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Service Quality and Mega Construction Project Success in Chinese Telecommunication Firms: The Moderating Effects of GAI Technology Application and Digital Human-AI Integration

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Posted Date: 7 May 2025

doi: 10.20944/preprints202505.0340.v1

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Service Quality and Mega Construction Project Success in Chinese Telecommunication Firms: The Moderating Effects of GAI Technology Application and Digital Human-AI Integration

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Abstract: This study investigates the relationship between service quality and mega construction project success in Chinese telecommunication firms, with a specific focus on the moderating effects of Generative Artificial Intelligence (GAI) technology application and digital Human-AI integration. Using the SERVQUAL framework as a theoretical foundation, this research employs a mixed-methods approach combining structural equation modeling (SEM) and fuzzy-set Qualitative Comparative Analysis (fsQCA) to analyze data collected from 278 telecommunications firms engaged in mega construction projects in China. Results indicate that service quality significantly impacts project success, while GAI technology application and Human-AI integration positively moderate this relationship. Specifically, The findings reveal specific configurational paths to project success, providing valuable insights for telecommunications industry practitioners and policymakers. This study contributes to the literature by developing an integrated theoretical framework that connects service quality dimensions with mega construction project outcomes in the digital transformation context of the telecommunications sector.

Keywords: Service quality; SERVQUAL; Mega construction projects; GAI technology; Human-AI integration; Chinese telecommunications industry; fsQCA; Artificial neural networks

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1. Introduction

The telecommunications industry in China has experienced unprecedented growth, with firms increasingly undertaking mega construction projects to expand infrastructure and service capabilities (Li et al., 2023). These projects, characterized by high complexity, substantial investment, and significant societal impact, require exceptional service quality to ensure successful outcomes (Zhang & Wang, 2022). Simultaneously, the rapid advancement of digital technologies, particularly Generative Artificial Intelligence (GAI), has created new opportunities for enhancing service delivery and project management in this sector (Chen et al., 2024).

Despite the growing importance of service quality in mega construction projects and the potential impact of digital technologies, existing literature reveals a significant research gap in understanding how GAI technologies and Human-AI integration influence the relationship between service quality and project success in the telecommunications industry context. Previous studies have examined service quality in construction projects (Wu & Zhao, 2021) and the application of AI in telecommunications (Liu et al., 2023), but few have investigated the interplay between these factors in mega construction projects undertaken by telecommunications firms.

This study addresses this research gap by examining how service quality dimensions influence mega construction project success in Chinese telecommunications firms and how GAI technology application and Human-AI integration moderate these relationships. We develop and test an integrated theoretical framework using a mixed-methods approach combining structural equation

 doi:10.20944/preprints202505.0340.v1

modeling with artificial neural networks (ANN) and fuzzy-set Qualitative Comparative Analysis (fsQCA).

The research objectives are: (1) to examine the impact of SERVQUAL dimensions on mega construction project success in Chinese telecommunications firms; (2) to investigate the moderating effect of GAI technology application on the relationship between service quality and project success; and (3) to explore the moderating effect of Human-AI integration on service quality-project success relationships.

This study makes several significant contributions to service quality and project management literature, particularly in the context of mega construction projects in the Chinese telecommunications industry. First, we extend the SERVQUAL framework beyond its traditional applications by empirically validating its relevance to mega construction projects in the telecommunications sector. While previous research has examined service quality in various contexts, our study uniquely addresses the specific challenges and requirements of large-scale telecommunications infrastructure development, thereby enriching the theoretical understanding of service quality dimensions in specialized project environments.

Second, our research introduces a novel theoretical perspective by investigating the moderating effects of digital technologies on established service quality-performance relationships. By identifying Generative Artificial Intelligence (GAI) application and Human-AI integration as significant contingency factors, we advance knowledge on how emerging technologies reshape traditional service quality dynamics. The findings reveal that these digital technologies strengthen the relationship between service quality and project success, providing empirical evidence of their transformative potential in project management contexts.

Third, our innovative methodological approach combines structural equation modeling (SEM) with artificial neural networks (ANN) and fuzzy-set Qualitative Comparative Analysis (fsQCA), offering a comprehensive understanding of both linear and non-linear relationships between variables. This methodological triangulation addresses limitations of single-method approaches and reveals complex interaction patterns that might otherwise remain undetected. The fsQCA analysis, in particular, advances our understanding of the equifinality in achieving project success, demonstrating that multiple configurational paths can lead to successful outcomes depending on organizational context.

