols
	57. Health, Safety and Security Risks

The results of this categorization from the meta-analysis revealed nine (9) risk categories as shown in Table 8.

Table 8. List of Categorized Risk Factors

Item	Risk Factor
RF1	Technical/ Design Risks
RF2	Financial and Economic Risks
RF3	Environmental Risks
RF4	Regulatory and Legal Risks
RF5	Socio-Political Risks
RF6	Logistics/ Supply Chain Risks
RF7	Management/ Supervision Risks
RF8	Quality Risks
RF9	Health and Safety Risks

The categorized risk factors are defined as the following:
RFI - Technical/Design Risks: This category encompasses risks associated with the technical and design aspects of construction projects. It may include challenges related to the design process, technological complexities, or unforeseen technical issues during implementation.
RF2 - Financial and Economic Risks: This describes the financial and economic uncertainties that may impact construction projects of condominiums. This includes factors like excess budget spending, material costs, or economic setbacks affecting funding and financial stability.
RF3 - Environmental Risks: This involves environmental risks of condominiums construction projects. This includes challenges related to environmental regulations, sustainability issues, or unexpected environmental consequences on the project.
RF4 - Regulatory and Legal Risks: These risks deal with the compliance of condominium construction projects with regulatory requirements and legal aspects. It includes challenges related to permits, zoning laws, and disputes affecting the progress of the construction project.
RF5 - Socio-Political Risks: These risks tied to social and political factors. It includes public opposition, political instability, or conflicts that may impact project timelines and success.
RF6 - Logistics/Supply Chain Risks: These risks are the challenges in the logistics and supply chain of the condominium construction projects. Concerns like the delays in material and deliveries, transportation challenges, or disturbances in the supply chain.
RF7 - Management/Supervision Risks: This includes challenges related to inadequate project management, lack of supervision, or ineffective communication within the project team.
RF8 - Quality Risks: These risks pertain to the poor workmanship, material defects, or poor-quality management.
RF9 - Health and Safety Risks: These risks related to the health and safety of individuals involved in the construction project. This includes hazards, accidents, or substandard safety measures that impact the well-being of workers and other stakeholders.

By categorizing the identified risk factors, the researcher provided a framework to easily understand and address the challenges that may arise in condominium construction projects. These categories provide a more focused and targeted approach to risk management, enabling stakeholders to develop specific strategies for mitigating the unique challenges within each category.

3.2 Experts' Consultation

3.2.1 Demographic Profile

The researcher invited experts to participate in the survey. Demographic information include gender, age, educational level, years of professional experience, job title, and employment status.

Understanding respondents' demographic profiles is crucial for the study's integrity and applicability, especially in identifying and managing risk factors in condominium construction projects. These profiles provide the varied backgrounds and experiences within the construction industry, covering gender, age, education, experience, job roles, and sector affiliation. Figure 2 shows the demographic profile of all the 100 research respondents.

