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Influence of client involvement on internal organization and performance of architectural design offices

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ABSTRACT

This study investigates how client involvement impacts the internal organization of architectural design offices, focusing on team dynamics and project performance. A mixed-methods approach that combines social network analysis and Likert-scales is employed to evaluate communication, collaboration, and trust between clients and design teams. Key performance indicators are used to measure project outcomes, while correlation analysis examines the relationship between client involvement and project performance. The findings reveal significant correlations between client involvement and the internal organization of architectural design offices. High levels of client communication and collaboration are positively linked to improved project performance, including higher design quality and better adherence to timelines. Trust between clients and design teams further enhances communication and decision-making processes. The study also highlights the influence of project type, scale, and location on project outcomes. Larger projects face more complex communication and collaboration challenges, underscoring the importance of tailored management strategies. Client involvement is a critical factor affecting the organization and performance of architectural design offices. Effective management of client relationships can improve team dynamics and project outcomes, while strategic engagement practices are essential for addressing country-specific factors. This study provides valuable insights into optimizing client relationships to enhance project performance and team efficiency.

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Design offices; client involvement; project performance; social network analysis (SNA); team dynamics

1. Introduction

The relationship between clients and architectural design offices plays a crucial role in the success and efficiency of construction projects. Precision in drafting documents ensures that client requirements are well represented in the design. In addition, project managers must clearly outline the obligations of both parties, particularly regarding client involvement and communication, to ensure that projects fulfill client needs effectively (Norouzi et al. 2015). Communication issues often arise from inadequate interaction between the client and the architect in the early stages, which can result in insufficient understanding of the client's perspective, missing stakeholder information, unsatisfactory design strategies, and frequently changing client requirements. These problems can lead to duplicated work and delays (Shen 2011). Misunderstandings may appear due to distinct mental models regarding project goals. Collaboration can be challenging when effective communication is lacking, project goals are not clearly defined, or stakeholders have different levels of clarity. Additionally, clients or designers may have an incomplete understanding of their objectives, further complicating the design process (Lee-Robbins, Ridley, and Adar 2024). Project managers must invest sufficient time in developing a clear project brief that includes instructions for the client and the architect. It is also essential to balance client involvement with the creative process of the design team to prevent the stifling of innovation (Taleb et al. 2017).

Involving all stakeholders is crucial for ensuring that clients feel their input is valued, which requires effective change management and visualization techniques. However, it remains unclear to what extent client involvement benefits the process without negatively affecting team performance, timelines, or design quality (Shen 2011). Client trust is key to project success. It allows clients to support design teams when exploring innovative solutions, as they are more likely to approve ideas when they trust the team's expertise. Building trust enables clients to embrace collaborative project delivery methods, which can lead to better project outcomes. Moreover, when clients believe, the team is committed to achieving the project's vision, it aligns the interests of both parties, enhancing collaboration and reducing friction (Engebø et al. 2022).

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Communication, trust, and commitment are foundational to the architect – client relationship, where trust is built through effective and sincere communication. Organizational performance can be assessed on the basis of this triadic relationship (Zeffane, Tipu, and Ryan 2011). Although social network analysis (SNA) can be used to evaluate communication and information flow within design offices, most studies have focused on large organizations, and its use in small architectural offices and the external factors affecting internal communication have yet to be explored (Alarcón, Alarcón, and Alarcón 2013).

In addition, a research gap exists in assessing how internal social networks in architectural firms impact information flow and performance. These aspects are associated with key performance indicators (KPIs), which are used to measure both project and organizational performance (KPI Working Group 2000). Although some studies suggest that design team performance is linked to internal organization, the influence of client involvement still requires exploration (Castillo, Herrera, and Alarcón 2023). Communication plays an important role in architectural projects; however, it often presents challenges among design team members, leading to implications in the project outcomes (Sonnenwald 1996). This study examines whether client involvement affects the internal organization and performance of architectural design offices, thereby providing valuable insights for managing work teams and client relationships more effectively. Key performance indicators (KPI) are used to evaluate the relationship between client communication, collaboration, and trust in the design process using the design process KPIs proposed by (Salvatierra et al. 2019) in which several metrics are categorized into four dimensions being this client management, external and internal coordination and human resources management. This framework enables a comprehensive analysis of architectural office performance (Salvatierra et al. 2019).

The findings of this study have the potential to improve how design offices manage client interactions and team dynamics. It also contributes to the theoretical understanding of client involvement and its impact on performance, as assessed by SNA. It offers practical recommendations for improving communication and team dynamics to enhance project outcomes and client satisfaction. Methodologically, the study employs a mixed-methods approach combining SNA with qualitative and quantitative tools, providing a comprehensive framework for future research. The findings can help transform architectural project management by offering actionable insights into effective client management strategies.