Fourth, we contribute practical knowledge by identifying specific service quality configurations that lead to successful mega construction projects in the Chinese telecommunications industry. The identification of reliability and assurance as the most influential dimensions in the ANN analysis provides actionable insights for industry practitioners, while the five configurational paths revealed through fsQCA offer strategic options for telecommunications firms facing resource constraints.

Finally, our study bridges the gap between service quality theory and digital transformation literature by integrating perspectives from both fields. By examining how traditional service quality dimensions interact with emerging technologies to influence project outcomes, we establish a foundation for future interdisciplinary research exploring the intersection of service management and digital innovation. This integrated perspective is particularly valuable as organizations across industries navigate the complexities of digital transformation while maintaining service excellence.

This paper employs a sequential structure comprising seven interconnected sections. Following the abstract, we introduce the research problem and objectives. The literature review synthesizes relevant scholarship, leading to hypothesis development. Our methodology details sampling procedures, measurement instruments, and analytical techniques. Results present statistical findings from SEM, ANN, and fsQCA analyses. The discussion interprets theoretical implications and practical significance, while the conclusion summarizes contributions and suggests future research directions.

2. Literature Review and Theoretical Support

2.1. Service Quality and SERVQUAL Model

Service quality has been widely recognized as a critical factor in organizational performance and competitive advantage (Parasuraman et al., 1988; Zeithaml et al., 2018). The SERVQUAL model,

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developed by Parasuraman et al. (1988), identifies five dimensions of service quality: tangibles, reliability, responsiveness, assurance, and empathy. This framework has been applied across various industries, including construction and telecommunications (Panda & Das, 2021; Wu & Zhao, 2021).

In the context of the Chinese telecommunications industry, Yang et al. (2022) found that service quality significantly influenced customer satisfaction and loyalty. Similarly, Li and Zhang (2023) demonstrated that service quality dimensions were critical factors in determining the success of construction projects undertaken by telecommunications firms. However, these studies did not specifically address the unique characteristics of mega construction projects or the influence of digital technologies.

2.2. Mega Construction Projects in Telecommunications

Mega construction projects in the telecommunications industry involve the development of large-scale infrastructure networks, data centers, and communication systems (Zhang & Wang, 2022). These projects differ from conventional construction projects in terms of scale, complexity, stakeholder involvement, and societal impact (Flyvbjerg, 2021). Chen et al. (2023) identified key success factors for mega construction projects, including effective stakeholder management, technical capability, and service quality.

In the Chinese context, telecommunications firms have increasingly undertaken mega construction projects to support the country's digital transformation initiatives and 5G network deployment (Wang et al., 2023). However, these projects face significant challenges, including technical complexity, regulatory constraints, and service quality management (Liu & Chen, 2024).

2.3. GAI Technology Application in Telecommunications

Generative Artificial Intelligence (GAI) technologies, including large language models, generative adversarial networks, and transformer models, have demonstrated significant potential for enhancing service delivery and project management in the telecommunications industry (Zhang et al., 2024). These technologies enable automated design optimization, predictive maintenance, intelligent resource allocation, and enhanced customer service (Wu et al., 2023).

Chen and Liu (2024) found that GAI technologies improved decision-making processes and service efficiency in telecommunications projects. Similarly, Wang et al. (2023) demonstrated that GAI applications enhanced project planning and risk management in large-scale infrastructure development. However, the moderating effect of GAI technology application on the relationship between service quality and project success remains underexplored.

2.4. Human-AI Integration in Digital Transformation

Human-AI integration represents the collaborative relationship between human workers and AI systems in organizational processes (Li et al., 2023). Effective integration involves balancing AI capabilities with human expertise, establishing appropriate governance mechanisms, and developing new organizational structures (Zhang & Wang, 2023).

In the telecommunications industry, Human-AI integration has been recognized as a critical factor in digital transformation initiatives (Chen et al., 2024). Liu and Zhang (2023) found that telecommunications firms with higher levels of Human-AI integration demonstrated improved service quality and operational efficiency. However, the moderating effect of Human-AI integration on service quality-project success relationships in mega construction projects requires further investigation.

3. Theoretical Framework and Hypotheses Development

Based on the literature review, we develop an integrated theoretical framework that connects service quality dimensions with mega construction project success, moderated by GAI technology application and Human-AI integration. The framework draws on the SERVQUAL model, project management theory, and the technology-organization-environment (TOE) framework.

3.1. Service Quality and Project Success

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Drawing on the SERVQUAL model, we propose that service quality dimensions—tangibles, reliability, responsiveness, assurance, and empathy—positively influence mega construction project success in telecommunications firms. High-quality service delivery ensures effective stakeholder management, efficient resource utilization, and timely project completion (Wu & Zhao, 2021; Li & Zhang, 2023).

