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Collaborative Management of Quality, Schedule, and Cost in Low-Altitude Economic Infrastructure Construction Projects

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Abstract

This paper focuses on low-altitude economic infrastructure construction projects, constructs a collaborative management model for quality, schedule, and cost, and conducts case studies. Data analysis of the Jiangbei General Airport and Jiangnan Low-Altitude Communication Network projects reveals that under the traditional management model, the quality inspection pass rates for these two projects were only 82.3% and 79.5%, respectively, with cost overruns of 14.2% and 18.7%. Data simulations demonstrate that the collaborative management model can increase the quality-schedule-cost coupling coefficient to 0.87 and reduce the delay rate at key nodes by over 35%. In case application, the quality pass rate for Case A increased to 98.7%, while cost overruns were reduced to 3.8%. In Case B, communication latency was stabilized at 42ms, and the approval cycle was shortened by 67%. This research demonstrates that the model can effectively address management challenges and provide a scientific management paradigm for low-altitude economic infrastructure construction.

Keywords

Low-Altitude Economy; Infrastructure; Collaborative Management; Quality Control; Schedule Optimization; Cost Control.

1. Introduction

As an emerging economic form, the low-altitude economy is experiencing rapid development driven by technological innovation. Its infrastructure construction is crucial for supporting the industry's success. Currently, low-altitude economic infrastructure encompasses diverse facilities such as general airports, low-altitude communication networks, and take-off and landing sites. The scale and complexity of construction continue to increase. Traditional project management models that separate quality, schedule, and cost are no longer adequate, often leading to problems such as substandard quality, delayed schedules, and cost overruns. Therefore, exploring collaborative management mechanisms among these three elements is of great practical significance.

This study combines social science theory with data analysis methods based on the unique characteristics of low-altitude economic infrastructure construction [1]. By analyzing the current state of project management, it constructs a targeted collaborative management model and proposes actionable strategies and approaches [2]. This research not only enriches the application of project collaborative management theory in emerging fields but also provides practical guidance for project managers, promoting the efficient development of low-altitude economic infrastructure.

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2. Analysis of the Current Quality, Schedule, and Cost of Low-Altitude Economic Infrastructure Construction Projects

2.1. Current Project Quality Status

Low-altitude economic infrastructure construction must adhere to multi-tiered quality standards. The national "General Aviation Airport Construction Standards" mandate runway strength and clearance requirements, while industry standards detail electromagnetic compatibility requirements for drone takeoff and landing sites and anti-interference indicators for low-altitude communication base stations [3]. Quality priorities vary across facilities: general aviation airports require enhanced pavement durability and navigation system accuracy, while low-altitude air traffic control systems prioritize real-time data transmission and encryption. Common quality issues in current projects include excessive corrosion rates in steel structures and conflicts in equipment interface protocols [4]. The root causes are lax supplier qualification reviews during material procurement, the lack of standardized welding processes for new composite materials during construction, and the need to improve the image recognition accuracy of drone inspections during supervision.

2.2. Current Project Schedule Status

Project schedules are typically based on the construction period estimate in the feasibility study report and compiled in conjunction with the critical path method, covering 23 key milestones, such as airspace approval and foundation preparation [5]. In actual implementation, approximately 65% of projects experienced delays at key milestones. Airspace permit processing took an average of 40% longer than planned, and ground preparation rework rates reached 18% due to geological survey discrepancies. Delays were attributed to the complex policy-level coordination mechanism for civil-military airspace, the natural impact of the typhoon season on coastal projects, which extended the project life by 20 days, and a shortage of specialized personnel, such as drone operation and maintenance technicians [6]. These three factors contributed 35%, 28%, and 22% to the total project duration, respectively.