2. Materials and methods

This study adopts a quantitative correlational design that combines SNA and Likert-scales to evaluate the relationship between client involvement (client communication, collaboration, and trust) in the design process. Project performance is measured by key performance indicators (KPIs). The methodological framework is shown in Figure 1.

2.1. Sample and data collection

The study focuses on architectural design offices, aiming to identify common behaviors among clients in construction project design. A convenience sample was selected given the indeterminate total population and practical constraints. According to (Wu, Zhao, and Fils-Aime 2022), survey response rates are typically around 44%, making it challenging to obtain responses from many offices (over 300) without significant resources and time. Therefore, the sample consists of seven architectural offices that agreed to participate: two offices in Ecuador (EC) and one office each in Colombia (CO), Honduras (HN), Peru (PU), Mexico (MX), and the United Kingdom (UK). These offices contributed a total of 21 projects completed in the last two years, with each office providing data from three projects that involved at least five team members.

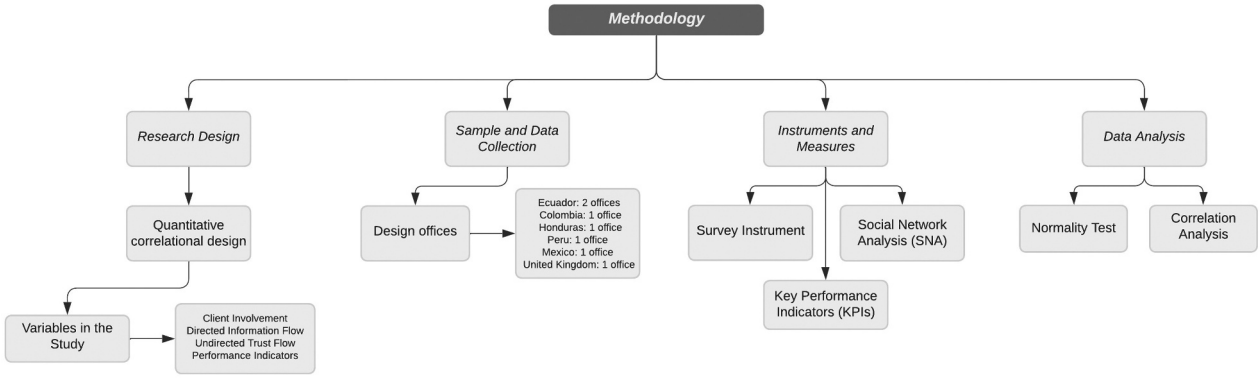

Figure 1. Methodological framework.

Table 1. Characteristics of project designs.

No.	Country	USD/m^2	Labor hours	Design versions
P1	HN	7.50	720	2
P2	HN	9.05	1440	5
P3	HN	8.33	1200	3
P4	MX	7.50	600	3
P5	MX	5.00	600	3
P6	MX	5.00	400	3
P7	EC	10.77	160	5
P8	EC	2.00	700	18
P9	EC	6.82	960	10
P10	CO	1.10	640	3
P11	CO	12.10	480	4
P12	CO	11.00	192	2
P13	PU	10.00	760	5
P14	PU	10.40	720	4
P15	PU	9.92	650	2
P16	EC	5.25	2400	1
P17	EC	17.50	1440	1
P18	EC	2.55	1600	4
P19	UK	20.51	960	5
P20	UK	20.24	1560	5
P21	UK	19.66	2400	5

Surveys were conducted with senior professionals, specifically project directors, to capture the perspectives of decision-makers. The survey also documented the multidisciplinary composition of design teams, noting the presence of specialists in structural engineering, mechanical systems, project management and others. Table 1 presents the detailed distribution of projects (denoted P1 to P21) by country and project name.

2.2. Variables in the study

The variables analyzed in this study are categorized into four main groups: client involvement, directed information flow, undirected trust flow, and KPIs. These variables are detailed in Table 2.

2.3. Instruments and measures

2.3.1. Survey instrument

A structured survey was developed and refined through a pilot test with one participating office to ensure the reliability and validity of the data collection instrument. To ensure that respondents fully understood the questions, the survey was reviewed and refined based on expert feedback. An expert with over 30 years of experience in design and 15 years in consultancy reviewed and improved the clarity and coherence of the questions. The final survey was administered with expert guidance to ensure accuracy.

The online survey collected information on client involvement, including their communication, collaboration, and trust levels, using a five-point Likert scale (1 = almost never to 5 = always). The Likert scale questions are given in Table 3.