Hypothesis 1 (H1): Service quality has a positive impact on mega construction project success in Chinese telecommunications firms.

3.2. Moderating Effect of GAI Technology Application

GAI technologies can enhance service quality by enabling automated design optimization, intelligent resource allocation, and predictive maintenance (Zhang et al., 2024). These capabilities may strengthen the relationship between service quality and project success by improving service efficiency, reducing errors, and enhancing decision-making processes (Chen & Liu, 2024).

Hypothesis 2 (H2): GAI technology application positively moderates the relationship between service quality and mega construction project success in Chinese telecommunications firms.

3.3. Moderating Effect of Human-AI Integration

Effective Human-AI integration involves balancing AI capabilities with human expertise and establishing appropriate organizational structures (Li et al., 2023). This integration may enhance the impact of service quality on project success by combining AI-driven efficiency with human creativity and adaptability (Liu & Zhang, 2023).

Hypothesis 3 (H3): Human-AI integration positively moderates the relationship between service quality and mega construction project success in Chinese telecommunications firms.

4. Methodology

4.1. Sample Selection and Data Sources

Data were collected through a structured survey administered to managers and executives of telecommunications firms engaged in mega construction projects in China. The sampling frame was developed using the China Telecommunications Industry Association directory, focusing on firms that had completed or were currently implementing mega construction projects with budgets exceeding 100 million RMB.

A total of 450 surveys were distributed, with 304 responses received (response rate: 67.6%). After removing incomplete responses, 278 valid responses were retained for analysis. The final sample represented diverse firms in terms of size, ownership structure, and project types. Table 1 presents the demographic characteristics of the sample.

Table 1. Sample Demographic Characteristics.

Characteristic	*Category*	*Frequency*	*Percentage*
Firm Size	Large (>1000 employees)	153	55.0%
	Medium (100-1000 employees)	97	34.9%
	Small (<100 employees)	28	10.1%
Ownership	State-owned	142	51.1%
	Private	98	35.3%
	Foreign/Joint Venture	38	13.7%
Project Type	Network Infrastructure	152	54.7%
	Data Centers	76	27.3%
	Smart City Solutions	50	18.0%
Project Budget	100-500 million RMB	125	45.0%
	501-1000 million RMB	97	34.9%
	>1000 million RMB	56	20.1%

4.2. Model Design and Definition of Variables

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4.2.1. Dependent Variable: Mega Construction Project Success

Project success was measured using a multidimensional scale adapted from Flyvbjerg (2021) and Chen et al. (2023), incorporating four dimensions: schedule performance, cost performance, quality performance, and stakeholder satisfaction. Each dimension was measured using three items on a seven-point Likert scale.

4.2.2. Independent Variable: Service Quality

Service quality was measured using the SERVQUAL framework (Parasuraman et al., 1988), adapted to the telecommunications industry context based on Yang et al. (2022) and Li and Zhang (2023). The scale included five dimensions: tangibles, reliability, responsiveness, assurance, and empathy, with each dimension measured using four items on a seven-point Likert scale.

4.2.3. Moderating Variables

GAI technology application was measured using a six-item scale adapted from Zhang et al. (2024) and Chen and Liu (2024), assessing the extent of GAI implementation in project planning, execution, monitoring, and customer service.

Human-AI integration was measured using a seven-item scale developed based on Li et al. (2023) and Liu and Zhang (2023), assessing the level of collaboration between human workers and AI systems, governance mechanisms, and organizational structures supporting integration.

4.2.4. Control Variables

Control variables included firm size, ownership structure, project type, and project budget, based on their potential influence on project success as identified in previous studies (Wu & Zhao, 2021; Chen et al., 2023).

Table 2 presents the measurement items for all variables.

Table 2. Measurement Items.

Variable	*Dimension*	*Item Code*	*Measurement Item*
Service Quality	Tangibles (TAN)	TAN1	The firm uses modern equipment and technology
		TAN2	Physical facilities are visually appealing
		TAN3	Staff members appear professional
		TAN4	Materials associated with service are visually appealing
	Reliability (REL)	REL1	Services are provided as promised
		REL2	The firm is dependable in handling service problems
		REL3	Services are performed right the first time
		REL4	Services are provided at the promised time
	Responsiveness (RES)	RES1	Customers are informed when services will be performed
		RES2	Staff provide prompt service to customers
		RES3	Staff are always willing to help customers
		RES4	Staff are never too busy to respond to customer requests
	Assurance (ASS)	ASS1	Staff behavior instills confidence in customers
		ASS2	Customers feel safe in their transactions
		ASS3	Staff are consistently courteous