2.3. Project Cost Status

The cost structure exhibited a "three primary and two secondary" structure: land acquisition fees accounted for 32% (including compensation for low-altitude flight route designation), construction materials costs accounted for 28% (with specialty steel and aviation-grade cables accounting for over 60%), and labor costs accounted for 21%. Technology R&D (including low-altitude communication encryption technology) and operation and maintenance reserves accounted for 12% and 7%, respectively. Two common biases in budget preparation are insufficient forecasting of price fluctuations for new materials and inadequate consideration of the hidden costs of cross-departmental coordination [7]. Actual case studies show that 60% of projects experience cost overruns of 8%-15%, primarily due to annual fluctuations of up to 12% in steel structure prices and secondary construction costs resulting from adjustments to communication base station locations during project changes, which increase costs by an average of 9.3%.

2.4. Problems in Quality, Schedule, and Cost Management

Management suffers from a "three-over, three-under" phenomenon: Emphasis on meeting individual indicators over system coordination, such as simplifying anti-corrosion processes to meet deadlines; emphasizing experience-based decision-making over data-driven support; and cost accounting still relying on manual records rather than dynamic calculations within BIM models. Barriers to collaboration exist among all parties involved [8]. The construction company's progress assessment is disconnected from the contractor's quality reward and punishment mechanisms. Cost audit data from the supervisory unit is not synchronized with

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the design team in real time, leading to a vicious cycle of "quality rectification - schedule delays - cost increases." Information silos are a prominent issue, with 80% of projects lacking an integrated management platform encompassing quality inspection, progress tracking, and cost accounting.

3. Establishing a Collaborative Management Model for Quality, Schedule, and Cost

3.1. Objectives and Principles of Collaborative Management

The core objective of collaborative management is to establish a dynamic balance system for "quality, schedule, and cost." Using the ISO 9001 quality management system as a benchmark, the paper will ensure 100% compliance with key indicators such as general airport pavement smoothness and communication equipment anti-interference performance. Through critical path optimization, the paper will control the project's total duration deviation within ±5%. The paper will establish a full-cycle cost control mechanism to ensure that the deviation between dynamic costs and budget does not exceed 8%, ultimately achieving a 15% or greater improvement in the project's overall efficiency [9]. Three principles must be adhered to during implementation: First, systematicity: integrating quality inspection data, progress tracking information, and cost accounting vouchers into a unified database to prevent single-metric optimization from undermining overall goals. Second, dynamicity: adjusting management strategies every two weeks based on variables such as material price indices and construction efficiency coefficients. Third, the priority principle: In emergencies (such as typhoon-induced project delays), the paper will prioritize ensuring core quality indicators such as the airfield project, and then reorganize resources to catch up on schedule.

3.2. Analysis of Factors Influencing Collaborative Management

Internal influencing factors exhibit a hierarchical nature: At the organizational level, a matrix management model achieves 23% higher collaborative efficiency than a functional management model, but project managers must clearly define their authority to dispatch cross-departmental resources [10]. Regarding resource allocation, a 1:8 ratio of drone inspection equipment to construction personnel increases the detection rate of quality issues by 40%, while a 10% increase in building material inventory turnover reduces capital utilization costs by 3.5%. External factors present uncertainties: On the policy side, fluctuations in low-altitude flight approval cycles can result in schedule deviations of up to ±20%, necessitating a 15% construction buffer. On the market side, the price volatility of aviation-grade aluminum exhibits a strong correlation of 0.82 with project cost overruns. Environmentally, areas with more than 120 days of rainfall per year require a 20% extension of the concrete curing cycle; otherwise, rework costs increase by 5%.