2.3.2. Social network analysis

An online survey about communication between design team members in the last six months was sent to the participating offices. Using the results, adjacency matrices were created to capture communication links (edges) among team members (nodes) to obtain a social work network during the design process. These matrices were analyzed using Gephi software to obtain network metrics, including average network diameter, mean path length, clustering coefficient, and mean degree of links.

Table 2. Variables in the study.

Category	Variables	Method
Client Involvement	Communication	Likert scale - Q1 and Q3
	Collaboration	Likert scale - Q2 and Q4
	Trust	Likert scale - Q5, Q6 and Q7
Directed Information Flow	Mean Degree I	Adjacency matrix (Tabassum et al. 2018)
	Network Diameter I	
	Mean Clustering Coefficient I	
	Mean Path Length I	
Undirected Trust Flow	Mean Degree C	Adjacency matrix (Tabassum et al. 2018)
	Network Diameter C	
	Mean Clustering Coefficient C	
	Mean Path Length C	
KPIs	Efficiency	KPI 1 (Castillo, Herrera, and Alarcón 2023)
	Quality	KPI 2, KPI 3, KPI 4, KPI 5, KPI 6 and KPI 7 (Castillo, Herrera, and Alarcón 2023)
	Timeline	KPI 8 (Castillo, Herrera, and Alarcón 2023)
	Budget	KPI 9 (Castillo, Herrera, and Alarcón 2023)

Table 3. Likert scale questions.

No.	Question	Client Involvement category
Q1	Does the client have a clear understanding of the type of project required to meet their needs?	Communication
Q2	Does the client attend meetings convened by the design team for defining and reviewing project progress?	Collaboration
Q3	Does the client contribute ideas and important information through emails, messages, or review meetings?	Communication
Q4	Does the client show willingness to effectively resolve project issues with the design team?	Collaboration
Q5	Is the client flexible with initial agreements (contracts) when the design team proposes project design improvements?	Trust
Q6	Does the client require unscheduled reviews of project progress?	Trust
Q7	Does the client trust when the design team proposes changes to design, cost, and project timeline?	Trust

Table 4. Key performance indicators.

KPI	Statement
KPI 1	Resource Utilization Efficiency: Design sale value (USD)/Total design hours (HH)
KPI 2	Design Quality 1: Number of revisions required by the client/Project area (m^2)
KPI 3	Design Quality 2: Number of revisions required by the reviewing entity/Project area (m^2)
KPI 4	Design Quality 3: Number of revisions required by the client/Design sale value (USD)
KPI 5	Design Quality 4: Number of revisions required by the reviewing entity/Design sale value (USD)
KPI 6	Design Quality 5: Number of design versions/Project area (m^2)
KPI 7	Design Quality 6: Number of design versions/Design sale value (USD)
KPI 8	Timeline Compliance: Actual duration (days)/Planned duration (days)
KPI 9	Budget Compliance: (Planned cost − Final cost)/Planned cost

2.4. Key performance indicators

A form was sent to design project managers to obtain the data detailed in Table 4. The quality of the data was reviewed by the research team members and outliers were removed. The KPIs in Table 4 were calculated to evaluate the performance of projects.

To measure these KPIs, data on design hours, project area, number of revision and financial metrics were recorded. These indicators evaluate efficiency, design quality as well as timeline and budget compliance using the formulas shown in Table 4 (Castillo, Herrera, and Alarcón 2023).

2.5. Data analysis

The Shapiro – Wilk test was used to assess the normality of the distribution of all variables, including the network data, client involvement, and performance indicators, to determine whether parametric or non-parametric analysis should be used. The data were then converted to an ordinal scale using Excel's data hierarchy function, followed by Spearman's correlation test using R statistical software (version 4.3.3). This analysis identified significant p-values (<0.05) and correlation coefficients (R), which were used to establish direct and inverse relationships among the variables.

3. Results

3.1. Results of client survey

The research team applied the survey to determine the number of people working on each project and their internal communication methods, as described in (Alarcón, Alarcón, and Alarcón 2013). The obtained client involvement scores are shown in Table 5 and Figure 2. Additionally, Table 6 gives the results obtained for the direct and undirected networks of the analyzed projects.

Table 5. Client involvement scores.