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		ASS4	Staff have the knowledge to answer customer questions
	Empathy (EMP)	EMP1	The firm gives customers individual attention
		EMP2	Operating hours are convenient for customers
		EMP3	Staff give customers personal attention
		EMP4	The firm has the customers' best interests at heart
Project Success	Schedule Performance (SP)	SP1	The project was completed on schedule
		SP2	The project experienced minimal schedule delays
		SP3	The project schedule management was effective
	Cost Performance (CP)	CP1	The project was completed within budget
		CP2	The project experienced minimal cost overruns
		CP3	The project cost management was effective
	Quality Performance (QP)	QP1	The project met technical specifications
		QP2	The project delivered high-quality outputs
		QP3	The project quality management was effective
	Stakeholder Satisfaction (SS)	SS1	Stakeholders were satisfied with project outcomes
		SS2	The project met stakeholder expectations
		SS3	Stakeholders would recommend the firm for future projects
GAI Technology Application		GAI1	GAI is used for project planning and design
		GAI2	GAI is used for resource allocation and optimization
		GAI3	GAI is used for risk assessment and management
		GAI4	GAI is used for quality control and monitoring
		GAI5	GAI is used for customer service and support
		GAI6	GAI is integrated into core project management processes
Human-AI Integration		HAI1	Human workers and AI systems collaborate effectively
		HAI2	Roles and responsibilities between humans and AI are clearly defined
		HAI3	Organizational structures support Human-AI collaboration
		HAI4	Governance mechanisms for Human-AI integration are established

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	HAI5	Staff are trained to work effectively with AI systems
	HAI6	The firm culture supports Human-AI integration
	HAI7	Leadership actively promotes Human-AI integration

4.3. Analytical Approaches

This study employed a mixed-methods approach combining structural equation modeling (SEM), artificial neural networks (ANN), and fuzzy-set Qualitative Comparative Analysis (fsQCA).

SEM analysis using AMOS 26.0 was conducted to test the hypothesized relationships between service quality dimensions, project success, and the moderating effects of GAI technology application and Human-AI integration. The two-step approach recommended by Anderson and Gerbing (1988) was followed, first assessing the measurement model and then testing the structural model.

ANN analysis was conducted to identify non-linear relationships and complex interaction patterns that might not be captured by traditional SEM. The ANN model used service quality dimensions, GAI technology application, and Human-AI integration as input variables, with project success as the output variable.

fsQCA was employed to identify configurational paths to project success, recognizing that different combinations of service quality dimensions, GAI technology application, and Human-AI integration might lead to high project success. fsQCA software version 3.0 was used for this analysis.

5. Results and Findings

5.1. Descriptive Statistics

Table 3 presents descriptive statistics and correlations for the study variables. Service quality dimensions showed moderate to high mean values (ranging from 4.83 to 5.56 on a seven-point scale), indicating relatively high service quality in the sample. Project success dimensions also demonstrated moderate to high mean values (ranging from 4.92 to 5.38), suggesting generally successful project outcomes. GAI technology application and Human-AI integration showed moderate mean values (4.72 and 4.58, respectively), indicating that these digital technologies were being adopted but not fully implemented across all firms.

Table 3. Descriptive Statistics and Correlations.

Variable	*Mean*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Tangibles	5.24	0.93	1.00										
2. Reliability	5.56	0.87	0.42*	1.00									
3. Responsiveness	5.12	0.97	0.38*	0.45*	1.00								
4. Assurance	5.34	0.92	0.36*	0.48*	0.43*	1.00							
5. Empathy	4.83	1.05	0.33*	0.37*	0.46*	0.40*	1.00						
6. Schedule Performance	4.92	1.12	0.35*	0.47*	0.42*	0.39*	0.31*	1.00					
7. Cost Performance	5.03	1.08	0.33*	0.49*	0.38*	0.36*	0.29*	0.53*	1.00				
8. Quality Performance	5.38	0.95	0.38*	0.52*	0.43*	0.45*	0.34*	0.48*	0.52*	1.00			

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9. *Stakeholder Satisfaction*	5.21	0.98	0.40*	0.55*	0.46*	0.48*	0.42*	0.51*	0.49*	0.58*	1.00		
10. *GAI Technology Application*	4.72	1.15	0.42*	0.38*	0.36*	0.41*	0.33*	0.44*	0.42*	0.46*	0.48*	1.00	
11. *Human-AI Integration*	4.58	1.21	0.39*	0.36*	0.34*	0.37*	0.35*	0.41*	0.39*	0.43*	0.45*	0.56*	1.00

*p < 0.05, SD = Standard Deviation.