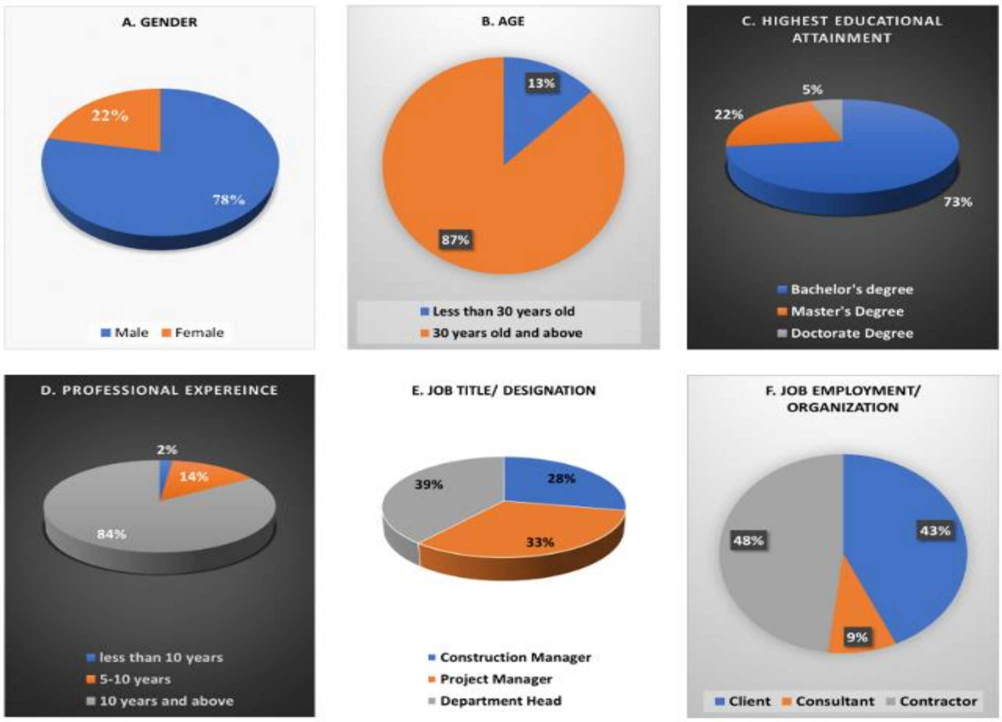

Figure 2. Demographic Profile of Research Respondents

The above figure no. 2 presents the exact number of respondents and their percentage based on their type or group under each category.

In terms of gender, the study presents that constituting 78.00% are male while 22.00% are female. The gender distribution highlights the need for assessing inclusivity and diversity within the industry, fostering opportunities for women in construction-related roles.

The age distribution reveals professionals aged 30 years and above with 87.00% and less than 30 years old with 13.00%. This emphasis on experienced professionals highlights the significance of having consultation to those with expertise and have already surpassed various challenges.

For the highest educational attainment, majority of respondents hold a bachelor's degree (73.00%), followed by those with a master's degree (22.00%), and a smaller percentage possessing a Doctorate Degree (5.00%). The inclusion of professionals with various educational attainments contributes to the comprehensiveness of the study.

The respondents in the study show that 2.00% have less than 5 years of experience, 14.00% with 5 to 10 years of experience and 84.00% with 10 or more years of experience in the construction industry. This characteristic highlights the significance of engaging with seasoned professionals, as valuable sources of insights in identifying and managing risk factors in condominium construction projects.

Examining job titles and designations, respondents also hold diverse roles within the construction sector. 28.00% are Construction Managers, 33.00% are Project Managers, and 39.00% are Department Heads which constitute the majority. This distribution reflects the nature of roles within the condominium construction industry, showcasing the participation of individuals with varying responsibilities and decision-making skills.

In terms of job employment and organization, respondents are affiliated with different sectors within the construction industry. Contractors form most of the respondents at 48.00%. It is followed by Clients at 43.00% and consultants at 9.00%. This distribution highlights the importance of gathering perspectives from various potential sectors, ensuring a more comprehensive understanding of risk factors within the condominium construction industry.

3.2.2 Survey Questionnaire

The second section of the survey instrument includes analysis for the nine critical RFs identified through Meta-Analysis. As shown in Table 9 is the pairwise comparisons matrix used during data gathering.

Table 9. Pairwise Comparison Matrix

Using the scale from 1 to 9 (where 9 is extremely and 1 is equally important), please indicate (X) the relative importance of options A (left columns) to options B (right columns)																				
	RF-A	Extremely		Very Strongly		Strongly		Moderately		Equally		Moderately		Strongly		Very Strongly		Extremely	RF-B	
RF1	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Financial/ Economic Risks	RF2
	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental/ natural risks	RF3
	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Regulatory/ legal Risk	RF4
	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Socio-Political Risk	RF5
	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Logistics/ Supply Chain Risk	RF6
	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management/ Supervision Risks	RF7
	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality Risks	RF8
	Technical/ Design Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9
RF2	Financial/ Economic Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental/ natural risks	RF3
	Financial/ Economic Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Regulatory/ legal Risk	RF4
	Financial/ Economic Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Socio-Political Risk	RF5
	Financial/ Economic Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Logistics/ Supply Chain Risk	RF6
	Financial/ Economic Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management/ Supervision Risks	RF7
	Financial/ Economic Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality Risks	RF8
	Financial/ Economic Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9
RF3	Environmental/ natural risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Regulatory/ legal Risk	RF4
	Environmental/ natural risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Socio-Political Risk	RF5
	Environmental/ natural risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Logistics/ Supply Chain Risk	RF6
	Environmental/ natural risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management/ Supervision Risks	RF7
	Environmental/ natural risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality Risks	RF8
	Environmental/ natural risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9
RF4	Regulatory/ legal Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Socio-Political Risk	RF5
	Regulatory/ legal Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Logistics/ Supply Chain Risk	RF6
	Regulatory/ legal Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management/ Supervision Risks	RF7
	Regulatory/ legal Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality Risks	RF8
	Regulatory/ legal Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9
RF5	Socio-Political Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Logistics/ Supply Chain Risk	RF6
	Socio-Political Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management/ Supervision Risks	RF7
	Socio-Political Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality Risks	RF8
	Socio-Political Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9
RF6	Logistics/ Supply Chain Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management/ Supervision Risks	RF7
	Logistics/ Supply Chain Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality Risks	RF8
	Logistics/ Supply Chain Risk	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9
RF7	Management/ Supervision Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality Risks	RF8
	Management/ Supervision Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9
RF8	Quality Risks	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health/ Safety Risks	RF9