Project Code	Communication Score	Collaboration Score	Trust Score
P1	0.60	0.70	0.80
P2	0.70	0.90	0.60
P3	0.60	0.70	0.67
P4	0.80	0.80	0.80
P5	0.60	0.80	0.80
P6	0.90	1.00	0.67
P7	0.80	0.90	0.87
P8	1.00	0.70	0.73
P9	0.50	0.80	0.73
P10	0.70	0.80	0.73
P11	0.50	0.60	0.53
P12	0.80	0.80	0.80
P13	0.90	0.50	0.60
P14	0.90	0.50	0.53
P15	0.90	0.90	0.80
P16	0.70	0.80	0.73
P17	1.00	0.90	0.87
P18	0.40	0.80	0.60
P19	0.90	0.90	0.80
P20	0.90	1.00	0.87
P21	0.80	1.00	0.87
Total	0.76	0.80	0.73

Table 7 gives the scores obtained from the client survey, the total scores in the table vary, reflecting different levels of performance across projects. A project achieving a total score of 35 would indicate that it received the maximum rating (5) on all seven questions. The Cronbach's alpha of 0.6989 for the questions in the survey indicate their reasonable reliability.

The questions were devised to allow the clients to assign scores for communication and collaboration with the architectural design office and trust in the performance of the design process, as shown in Table 3. Q1 and Q3 evaluated communication; Q2 and Q4 evaluated collaboration; and Q5, Q6, and Q7 evaluated trust.

It was found that clients have good communication in 57% of projects, with scores above 0.7.

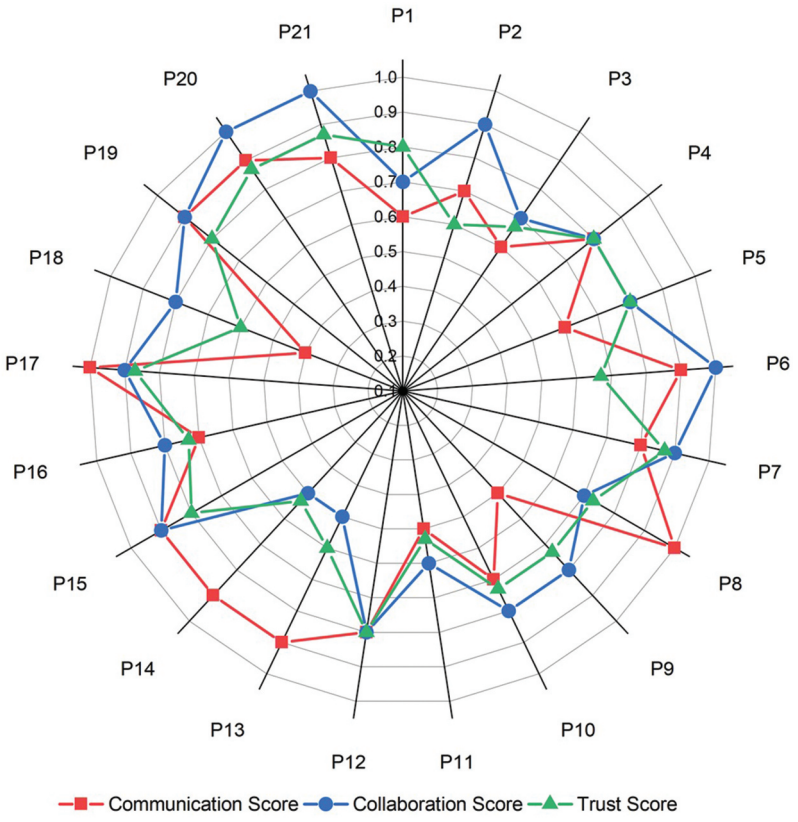

Figure 2. Client involvement scores.

Table 6. Results obtained for direct and undirected networks.

Project Code	Mean Degree I	Network Diameter I	Mean Clustering Coefficient I	Mean Path Length I	Mean Degree C	Network Diameter C	Mean Clustering Coefficient C	Mean Path Length C
P1	2.14	3.00	0.28	1.50	3.14	3.00	0.73	1.52
P2	2.14	2.00	0.46	1.42	3.14	3.00	0.69	1.71
P3	2.86	2.00	0.66	1.36	2.86	3.00	0.47	1.57
P4	2.40	2.00	0.70	1.25	4.00	1.00	1.00	1.00
P5	2.20	2.00	0.75	1.31	3.60	2.00	0.90	1.10
P6	2.60	2.00	0.80	1.19	4.00	1.00	1.00	1.00
P7	2.00	2.00	0.42	1.29	2.67	2.00	0.73	1.47
P8	3.00	2.00	0.73	1.40	2.67	2.00	0.83	1.47
P9	2.40	2.00	0.75	1.25	2.00	2.00	0.72	1.50
P10	2.75	2.00	0.72	1.37	3.75	3.00	0.68	1.50
P11	2.25	3.00	0.34	1.56	3.50	3.00	0.68	1.54
P12	2.00	3.00	0.31	1.44	4.25	2.00	0.82	1.39
P13	3.00	3.00	0.41	1.55	4.20	3.00	0.73	1.60
P14	2.80	2.00	0.45	1.43	4.80	0.00	0.78	1.47
P15	4.40	3.00	0.65	1.28	4.80	0.00	0.82	1.47
P16	2.20	2.00	0.75	1.31	2.00	0.00	0.72	1.50
P17	4.22	3.00	0.55	1.51	4.44	3.00	0.57	1.47
P18	2.50	3.00	0.65	1.70	2.33	2.00	0.72	1.53
P19	4.38	2.00	0.72	1.39	4.50	2.00	0.72	1.36
P20	4.38	3.00	0.65	1.43	5.00	2.00	0.78	1.32
P21	4.50	2.00	0.66	1.29	4.25	2.00	0.72	1.39