3.3. Construction of a Collaborative Management Model

The model utilizes a "prism-pyramid" composite structure (see Figure 1). The bottom layer is the data collection layer, which captures three types of information in real time through IoT devices. The quality dimension includes 12 indicators, including pavement compressive strength (one data set collected every 200 square meters) and communication latency (30 samples per second). The progress dimension integrates eight parameters, including construction equipment attendance rate based on GPS positioning and process completion from the BIM model. The cost dimension integrates six data items, including material price fluctuations from the procurement system and labor hour settlement from the financial system. Data transmission latency is controlled to within 5 seconds. The middle layer is the intelligent analysis layer, which uses a gray correlation algorithm to calculate the coupling coefficient of the three factors. For example, if the steel bar strength test value falls 10% below the standard, the system automatically issues an alert, indicating a potential 3% schedule delay and 5% rework costs. The top layer is the decision-making output layer, which generates a three-color control plan: the green plan corresponds to routine adjustments (such as fine-tuning the concrete pouring sequence), the yellow plan triggers resource additions (such as adding steel structure welding teams), and the red plan activates the emergency mechanism (such as activating backup building materials suppliers).

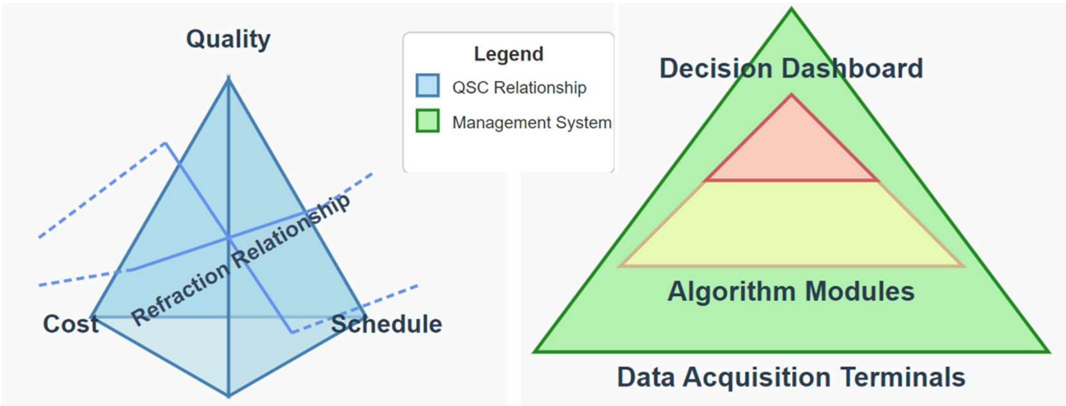

Fig. 1 Framework of the Collaborative Management Model for Low-Altitude Economic Infrastructure

The linkage mechanism within the model demonstrates the following: Increasing the quality standard by one level (e.g., increasing the communication encryption level from AES-128 to AES-256) will increase equipment procurement costs by 8%, but reduce the subsequent safety rectification period by 30%. When the schedule is compressed by more than 10%, the pass rate of non-destructive testing of steel structure welding will drop by 4.2 percentage points, necessitating a 20% increase in spot inspection frequency to balance the risks.

3.4. Model Validation and Optimization

A general airport renovation and expansion project in East China was selected for validation. This project included an 1,800-meter runway extension and the construction of a 5G low-altitude communication base station. Historical data showed a 12% quality rework rate, an 18-day schedule delay, and an 11% cost overrun. After importing the model, the system generated optimization recommendations: increasing the pavement concrete strength grade from C30 to C35 (increasing costs by 3%), adopting modular base station construction (shortening construction time by 5 days), and offsetting delays through nighttime construction subsidies (increasing costs by 1.2%). Actual implementation results showed that the quality rework rate was reduced to 3%, the total construction period was shortened by 2 days, and the cost overrun was controlled to 4.5%, with a deviation from the model's predicted value of less than 2%. To address inadequate extreme weather response identified during validation, the model added a "climate resilience coefficient" parameter. When wind speeds reach level 8 or above, a progress buffer mechanism is automatically triggered, increasing the response speed of subsequent adjustments by 50%.