3.3 Analytic Hierarchy Process

The researcher employed the Analytical Hierarchy Process (AHP) as a statistical tool to analyze the ranking of RFs. The random consistency index (RI) utilized was 1.45, which corresponds to the size of the matrix, i.e., 9. The consistency ratio (CR) was computed based on the Eigenvalue, CI, and RI.

Individual pairwise comparison matrices of the criteria were created for each expert, corresponding to each criterion, to compare the results and rankings. The table 10 illustrates the calculation for the results of the pairwise comparison of respondents.

Table 10. Sample Result of Respondent 1

	RF-1 Tech./Design Risk	RF-2 Financial/ Economic Risk	RF-3 Environmental Risk	RF-4 Regulatory/ Legal Risk	RF-5 Socio-Political Risk	RF-6 Logistics/ Supply chain Risk	RF-7 Management / Supervision Risk	RF-8 Quality Risk	RF-9 Health & Safety Risk	Total
RF-1 Tech./Design Risk	1.0000	0.2000	1.0000	1.0000	1.0000	0.3333	0.1429	0.2000	0.3333	5.2095
RF-2 Financial/ Economic Risk	5.0000	1.0000	2.0000	2.0000	2.0000	0.3333	0.3333	0.3333	0.3333	13.3333
RF-3 Environmental Risk	1.0000	0.5000	1.0000	1.0000	1.0000	0.5000	0.3333	0.2500	0.3333	5.9167
RF-4 Regulatory/ Legal Risk	1.0000	0.5000	1.0000	1.0000	1.0000	0.5000	0.3333	0.2500	0.3333	5.9167
RF-5 Socio-Political Risk	1.0000	0.5000	1.0000	1.0000	1.0000	0.5000	0.3333	0.2500	0.3333	5.9167
RF-6 Logistics/ Supply chain Risk	3.0000	3.0000	2.0000	2.0000	2.0000	1.0000	0.5000	0.3333	0.5000	14.3333
RF-7 Management/ Supervision	7.0000	3.0000	3.0000	3.0000	3.0000	2.0000	1.0000	0.5000	0.5000	23.0000
RF-8 Quality Risk	5.0000	3.0000	4.0000	4.0000	4.0000	3.0000	2.0000	1.0000	2.0000	28.0000
RF-9 Health & Safety Risk	3.0000	3.0000	3.0000	3.0000	3.0000	2.0000	2.0000	0.5000	1.0000	20.5000
Sum	27.0000	14.7000	18.0000	18.0000	18.0000	10.1667	6.9762	3.6167	5.6667	122.1262

The next step was to consolidate and normalize the pairwise comparison of all respondents. The Table 11 shows the consolidated pairwise comparison matrix for RFs with its corresponding computed criteria weight. It stands as a significant component for capturing decision-makers' subjective judgments concerning the relative importance or preference of criteria.