Client collaboration was found to be good in 67% of projects, with scores above 0.7. However, 24% of projects have collaboration scores between 0.6 and 0.7, and 10% of projects have scores below 0.6. Furthermore, client trust is reasonably high in 52% of projects, with scores between 0.7 and 0.8, but it is between 0.6 and 0.7 in 33% of projects and below 0.6 in 14% of projects. For all indicators, a score above 0.7 is classified as good, scores between 0.7 and 0.4 are considered regular, and values below 0.4 indicate poor performance. According to (Zeffane, Tipu, and Ryan 2011), trust is fundamental as it is at the core of the triadic relationship and is formed and maintained through effective communication.

3.2. Internal network metrics of variables

Regarding communication and collaboration, 61.9% of projects have a mean degree of information flow between 2 and 3, while 38.1% have values between 3 and 4. The network diameter for information flow is 2

Table 7. Scores obtained from client survey.

Project Code	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total (35)*
P1	4	2	4	3	4	4	4	25
P2	4	3	4	5	3	2	4	25
P3	3	3	4	3	2	4	4	23
P4	4	4	5	3	4	4	4	28
P5	4	2	5	3	4	4	4	26
P6	4	5	5	5	3	3	4	29
P7	5	3	5	4	4	5	4	30
P8	5	5	5	2	4	2	5	28
P9	3	2	5	3	3	4	4	24
P10	4	3	4	4	3	5	3	26
P11	3	2	3	3	2	2	4	19
P12	4	4	4	4	4	4	4	28
P13	4	5	2	3	3	2	4	23
P14	5	4	3	2	2	2	4	22
P15	5	4	5	4	4	4	4	30
P16	4	3	5	3	3	3	5	26
P17	5	5	5	4	5	3	5	32
P18	2	2	5	3	3	3	3	21
P19	5	4	5	4	4	4	4	30
P20	5	4	5	5	4	5	4	32
P21	4	4	5	5	4	4	5	31

*Highest possible score.

for 57.1% of projects and 3 for 42.9% of projects, with 61.9% having a mean clustering coefficient of around 0.5. Additionally, 38.1% of projects have a mean path length of about 1.4, indicating relatively direct communication. Regarding trust, 66.7% of projects exhibit a mean degree of trust between 2 and 3, while 33.33% have a value between 3 and 4.5. The trust network diameter is 2 for 38.1% of projects and 3 for 61.9% of projects, with a mean clustering coefficient of around 0.7 for 47.6% of projects and between 0.72 and 1 for 52.4% of projects. The mean path length for trust is about 1.5 for 33.3% of projects and between 1.32 and 1.47 for 66.7% of projects.

3.3. Data analysis

Outliers in the matrix of performance indicators were excluded from the study to provide a clearer understanding of the sample, as shown in Table 8. The results of the normality test (Table A1) revealed that the performance indicators did not follow a normal distribution. To address this, the data were converted to ordinal scales as per (Ferrari and Barbiero 2012) recommendations, allowing a Spearman's correlation analysis, the results of which are given in Table 9. This adjustment ensured a more accurate interpretation of the relationships among the variables.

Table 9 illustrates that the client is primarily connected to the internal network, while it is associated with only 3 of the 9 indicators presented in Table 8. These findings indicate an equal distribution of direct and inverse relationships, each accounting for 50%.

4. Discussion

The results of this study provide valuable insights into the influence of client communication, collaboration, and trust on the internal organization and

Table 8. Key performance indicators.