5.2. Measurement Model Assessment

Confirmatory factor analysis (CFA) was conducted to assess the validity and reliability of the measurement model. Table 4 presents the results of the CFA analysis, including factor loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE).

Table 4. Measurement Model Assessment.

Construct	*Item*	*Factor Loading*	*Cronbach's Alpha*	*CR*	*AVE*
Tangibles	TAN1	0.82	0.86	0.88	0.65
	TAN2	0.78			
	TAN3	0.84			
	TAN4	0.79			
Reliability	REL1	0.85	0.89	0.91	0.72
	REL2	0.87			
	REL3	0.83			
	REL4	0.84			
Responsiveness	RES1	0.81	0.88	0.90	0.68
	RES2	0.83			
	RES3	0.86			
	RES4	0.80			
Assurance	ASS1	0.84	0.87	0.89	0.67
	ASS2	0.82			
	ASS3	0.78			
	ASS4	0.83			
Empathy	EMP1	0.79	0.85	0.87	0.64
	EMP2	0.77			
	EMP3	0.84			
	EMP4	0.81			
Schedule Performance	SP1	0.87	0.88	0.90	0.74
	SP2	0.85			
	SP3	0.86			
Cost Performance	CP1	0.89	0.89	0.91	0.76
	CP2	0.86			
	CP3	0.87			
Quality Performance	QP1	0.85	0.87	0.89	0.73
	QP2	0.88			
	QP3	0.84			
Stakeholder Satisfaction	SS1	0.86	0.88	0.90	0.75
	SS2	0.88			
	SS3	0.85			
GAI Technology Application	GAI1	0.83	0.91	0.93	0.68
	GAI2	0.84			
	GAI3	0.82			

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	GAI4	0.81			
	GAI5	0.85			
	GAI6	0.79			
Human-AI Integration	HAI1	0.82	0.92	0.94	0.69
	HAI2	0.83			
	HAI3	0.85			
	HAI4	0.80			
	HAI5	0.82			
	HAI6	0.84			
	HAI7	0.86			

All factor loadings exceeded the threshold of 0.70, indicating good indicator reliability. Cronbach's alpha and composite reliability values were above 0.80, demonstrating good internal consistency. AVE values were above 0.60, confirming good convergent validity. Discriminant validity was assessed by comparing the square root of AVE for each construct with its correlations with other constructs, with all constructs demonstrating good discriminant validity.

The measurement model demonstrated good fit with the data: $\chi^2/df = 2.35$, CFI = 0.94, TLI = 0.93, RMSEA = 0.057, SRMR = 0.048, indicating that the measurement model was appropriate for structural analysis.

5.3. Structural Model and Hypothesis Testing

The structural model was tested using AMOS 26.0. Table 5 presents the model fit indices for the structural model, which demonstrated good fit with the data.

Table 5. Structural Model Fit Indices.

Fit Index	*Value*	*Threshold*	*Result*
χ^2/df	2.46	<3.00	Good fit
CFI	0.93	>0.90	Good fit
TLI	0.92	>0.90	Good fit
RMSEA	0.059	<0.08	Good fit
SRMR	0.052	<0.08	Good fit

Table 6 presents the results of the hypothesis testing, including path coefficients, t-values, and significance levels.

Table 6. Results of Hypothesis Testing.

Hypothesis	*Path*	*Path Coefficient*	*t-value*	*p-value*	*Result*
H1	Service Quality → Project Success	0.485	7.83	<0.001	Supported
H2	Service Quality × GAI Technology Application → Project Success	0.172	3.45	<0.01	Supported
H3	Service Quality × Human-AI Integration → Project Success	0.156	3.28	<0.01	Supported

The results indicated that service quality had a significant positive impact on project success ($\beta = 0.485$, $p < 0.001$), supporting Hypothesis 1. GAI technology application positively moderated the relationship between service quality and project success ($\beta = 0.172$, $p < 0.01$), supporting Hypothesis 2. Similarly, Human-AI integration positively moderated the relationship between service quality and project success ($\beta = 0.156$, $p < 0.01$), supporting Hypothesis 3.

5.4. Artificial Neural Network Analysis

ANN analysis was conducted to identify non-linear relationships and complex interaction patterns. Table 7 presents the normalized importance of input variables in the ANN model.

 doi:10.20944/preprints202505.0340.v1

Table 7. Normalized Importance of Input Variables in ANN Model.

Input Variable	*Normalized Importance (%)*
Reliability	100.0
Assurance	87.6
Responsiveness	82.3
Tangibles	75.8
GAI Technology Application	72.5
Human-AI Integration	68.9
Empathy	64.2

Notes. The ANN analysis revealed that reliability was the most important service quality dimension in predicting project success, followed by assurance and responsiveness. GAI technology application and Human-AI integration demonstrated moderate importance, confirming their role in enhancing project success.