Table 11. Consolidated Pairwise Comparison Matrix

	RF-1 Tech./Design Risk	RF-2 Financial/ Economic Risk	RF-3 Environmental Risk	RF-4 Regulatory/ Legal Risk	RF-5 Socio-Political Risk	RF-6 Logistics/ Supply chain Risk	RF-7 Management / Supervision Risk	RF-8 Quality Risk	RF-9 Health & Safety Risk	Total
RF-1 Tech./Design Risk	1.0000	1.3710	0.8091	0.8867	2.1363	1.1220	0.4823	0.5082	0.4121	8.72766
RF-2 Financial/ Economic Risk	0.7294	1.0000	0.6882	0.8172	1.3434	0.8767	0.4962	0.5525	0.4352	6.93881
RF-3 Environmental Risk	1.2359	1.4531	1.0000	1.3390	1.6689	1.4254	0.8418	0.6971	0.5716	10.23288
RF-4 Regulatory/ Legal Risk	1.1278	1.2236	0.7468	1.0000	1.6191	1.3138	0.7594	0.6513	0.5166	8.95851
RF-5 Socio-Political Risk	0.4681	0.7444	0.5992	0.6176	1.0000	0.5389	0.3313	0.2587	0.2612	4.81935
RF-6 Logistics/ Supply chain Risk	0.8913	1.1407	0.7016	0.7611	1.8557	1.0000	0.3610	0.3312	0.3206	7.36329
RF-7 Management/ Supervision	2.0736	2.0152	1.1879	1.3169	3.0186	2.7698	1.0000	1.1251	0.8504	15.35744
RF-8 Quality Risk	1.9678	1.8099	1.4346	1.5354	3.8658	3.0190	0.8888	1.0000	0.7109	16.23204
RF-9 Health & Safety Risk	2.4263	2.2978	1.7494	1.9356	3.8282	3.1190	1.1760	1.4067	1.0000	18.93898
Sum	11.9202	13.0558	8.9167	10.2095	20.3360	15.1845	6.3367	6.5308	5.0787	97.56896

Table 12 shows the pairwise comparison matrix for RFs with its corresponding computed criteria weight and the ranking of priority or critical risk factors (CRFs). Normalizing this matrix is a crucial step within the AHP methodology. This serves different purposes that enhance the integrity of the decision-making process.

First, normalization acts as a consistency check to ensure reliability in the decision-makers' evaluation of the criteria's importance and how to facilitate solutions. Second, it allows easy computation of weights for criteria or alternatives by converting raw judgments into consistent set of priority values, which are essential for subsequent computations within the AHP process. Lastly, normalization assures that the matrix adheres to the positive and reciprocal relationships assumed by the AHP, thus, transforming the matrix into a positive reciprocal form.

Table 12. Normalized Pairwise Comparison Matrix

	RF-1 Tech./Design Risk	RF-2 Financial/ Economic Risk	RF-3 Environmental Risk	RF-4 Regulatory/ Legal Risk	RF-5 Socio-Political Risk	RF-6 Logistics/ Supply chain Risk	RF-7 Management / Supervision Risk	RF-8 Quality Risk	RF-9 Health & Safety Risk	Criteria Weight	Criteria Weight (%)
RF-1 Tech./Design Risk	0.0839	0.1050	0.0907	0.0868	0.1051	0.0739	0.0761	0.0778	0.0812	0.0867	8.67%
RF-2 Financial/ Economic Risk	0.0612	0.0766	0.0772	0.0800	0.0661	0.0577	0.0783	0.0846	0.0857	0.0742	7.42%
RF-3 Environmental Risk	0.1037	0.1113	0.1121	0.1312	0.0821	0.0939	0.1329	0.1067	0.1126	0.1096	10.96%
RF-4 Regulatory/ Legal Risk	0.0946	0.0937	0.0838	0.0979	0.0796	0.0865	0.1198	0.0997	0.1017	0.0953	9.53%
RF-5 Socio-Political Risk	0.0393	0.0570	0.0672	0.0605	0.0492	0.0355	0.0523	0.0396	0.0514	0.0502	5.02%
RF-6 Logistics/ Supply chain Risk	0.0748	0.0874	0.0787	0.0746	0.0913	0.0659	0.0570	0.0507	0.0631	0.0715	7.15%
RF-7 Management/ Supervision	0.1740	0.1544	0.1332	0.1290	0.1484	0.1824	0.1578	0.1723	0.1674	0.1577	15.77%
RF-8 Quality Risk	0.1651	0.1386	0.1609	0.1504	0.1901	0.1988	0.1403	0.1531	0.1400	0.1597	15.97%
RF-9 Health & Safety Risk	0.2035	0.1760	0.1962	0.1896	0.1882	0.2054	0.1856	0.2154	0.1969	0.1952	19.52%
Sum	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	100.00%

Moreover, normalization process plays an important role in computing the eigenvalues and eigenvectors. This is crucial to determine the principal eigenvector. Through consistency and positive reciprocity, the normalization contributes to the reduction of subjectivity in the matrix, reinforcing the reliability of AHP results. In essence, normalizing the pairwise comparison matrix is indispensable for upholding the validity and reliability of the decision-making process in AHP, aligning the matrix with the foundational principles of the methodology and ensuring a robust and coherent assessment of criteria and alternatives.