Project Code	KPI 1	KPI 2	KPI 3	KPI 4	KPI 5	KPI 6	KPI 7	KPI 8	KPI 9
P1	8.333	0.003	0.004	0.000	0.001	0.003	0.000	0.833	0.000
P2	25.139	0.003	0.001	0.000	0.000	0.001	0.000	1.250	0.000
P3	12.500	0.003	0.002	0.000	0.000	0.002	0.000	1.417	−0.250
P4	3.000					0.002		1.143	0.000
P5	3.333	0.005	0.003	0.001	0.008	0.002	1.300	0.000	
P6	3.000		0.008		0.002		0.003	1.200	0.000
P7	82.500	0.003	0.002	0.000	0.000	0.004	0.000	1.333	0.000
P8	14.286	0.003	0.004	0.002	0.004	0.002		−1.000	
P9	1.563							1.125	−0.250
P10	4.406	0.001	0.001	0.001	0.001	0.001	0.001	1.143	0.900
P11	14.747	0.007	0.003	0.001	0.000	0.007	0.001	1.333	−0.100
P12	31.625	0.004	0.004	0.000	0.000	0.004	0.000	1.000	0.000
P13	88.553	0.001	0.000	0.000	0.000	0.001	0.000	1.286	0.000
P14	55.729	0.001	0.001	0.000	0.001	0.001	0.000	1.429	−0.040
P15	55.385	0.001	0.001	0.000	0.001	0.001	0.000	1.357	0.000
P16	26.250	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000
P17	24.306	0.001	0.000	0.000	0.000	0.001	0.000	1.000	0.000
P18	15.625	0.000	0.000	0.000	0.000	0.000	0.000	1.444	−0.250
P19		0.001	0.001	0.000	0.001	0.001	0.000	1.083	0.000
P20		0.000	0.000	0.000	0.000	0.000	0.000	1.153	0.000
P21		0.000	0.000	0.000	0.000	0.000	0.000	1.055	0.000

Table 9. Results of correlation analysis.

Client Variable	Network and Performance Variable	P-Value	R	Relationship
Trust Score	Mean Path Length C	0.0085	−0.5588	Strong Inverse
Trust Score	KPI 8 (Timeline Compliance)	0.0221	−0.5084	
Collaboration Score	Mean Path Length C	0.0227	−0.4946	Moderate Inverse
Collaboration Score	Mean Path Length I	0.0461	−0.4397	
Communication Score	Mean Path Length C	0.0478	−0.4367	
Collaboration Score	KPI 9 (Budget Compliance)	0.0195	0.5051	Strong Direct
Trust Score	KPI 9 (Budget Compliance)	0.0162	0.518	Strong Direct
Collaboration Score	KPI 4 (Design Quality)	0.0176	0.552	
Communication Score	Mean Degree I	0.0082	0.5605	
Communication Score	Mean Degree C	0.0018	0.6397	Strong Direct

performance of architectural design offices. Specifically, the analysis reveals that most projects have well-connected information and trust networks, with mean degrees between 2 and 4, network diameters between 2 and 3, and clustering coefficients between 0.5 and 0.7. This moderate cohesion facilitates efficient communication and collaboration within design teams, promoting project success. Furthermore, the client survey results indicate reasonably high levels of communication and trust, with 71.43% of clients frequently trusting the design team and 61.90% consistently attending scheduled review meetings. However, despite these positive indicators, there are notable areas for improvement. For example, 42.86% of projects experience frequent unscheduled review requests, and 47.62% of clients need more flexibility with initial agreements. To address these challenges, incorporating structured communication practices, as suggested in (Norouzi et al. 2015) and (Shen 2011), could significantly enhance client satisfaction and improve project outcomes. These findings underscore the importance of well-structured internal networks and active client engagement, aligning with (Alarcón, Alarcón, and Alarcón 2013), which emphasizes that effective collaboration is crucial for successful project execution.

4.1. Client involvement: communication, collaboration, and trust

Cultural differences, economic conditions, and project characteristics significantly influence communication, collaboration, and trust within architectural projects (Rubio Bañuls and Capuz-Rizo 2020). For example, projects in more economically stable countries tend to have higher client trust and more transparent communication. The communication score, shown in Figure 2, varies across projects, with P6 and P17 demonstrating high communication and trust scores, reinforcing the relationship between effective communication and trust, as suggested in (Zeffane, Tipu, and Ryan 2011). Conversely, projects P11 and P18 have low scores for both communication and trust. Similarly, collaboration plays a crucial role, as projects with solid collaboration, such as P21 and P19, tend to have higher trust scores, whereas projects with weaker collaboration, such as P6 and P18, have low trust scores. According to (Zeffane, Tipu, and Ryan 2011), trust is at the core of the triadic relationship between communication, collaboration, and commitment, and projects such as P6 and P17 exemplify how these elements work together to build high trust.