5.5. Fuzzy-set Qualitative Comparative Analysis

fsQCA was employed to identify configurational paths to high project success. Table 8 presents the calibration criteria for fsQCA.

Table 8. Calibration Criteria for fsQCA.

Variable	*Full Membership (0.95)*	*Crossover Point (0.5)*	*Full Non-membership (0.05)*
Tangibles	6.5	5.0	3.5
Reliability	6.5	5.5	4.5
Responsiveness	6.0	5.0	4.0
Assurance	6.5	5.3	4.0
Empathy	6.0	4.8	3.5
GAI Technology Application	6.0	4.7	3.5
Human-AI Integration	6.0	4.6	3.0
Project Success	6.5	5.0	3.5

Table 9 presents the fsQCA truth table analysis results, showing configurational paths to high project success.

Table 9. fsQCA Truth Table Analysis Results.

Configuration	*TAN*	*REL*	*RES*	*ASS*	*EMP*	*GAI*	*HAI*	*Raw Coverage*	*Unique Coverage*	*Consistency*
1	●	●	●	●	○	●	●	0.386	0.098	0.921
2	●	●	○	●	●	●	○	0.342	0.075	0.908
3	○	●	●	●	○	●	●	0.325	0.064	0.895
4	●	●	●	○	●	○	●	0.298	0.052	0.882
5	●	●	○	●	○	●	●	0.287	0.046	0.876

Solution coverage: 0.754 Solution consistency: 0.874 ● = presence of condition, ○ = absence of condition

The fsQCA results revealed five configurational paths to high project success, with an overall solution coverage of 0.754 and consistency of 0.874. Configuration 1, featuring high levels of tangibles, reliability, responsiveness, assurance, GAI technology application, and Human-AI integration (but not empathy), demonstrated the highest raw coverage (0.386), indicating its empirical relevance.

5.6. Model Fit Analysis

doi:10.20944/preprints202505.0340.v1

The model fit analysis assessed the overall explanatory power of the proposed model. Table 10 presents the model fit analysis results.

Table 10. Model Fit Analysis Results.

Fit Index	*Value*	*Threshold*	*Interpretation*
R^2	0.583	-	Model explains 58.3% of variance in project success
Adjusted R^2	0.575	-	Good explanatory power after adjustment for variables
F-value	48.63	-	Significant at $p < 0.001$
Q^2	0.492	>0	Good predictive relevance
GoF	0.615	>0.36	Large effect size and good overall fit

The model demonstrated good explanatory power ($R^2 = 0.583$) and predictive relevance ($Q^2 = 0.492$), indicating that the proposed theoretical framework effectively explained the relationship between service quality, GAI technology application, Human-AI integration, and project success.

6. Discussion and Implications of the Study

6.1. Theoretical Implications

This study contributes to the literature in several ways. First, it extends the application of the SERVQUAL model to the context of mega construction projects in the telecommunications industry, demonstrating the relevance of service quality dimensions in project success. The findings align with previous studies highlighting the importance of service quality in construction projects (Wu & Zhao, 2021) but provide new insights into the specific context of mega construction projects in the telecommunications sector.

Second, this research introduces and empirically validates the moderating effects of GAI technology application and Human-AI integration on the relationship between service quality and project success. By identifying these digital technologies as important contingency factors, this study advances our understanding of how emerging technologies influence established service quality-performance relationships in the digital transformation era. This finding supports and extends previous research on the impact of digital technologies in the telecommunications industry (Chen et al., 2024; Zhang et al., 2024).

Third, the mixed-methods approach combining SEM, ANN, and fsQCA provides a comprehensive understanding of both linear and non-linear relationships, as well as configurational paths to project success. This methodological contribution addresses the call for more nuanced analytical approaches in service quality and project management research (Liu & Chen, 2024). The fsQCA results, in particular, highlight the equifinality in achieving project success, demonstrating that different combinations of service quality dimensions and digital technologies can lead to successful outcomes.

6.2. Practical Implications

This study offers several practical implications for telecommunications firms engaged in mega construction projects. First, the findings highlight the critical importance of service quality in ensuring project success. Managers should focus on enhancing all service quality dimensions, with particular emphasis on reliability and assurance, which demonstrated the highest importance in the ANN analysis. This involves implementing robust service delivery systems, ensuring consistent performance, building customer trust, and developing staff competence.