As a result, the following CRFs were identified as having the highest priority, as shown in Table 13.

Table 13. Ranking of Risk Factors

Ranking	Risk Factors	Criteria Weight
1	RF9. Health and Safety Risk	19.52%
2	RF8. Quality Risk	15.97%
3	RF7. Management / Supervision Risk	15.77%
4	RF3. Environmental / Natural Risk	10.96%
5	RF4. Regulatory / Legal Risk	9.53%
6	RF1. Technical / Design Risk	8.67%
7	RF2. Financial and Economic Risk	7.42%
8	RF6. Logistics/ Supply Chain Risk	7.15%
9	RF5. Socio-Political / Cultural Risk	5.02%

According to the results of the Analytic Hierarchy Process, the top-ranking priority or CRFs are as follows: (1) Health and Safety Risk, 19.52%; (2) Quality Risk, 15.97%; and (3) Management/Supervision Risk, 15.77%.

After a thorough examination, the researcher found that Health and Safety Risk had the highest score because safety is crucial in any building project, especially in condominiums where many workers are doing different tasks at the same time. Potential health and safety risks include accidents, injuries, and health problems. Due to strict legal requirements and the responsibility to protect workers, managing these risks is essential to prevent harm and keep the project going smoothly. This finding is consistent with other studies that highlight the importance of safety in construction.

Furthermore, this statistical tool needed to verify the consistency ration of the pairwise comparison to signify that the judgment of the experts was consistent. The consistency ratio to compute the eigenvalue max (λ_{max}), is shown in Table 14.

Table 14. Calculation of Eigenvalue Max

	RF-1 Tech./Design Risk	RF-2 Financial/ Economic Risk	RF-3 Environmental Risk	RF-4 Regulatory/ Legal Risk	RF-5 Socio-Political Risk	RF-6 Logistics/ Supply chain Risk	RF-7 Management / Supervision Risk	RF-8 Quality Risk	RF-9 Health & Safety Risk	Weighted Sum	Criteria Weight	Ratio
RF-1 Tech./Design Risk	0.0867	0.1017	0.0887	0.0845	0.1073	0.0802	0.0760	0.0812	0.0805	0.7867	0.0867	9.0710
RF-2 Financial/ Economic Risk	0.0633	0.0742	0.0754	0.0779	0.0675	0.0627	0.0782	0.0882	0.0850	0.6722	0.0742	9.0652
RF-3 Environmental Risk	0.1072	0.1078	0.1096	0.1276	0.0838	0.1019	0.1327	0.1113	0.1116	0.9934	0.1096	9.0644
RF-4 Regulatory/ Legal Risk	0.0978	0.0907	0.0818	0.0953	0.0813	0.0939	0.1197	0.1040	0.1009	0.8655	0.0953	9.0839
RF-5 Socio-Political Risk	0.0406	0.0552	0.0657	0.0588	0.0502	0.0385	0.0522	0.0413	0.0510	0.4536	0.0502	9.0321
RF-6 Logistics/ Supply chain Risk	0.0773	0.0846	0.0769	0.0725	0.0932	0.0715	0.0569	0.0529	0.0626	0.6484	0.0715	9.0707
RF-7 Management/ Supervision	0.1798	0.1494	0.1302	0.1255	0.1516	0.1980	0.1577	0.1797	0.1660	1.4378	0.1577	9.1201
RF-8 Quality Risk	0.1707	0.1342	0.1572	0.1463	0.1941	0.2158	0.1401	0.1597	0.1388	1.4569	0.1597	9.1229
RF-9 Health & Safety Risk	0.2104	0.1704	0.1917	0.1844	0.1922	0.2229	0.1854	0.2246	0.1952	1.7774	0.1952	9.1052

Eigenvalue M	9.081719
CI-Consistency Index	0.01021
CR-Consistency Ratio	0.7045%
ndom Index for 9 Crite	1.45

The Table 14 reveals the eigenvalue max (λ_{max}) of 9.0817. This led to the consistency index and consistency ratio, shown below.

$$\text{C. I.} = \frac{\lambda_{max} - n}{n - 1}$$

$$\text{C. I.} = \frac{9.0817 - 9}{9 - 1}$$

$$\mathbf{C.\,I.} = \mathbf{0.0102}$$

$$\text{C. R.} \quad = \frac{\text{Consistency Index}}{\text{Random Consistency Index}} \text{x}100$$

$$\text{C. R.} = \frac{0.0102}{1.45} \text{x}100$$

$$\mathbf{C.\,R.} = \mathbf{0.70}\%$$

.