More extensive projects, such as multifamily buildings and metro stations (e.g., P7 and P8), face challenges in maintaining consistent communication and collaboration due to their complexity, often leading to trust issues. In contrast, although smaller projects, such as single-family homes (e.g., P9), involve more straightforward communication, they rely on close interaction, which can either strengthen or weaken trust. Geographic location, regulatory environments, and cultural differences also influence client expectations and internal team dynamics, as noted in (Luo, He, Jaselskis, et al. 2017; Luo, He, Xie, et al. 2017), and (Hofstede and Bond 1984).

4.2. Directed and undirected information flows

Projects with higher mean degree scores for their directed networks, such as P1, P17, and P20, show better connectivity, facilitating efficient information dissemination. In contrast, the lower scores in projects P8 and P14 suggest potential information silos. Similarly, low network diameters of around 2 support faster information flow, whereas higher diameters, such as those for P4 and P10 May 2001indicate slower information flow. Projects with high mean clustering coefficients, such as P6 and P20, exhibit strong information clusters, supporting effective collaboration, whereas the lower coefficients in projects P9 and P14 suggest less interconnectivity. Additionally, the shorter mean path lengths in projects P1 and P20 enable direct communication routes, thereby enhancing efficiency. In contrast, the longer mean path lengths in projects P8 and P14 May cause delays in information exchange.

Furthermore, regarding undirected trust flow within the team, projects P1, P17, and P20 demonstrate strong trust connectivity, whereas projects P12 and P14 exhibit weaker trust networks. Efficient trust networks are indicated by lower network diameters, with most projects having values around 2, although the higher diameters for projects P4 and P10 suggest

potential challenges in building trust. The strong trust clusters in projects such as P6 and P20 can enhance teamwork, whereas the lower clustering coefficients in projects P9 and P14 indicate weaker trust networks. Additionally, projects with shorter mean path lengths, such as P1 and P20, reflect efficient trust flow, whereas the longer mean path lengths in projects P8 and P14 May hinder the development of trust.

4.3. Comparative analysis

The comparative analysis between the directed information flow and the undirected trust flow reveals a strong correlation between well-connected networks and project success. Specifically, projects such as P1, P17, and P20, which score highly in both metrics, suggest that adequate information flow fosters trust by ensuring transparency and timely updates. In turn, the trust encourages team members to share information openly, as discussed in (Zeffane, Tipu, and Ryan 2011). Conversely, the low scores in both areas in P8 and P14 highlight the challenges posed by weak internal networks, which lead to information bottlenecks, trust deficits, and potential project delays, particularly in larger projects (Luo, He, Xie, et al. 2017). Design offices should strengthen internal networks by promoting transparent communication, regular team-building activities, and structured collaboration to mitigate these issues. Furthermore, communication strategies should be tailored to the type and scale of the project; larger projects often require more structured communication channels, whereas smaller projects benefit from more direct and flexible approaches.

Technological tools such as BIM can enhance information flow and trust by providing a collaborative platform for real-time updates and shared project data. Moreover, it is essential to consider cultural and economic contexts, as they influence communication and trust-building strategies (Hofstede and Bond 1984; Javidan et al. 2006).

Additionally, this study identifies strong relationships between client communication, collaboration, and trust, highlighting their impact on project efficiency, quality, and budget adherence. A strong inverse relationship was observed between client trust in the architectural office and the average path length (C), suggesting that higher trust reduces the number of intermediaries in communication, resulting in more efficient interactions. This aligns with (Zeffane, Tipu, and Ryan 2011), who emphasize the role of trust in fostering strong organizational relationships and improving communication quality.

Similarly, client trust was found to correlate with project execution time (KPI 8), indicating that higher trust levels reduce the likelihood of project delays. Previous studies have demonstrated that trust contributes to efficiency in project execution (Zeffane, Tipu, and Ryan 2011). Furthermore, a moderate inverse relationship was found between client collaboration and the average path length (C), suggesting that higher collaboration enables faster decision-making and more effective design processes.

Moreover, a direct relationship was identified between client collaboration and timeline compliance (KPI 9), supporting that greater client involvement reduces delays and ensures on-time project delivery. Studies on client collaboration suggest that active involvement enhances facilitates timely project execution (Zeffane, Tipu, and Ryan 2011). Additionally, client collaboration was strongly correlated with design quality (KPI 4), supporting that greater involvement leads to improved architectural outcomes, consistent with (Shen 2011), who highlights the importance of client involvement in achieving mutual understanding among stakeholders.