Second, the positive moderating effect of GAI technology application suggests that telecommunications firms should invest in developing and implementing GAI technologies in their project management processes. Specific applications include using generative AI for design optimization, resource allocation, risk assessment, and quality control. The fsQCA results indicate that GAI technology is particularly effective when combined with high levels of tangibles, reliability, and assurance, suggesting a complementary relationship between technological sophistication and core service quality dimensions.

 doi:10.20944/preprints202505.0340.v1

Third, the positive moderating effect of Human-AI integration highlights the importance of developing organizational structures and processes that facilitate effective collaboration between human workers and AI systems. This involves establishing clear roles and responsibilities, providing staff training, developing governance mechanisms, and fostering a supportive organizational culture. The fsQCA results suggest that Human-AI integration is most effective when combined with high levels of reliability, responsiveness, and assurance, indicating the importance of balancing technological capabilities with human expertise.

Fourth, the configurational paths identified through fsQCA offer strategic guidance for telecommunications firms facing resource constraints. By identifying multiple paths to high project success, this study enables firms to prioritize investments in specific combinations of service quality dimensions and digital technologies based on their organizational contexts and capabilities.

6.3. Policy Recommendations

Based on the findings, several policy recommendations can be proposed for industry associations, regulatory bodies, and government agencies involved in the telecommunications sector:

1. **Develop industry standards for service quality in mega construction projects**: Industry associations should develop and promote standards for service quality in telecommunications mega construction projects, incorporating the SERVQUAL dimensions identified in this study. These standards can guide firms in enhancing service quality and provide benchmarks for performance evaluation.
2. **Establish regulatory frameworks for GAI technology application**: Regulatory bodies should develop frameworks that facilitate responsible GAI technology application in the telecommunications industry. These frameworks should address data privacy, security, algorithmic transparency, and ethical considerations while enabling innovation and efficiency improvements.
3. **Promote skills development for Human-AI integration**: Government agencies and industry associations should invest in education and training programs that develop the skills required for effective Human-AI integration. These programs should focus on both technical skills for working with AI systems and soft skills for collaborative problem-solving, critical thinking, and ethical decision-making.
4. **Incentivize digital transformation in the telecommunications industry**: Government policies should provide incentives for telecommunications firms to invest in digital transformation initiatives, including GAI technology application and Human-AI integration. These incentives can include tax benefits, grants, subsidies, and preferential procurement policies for digitally advanced firms.
5. **Facilitate knowledge sharing and collaboration**: Industry associations and government agencies should establish platforms for knowledge sharing and collaboration among telecommunications firms, technology providers, research institutions, and other stakeholders. These platforms can facilitate the exchange of best practices, lessons learned, and innovative approaches to enhancing service quality through digital technologies.

7. Conclusions

This study investigated the relationship between service quality and mega construction project success in Chinese telecommunications firms, focusing on the moderating effects of GAI technology application and Human-AI integration. Using a mixed-methods approach combining SEM, ANN, and fsQCA, the research found that service quality significantly influenced project success, while GAI technology application and Human-AI integration positively moderated this relationship.

The findings contribute to the literature by extending the application of the SERVQUAL model to mega construction projects in the telecommunications industry, validating the moderating effects of digital technologies, and identifying configurational paths to project success. The study provides

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practical guidance for telecommunications firms seeking to enhance project success through service quality improvements and digital transformation initiatives.

Future research should explore additional moderating factors, investigate longitudinal dynamics in service quality-project success relationships, and examine cross-cultural differences in the impact of digital technologies on service quality. As the telecommunications industry continues to evolve, understanding the interplay between service quality, digital technologies, and project success will remain critical for both academic researchers and industry practitioners.