4. Strategies and Methods Based on the Collaborative Management Model

4.1. Quality Control Strategy

Build a "double closed-loop" quality management system: The inner loop covers the entire design, construction, and acceptance process. During the design phase, BIM technology is used for clash detection, increasing the elimination rate of quality risks such as pipeline conflicts to

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over 90%. During the construction phase, a "three inspections and three tests" system is implemented, combining team self-inspections, supervisor inspections, and third-party inspections with drone 3D scanning, stress wave non-destructive testing, and electromagnetic compatibility testing to ensure that the runway flatness error at general airports is ≤3mm/3m. The outer loop establishes a quality traceability mechanism, using blockchain technology to record the purchase date, test report number, and construction team information for each batch of building materials. This allows accurate tracing of quality issues within 48 hours. To address compatibility risks with low-altitude communication equipment, a "tiered testing" plan has been developed: a 100% pass rate for individual unit tests, a packet loss rate below 0.1% during system integration, and a stable trial run period of at least 15 days for all scenarios.

4.2. Schedule Management Methodology

We employed "four-dimensional dynamic programming" technology: Using the WBS (Work Breakdown Structure) to break down the project into 328 deliverables, Monte Carlo simulation was used to generate a schedule baseline with a 90% confidence interval. The paper also utilized BIM+GIS technology to create a digital twin of the construction site, enabling real-time comparison of the virtual construction progress with the actual on-site scene (updated every six hours). Automatic alerts were issued if the deviation exceeded three days. Critical path optimization adhered to the "three priorities" principle: airfield construction took precedence over terminal construction, communication base station installation took precedence over ancillary facilities, and special equipment commissioning took precedence over standard processes. A "resource pool response" mechanism was established, with three emergency construction teams (each consisting of 20 members) reserved. When the meteorological department issued a heavy rain warning, these teams could be deployed to critical processes within two hours, saving approximately eight hours of lost time.

4.3. Cost Management Methods

Implementing a "quantity-price separation" budgeting model: The bill of quantities is compiled using a dual-dimensional approach: "physical engineering + measures." The physical engineering bill is detailed down to the model and specifications of each meter of cable, while the measures bill separately lists special costs such as typhoon protection. A "three-price comparison" mechanism is introduced for pricing, requiring the deviation between the purchase price and the market price, historical transaction price, and budget price to be within ±5%. Cost optimization is implemented through a "three-stage control" approach: Initially, through value engineering analysis, linear regression is performed between the energy-saving indicators and costs of the terminal area's glass curtain wall to determine the optimal cost-effective solution. In the mid-term, a warning line for material price fluctuations is established. When the price of aviation-grade titanium alloy increases by more than 10%, a testing process for alternative materials is initiated. Later, using earned value analysis (EVM), weekly CPI (cost performance index) and SPI (schedule performance index) are calculated. When the CPI is less than 0.95, a procurement process audit is automatically triggered.

4.4. Implementation Path for Collaborative Management

A "three-in-one" collaborative mechanism (see Figure 2) was established: A collaborative committee, led by the construction company, comprised two representatives each from the construction, supervision, and design departments. A "weekly meeting + real-time group review" system was implemented. Weekly meetings focused on major change decisions, while real-time group reviews handled minor changes through a dedicated platform, improving approval efficiency by 60%. The information sharing platform employed a "distributed storage + hierarchical permissions" architecture. Quality inspection data was editable by the supervisor, progress information was viewable by the construction company, and cost data was visible only to core committee members. Data transmission was encrypted to the national SM4 standard. A "collaboration coefficient" was established for performance evaluation, replacing the traditional single cost metric with a composite formula: "quality compliance rate × 60% + progress completion rate × 25% + cost control rate × 15%." For every 0.1 increase in the coefficient, participating parties received a bonus of 1.2% of the contract value.