Results reveal a consistency ratio of 0.70%, derived from the pairwise comparison using the computed eigenvalue and consistency index which signifies consistency of expert's judgment

3.4. Development of Effective Mitigating Strategies

This research aspired to provide a complete set of mitigating strategies for condominium construction projects, addressing risks that would influence the timelines, budgets, and overall project outcomes. The study employed the Analytic Hierarchy Process (AHP) to prioritize risk factors, with combine insights from construction industry professionals through structured decision-making and a survey questionnaire. The mitigating measures extracted from practical experience, serve as valuable tool for potential clients, policymakers, and project managers to overcome condominium construction challenges.

Effective communication is critical to manage the risk factors and come up with mitigating measures. According to Gomez (2022), communication skills are very essential and can be applied in promoting the mitigating strategies across all the steps of the condominium construction projects. Effective communication can contribute to the success of decision-making and achieving strategies to easily overcome construction challenges.

The strategies and action plans presented in Table 9 came from the analysis of responses from the survey questionnaire which were then refined through a review before being incorporated into the risk register. Identification of risk factors such as health and safety, quality, and management were extracted from a meta-analysis of existing literature. It is important to note that the risk register consists of "categorized risk factors," with all specific risks falling under these broader categories. The researcher found no specific literature directly stating or comparing the top risks identified in the study because the meta-analysis focused on specific risk factors, which were then grouped into broader categories. This approach ensures a comprehensive understanding of the risks, contextualized within the broader framework of construction project management.

While existing literature supports the significance of these factors, the universal recognition of risk priorities may vary based on project specifics and industry nuances. The study provides a nuanced and context-aware perspective on mitigation strategies, blending insights from expert consultations, meta-analysis, and comprehensive surveys. This approach enhances risk management practices in the construction industry by offering tailored and informed strategies.

Table 15. Proposed Risk Register and Mitigating Plan for Condominium Building Construction Projects.

Risk Factors	Risk Description	Mitigation Plan	Risk Owner
1. Health and Safety Risk	1.Accidents 2. Hazardous Materials 3. Unsafe Work Practices	1. Establish a Hazard Identification and Risk Assessment (HIRAC) and Safety Risk Register. 2. Establish a Safety Committee and Emergency Response Team. 3.Conduct job hazard analysis and implement a safety risk management plan. 4. Ensure strict compliance with RA11508, utilizing technologies such as CCTV for monitoring safety. 5. Conduct regular safety audits and inspections. 6. Conduct regular toolbox meeting, safety audits and inspections. 7. Apply Construction All Risk Insurance	Contractor/ Client
2. Quality Risk	1. Poor quality control and assurance can lead to rework 2. Customer dissatisfaction 3. Compromised safety in the final product	1. Establish a Quality Assurance/Quality Control (QA/QC) Program with a comprehensive plan. 2. Implement a Quality Risk Register Plan, ensuring 24/7 monitoring and control. 3. Conduct regular inspections and testing as part of a comprehensive quality control and assurance program. 4. Regular communication with all quality site team	Contractor
3.Management/ Supervision Risk	1. Delays 2. Communication breakdowns, and conflicts between different project teams due to poor project coordination	1. Proactiveness, proper coordination and collaboration are highly encouraged to all site team members 2. Proper dissemination of information to avoid misinterpretation and mis communication	All parties
4.Environmental/ Natural Risk	1. Environmental risks pertain to the potential adverse impacts a construction project may have on the surrounding environment 2. Natural disaster risks involve the project's susceptibility to natural calamities such as earthquakes, typhoons, and floods	1. Apply Construction All Risk Insurance 2. Establish a Hazard Identification and Risk Assessment (HIRAC) and Environmental Impact Assessment (EIA). 3. Provide a Risk Management Plan (HIRAC) with strict compliance on implementation. 4. Advocate for more laws and stringent compliance measures. 5. Conduct regularly for fire and earthquake drill	Contractor/ Client