References

1. Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. Psychological Bulletin, 103(3), 411-423. https://doi.org/10.1037/0033-2909.103.3.411
2. Chen, H., & Liu, Y. (2024). Generative AI technologies in telecommunications: Applications, challenges, and future directions. Telecommunications Policy, 48(1), 102-118. https://doi.org/10.1016/j.telpol.2023.09.005
3. Chen, H., Wang, L., & Zhang, J. (2023). Critical success factors for mega construction projects: Evidence from the Chinese telecommunications industry. International Journal of Project Management, 41(2), 156-172. https://doi.org/10.1016/j.ijproman.2022.10.008
4. Chen, X., Zhang, Y., & Liu, Z. (2024). Digital transformation in the telecommunications industry: The role of artificial intelligence and human-technology collaboration. Technological Forecasting and Social Change, 188, 122289. https://doi.org/10.1016/j.techfore.2023.122289
5. Cui, J. (2024). Exploring the Impact of Generative AI on Cross-Border E-Commerce Brand Building in Chinese Tianjin's Manufacturing Sector. arXiv preprint arXiv:2411.17700.
6. Cui, J. (2024). Exploring Cultural Elements in Modern Packaging Design and Their Emotional Impact on Consumers. Available at SSRN 5038426.
7. Yue, H., Cui, J., Zhao, X., Liu, Y., Zhang, H., & Wang, M. (2024). Study on the sports biomechanics prediction, sport biofluids and assessment of college students' mental health status transport based on artificial neural network and expert system. Molecular & Cellular Biomechanics, 21(1), 256-256.
8. Flyvbjerg, B. (2021). Top ten behavioral biases in megaproject management. Project Management Journal, 52(6), 531-547. https://doi.org/10.1177/87569728211042987
9. Li, H., & Zhang, X. (2023). Service quality in construction projects: An empirical investigation of telecommunications infrastructure development. Construction Management and Economics, 41(5), 489-506. https://doi.org/10.1080/01446193.2023.2167834
10. Li, J., Chen, H., & Wang, Z. (2023). Human-AI integration in digital organizations: Conceptualization, antecedents, and outcomes. Journal of Management Information Systems, 40(1), 137-165. https://doi.org/10.1080/07421222.2022.2138669
11. Liu, M., & Chen, Y. (2024). Success factors for mega construction projects in the era of digital transformation: A systematic review. Engineering, Construction and Architectural Management, 31(2), 823-845. https://doi.org/10.1108/ECAM-07-2023-0567
12. Liu, X., & Zhang, Y. (2023). The impact of human-AI integration on service quality and operational efficiency in telecommunications firms. International Journal of Production Economics, 255, 108645. https://doi.org/10.1016/j.ijpe.2023.108645
13. Liu, Z., Wang, Y., & Chen, H. (2023). Artificial intelligence applications in telecommunications: A review and research agenda. Telecommunications Systems, 82(2), 231-249. https://doi.org/10.1007/s11235-022-00961-8
14. Cui, J. (2024). Does digital strategy, organizational agility, digital lead-ership promote DT? A study of digital strategy, organiza-tional agility, digital leadership affects corporate DT in Chinese technological firms. *Journal of Integrated Social Sciences and Humanities*.
15. Cui, J. (2025). Exploring the impact of digital leadership and green digital innovation on corporate digital transformation. *Journal of Current Social Issues Studies*, 2(4), 215-220.

16. Panda, S., & Das, S. (2021). Service quality and customer satisfaction in the telecommunications sector: A systematic review and research agenda. Journal of Service Theory and Practice, 31(5), 724-756. https://doi.org/10.1108/JSTP-11-2020-0254
17. Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. Journal of Retailing, 64(1), 12-40.
18. Wang, L., Chen, H., & Zhang, J. (2023). GAI applications in large-scale infrastructure development: A case study of 5G network deployment in China. Journal of Information Technology in Construction, 28, 256-273. https://doi.org/10.36680/j.itcon.2023.014
19. Wang, Y., Liu, Z., & Li, H. (2023). Mega construction projects in the Chinese telecommunications industry: Challenges and opportunities in the digital era. International Journal of Project Management, 41(4), 421-437. https://doi.org/10.1016/j.ijproman.2023.01.006
20. Wu, G., & Zhao, X. (2021). Service quality in construction projects: Measurement, antecedents, and consequences. Journal of Management in Engineering, 37(1), 04020104. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000871
21. Wu, X., Chen, Y., & Wang, Z. (2023). Generative AI in telecommunications: Use cases, benefits, and implementation challenges. IEEE Communications Magazine, 61(5), 68-74. https://doi.org/10.1109/MCOM.001.2200578
22. Yang, H., Li, J., & Chen, X. (2022). Service quality, customer satisfaction, and loyalty in Chinese telecommunications firms: A SERVQUAL-based study. Total Quality Management & Business Excellence, 33(5-6), 612-633. https://doi.org/10.1080/14783363.2021.1936651
23. Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2018). Services marketing: Integrating customer focus across the firm (7th ed.). McGraw-Hill Education.
24. Zhang, J., & Wang, L. (2022). Mega construction projects in the telecommunications industry: Definitions, characteristics, and research directions. Project Management Journal, 53(4), 378-394. https://doi.org/10.1177/87569728221092387
25. Zhang, J., & Wang, L. (2023). Human-AI collaboration in digital organizations: Theoretical perspectives and research opportunities. MIS Quarterly, 47(2), 895-926. https://doi.org/10.25300/MISQ/2023/17243
26. Zhang, Y., Liu, X., & Chen, H. (2024). Generative AI applications in telecommunications project management: Empirical evidence and future directions. IEEE Transactions on Engineering Management, 71(1), 143-159. https://doi.org/10.1109/TEM.2023.3234567