Furthermore, client communication demonstrated a direct relationship with network connectivity, indicating that clearer communication strengthens internal interactions and enhances trust within the team. A strong direct relationship was also observed between client communication and mean degree (C), suggesting that effective client interaction contributes to a more cohesive and trustworthy project environment. These results show that trust is built through effective communication (Zeffane, Tipu, and Ryan 2011).

The KPIs in this study reveal that client communication, collaboration, and trust significantly impact project efficiency, quality, and budget adherence. Clear communication shortens problem-solving times, and increased collaboration and trust directly improve budget compliance and design quality. To optimize project outcomes, design offices should enhance client communication through structured strategies, promote active client collaboration in decision-making, and build trust by maintaining transparency and reliability. These findings emphasize that well-connected internal networks and strong client relationships are essential for successful project execution.

5. Conclusions

This study examined the impact of client communication, collaboration, and trust on the internal organization and performance of architectural design offices. The findings indicate that well-connected internal networks facilitate efficient communication and collaboration, improving project outcomes. High client trust and active involvement positively correlate with better project results, whereas frequent unscheduled review requests and client inflexibility were identified as areas needing improvement. Positive correlations were found between client collaboration, budget compliance,

and design quality, highlighting the importance of these interactions. Additionally, effective client communication enhances internal information flow and trust within the design team.

The analysis also highlighted the influence of the type, scale, and geographic location of a project on its outcomes. Larger projects, such as multifamily buildings and metro station consortiums, often involve more stakeholders and complex communication channels, leading to challenges in maintaining consistent communication, collaboration, and trust. In contrast, although smaller projects, such as single-family houses and cooperatives, have simpler communication needs, they require closer interaction, which can enhance or hinder trust and collaboration. Cultural differences, economic conditions, and regulatory environments in different countries significantly impact client involvements and internal network metrics (Hofstede and Bond 1984; Javidan et al. 2006).

It was also observed that the efficiency of information flow (directed information flow) and trust networks (undirected trust flow) within design teams varies significantly across the projects. Projects with robust internal networks demonstrate high trust and efficient communication, corroborating (Zeffane, Tipu, and Ryan 2011). Conversely, projects with weaker networks face significant challenges in communication and trust, adversely affecting project performance. These findings align with (Luo, He, Xie, et al. 2017), which highlighted the complexities of managing more substantial projects.

Recommendations for future research include expanding the sample size to encompass more diverse design offices, conducting longitudinal studies to examine the long-term impacts of client involvement, utilizing qualitative methods to obtain deeper insights into client – team dynamics based on previous experiences with design offices, and investigating the role of technological tools in improving client communication and collaboration. While the findings indicate strong correlations between client involvement and project performance, further research is required to establish whether these relationships are causal or influenced by external factors. Advanced statistical modeling and experimental research designs could provide a more comprehensive understanding of the direct impact of client involvement on project outcomes

Strong client communication, collaboration, and trust are essential for successful architectural projects, as they improve project outcomes and client satisfaction. This study provides valuable insights for practitioners and researchers by highlighting the importance of these factors and the need to consider country-specific factors in managing and executing architectural projects to enhance overall performance.

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CRediT authorship contribution statement

Conceptualization, W.C. and T.C.; methodology, T.C.; software, K.J.; validation, R.H.; formal analysis, K.J. and A.Z.; investigation, W.C. and T.C.; resources, A.Z.; data curation, A.A. and W.C.; writing – original draft preparation, W.C.; writing – review and editing, A.Z.; visualization, A.Z.; supervision, R.H.; project administration, A.A. All authors have read and agreed to the published version of the manuscript.

Data availability statement

Data are contained within the article.

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Appendix

Table A1. Normality test results.

Variables	W	P
Mean Path Length I	0.96514	0.625
Mean Degree I	0.80653	0.000827
Mean Clustering Coefficient I	0.88021	0.01474
Network Diameter I	0.61975	0.000003207
Network Diameter C	0.77365	0.0002665
Mean Clustering Coefficient C	0.91856	0.0812
Mean Degree C	0.94624	0.2887
Mean Path Length C	0.83899	0.002761
Resource Efficiency (KPI 1)	0.8138	0.002395
Design Quality (KPI 2)	0.82808	0.005056
Design Quality (KPI 3)	0.81849	0.002148
Design Quality (KPI 4)	0.67089	0.00003734
Design Quality (KPI 5)	0.70352	0.00008778
Design Quality (KPI 6)	0.79028	0.001111
Design Quality (KPI 7)	0.74099	0.0001289
Timeline Compliance (KPI 8)	0.96088	0.5617
Budget Compliance (KPI 9)	0.62267	0.000003451
Collaboration Score	0.91083	0.05703
Communication Score	0.92946	0.1342
Trust Score	0.89846	0.03267