5.Regulatory/ Legal Risk	1. Non-compliance with local, state, or national construction codes and regulations 2. Legal disputes, fines, or even the suspension of the construction project due to regulatory or legal violations	1. Establish and engage legal compliance professionals and maintain open communication channels with regulatory authorities. 2. Develop a Legal Registry and Monitoring Plan with a risk assessment component. 3. Advocate for regulations with higher penalties for non-compliance. 4. Consider in the early planning stage the local city ordinance especially noise disturbance	Client & Contractor
6.Logistics/ Supply Chain Risk	1. Material shortages 2. Transportation issues 3. Supplier bankruptcies	1. Establish a resource management plan that includes alternative suppliers and balance resource allocations with suppliers. 2. Develop an Alternative Resources Plan. 3. Increase the number of accredited suppliers before project initiation. 4. Implement real-time tracking and monitoring systems for the supply chain.	Contractor/ Client
7.Technical/ Design Risk	1. Potential flaws in the project's design 2. The use of inappropriate materials 3. The application of outdated construction techniques that may compromise the project's overall integrity.	1. Utilize innovative software, including high technology design software. 2. Conduct regular design meetings and reviews of plans, employing a rigorous design review process with experienced professionals to identify and rectify flaws early in the project. 3. Incorporate technology such as Building Information Modelling (BIM) and database management in the design phase.	Consultant / Designer
8.Financial/ Economic Risk	1. Budget overruns 2. Fluctuating material prices 3. Economic downturns that could threaten the project's financial viability and successful completion.	1. Implement a financial contingency plan and engage financial experts before project initiation. 2. Conduct a comprehensive Market Study (SWOT). 3. Establish backup financial supports like standby loans from banks. 4. Regularly monitor and update financial projections to accommodate changes in material prices and economic conditions.	Client & Contractor
9.Socio-Political/ Cultural Risk	1. Political instability 2. Labor disputes 3. Community opposition to the project 4. Potential misunderstandings or conflicts due to cultural differences among stakeholders or between the project and the local community.	1. Conduct stakeholder engagement and communication plans. 2. Establish an engagement plan, build good personal relationships with political officials, and conduct proper public hearings to determine affected socio-political and cultural risks. 3. Develop contingency plans for potential labor disputes, including alternative dispute resolution mechanisms.	Client & Contractor

While the study acknowledges the absence of a formal validation process for the developed risk register, it is crucial to clarify that proving the effectiveness of the mitigation strategies was beyond the study's scope. However, the researcher initiated a preliminary validation of the risk register by some construction project experts and survey respondents. This initial step is still subject to formal and more rigorous validation. The study emphasized the importance of a validation process, suggesting that the risk register's reliability would benefit from practical application in an actual residential building construction project in the Philippines.

In the future, a comparative analysis incorporating traditional methods and hypothesis testing could be explored to further validate the effectiveness of AHP in specific contexts. However, the current research contributes valuable insights by emphasizing the distinct advantages of AHP in risk assessment for condominium construction projects.

Conclusion

Based on the study's objectives and the results obtained from the conducted survey and statistical tools, the following conclusions were drawn:

i. Based on the Meta-Analysis, the researcher categorized 57 specific risk factors into nine (9) risk factors in residential building construction. This includes (1) Technical/ Design Risks, (2) Financial and Economic Risks, (3) Environmental Risks, (4) Regulatory and Legal Risks, (5) Socio-Political Risks, (6) Logistics/ Supply Chain Risks, (7) Management/ Supervision Risks, (8) Quality Risks, and (9) Health and Safety Risks.

ii. Utilizing Analytic Hierarchy Process, the top-priority Critical Risk Factors (CRFs) are as follows: (1st) Health and Safety Risk, 19.52%; (2nd) Quality Risk, 15.97%; and (3rd) Management/Supervision Risk, 15.77%.

iii. The study proposes tabulating a risk register for condominium construction projects, based on expert suggestions. A comprehensive risk registry, incorporating criterion weights from the AHP bridges theoretical assessment and actual execution, promoting confidence and efficacy in construction project management.

Using Analytical Hierarchy Process (AHP) as a statistical tool presents a sophisticated approach to risk assessment of condominium construction projects.

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