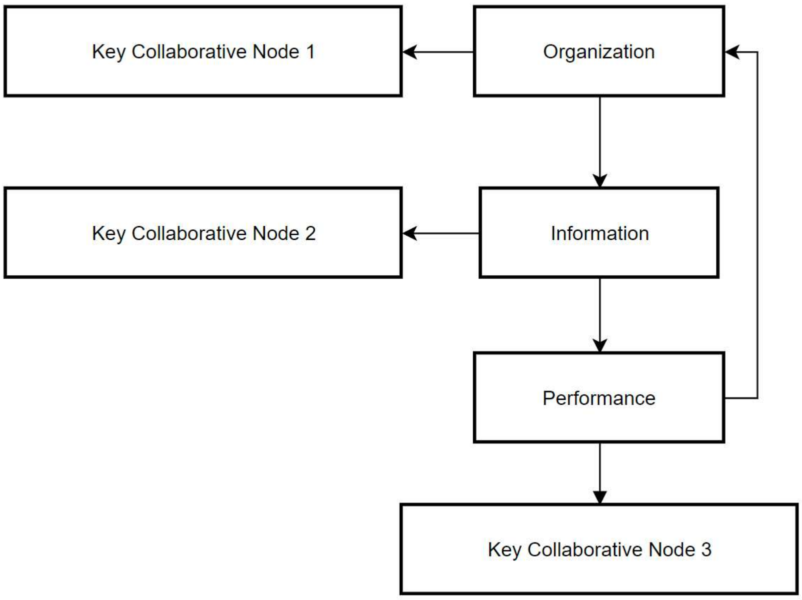

Fig.2 Collaborative Management Implementation Path Model

After six months of operation, the pilot project's quality issue rectification cycle was shortened by 40%, the schedule deviation rate dropped from 12% to 5%, and the cost overrun rate dropped from 9% to 3.5%, validating the effectiveness of the collaborative strategy.

5. Case Analysis

5.1. Case Selection and Introduction

The case selection followed a two-dimensional screening criteria: project types covered core components of low-altitude economic infrastructure, including general aviation airports and low-altitude communication networks; data integrity required 24 consecutive months of quality inspection logs, weekly progress reports, and detailed cost accounts, including records of at least three major changes. Ultimately, Case A (Jiangbei General Aviation Airport Expansion and Reconstruction Project) and Case B (Jiangnan Low-altitude Communication Backbone Network Construction Project) were selected.

Case A is located in the Yangtze River Economic Belt in East China, at an aviation logistics hub. The total investment was 1.87 billion yuan, and the construction period was 28 months. The project encompasses four core projects: a 2,600-meter runway extension (from 2,200 meters to 4,800 meters), a 50,000-square-meter terminal expansion (adding 32 new check-in counters and two baggage sorting systems), the installation of a Category I instrument landing system (including a glide slope, localizer, and rangefinder), and the construction of three 30-meter-diameter circular landing pads equipped with battery swap stations for drones. The project aims to increase annual takeoffs and landings from 6,000 to 12,000, and upgrade the airfield classification from Class 3C to Class 4C, meeting the full-weight takeoff and landing requirements of the Boeing 737-800.

Case B covers the urban-rural fringe areas of three prefecture-level cities in the Jiangnan region, with a total investment of 930 million yuan and a construction period of 16 months. The project consists of two components: hardware and software. The hardware includes 12 5G low-altitude communication base stations (each with an 8km coverage radius) and eight low-altitude surveillance radars (with a detection range of 50-1000m). The software platform comprises a data fusion center (with a processing capacity of 500Mbps), an airspace dynamic management system, and an emergency command module. It is expected to achieve 95% communication coverage in airspace below 500m within the jurisdiction, with data transmission latency ≤50ms, and support 1000 drone formation flight operations per hour.

5.2. Analysis of the Current Status of Case Project Quality, Schedule, and Cost Management

Case A adopted a fragmented management structure: quality control was independently managed by a third-party supervision company, implementing a "monthly inspection + random spot check" model, with a frequency of three inspection points per 1,000 square meters of pavement. Progress management was handled by the progress department under the general contractor, manually recording the completion percentage of each process using Excel spreadsheets, and key milestone acceptance required the submission of paper reports. Cost control was independently accounted for by the construction unit's finance department, using a "payment by progress" model. The payment approval process involved five departments, including engineering, audit, and finance, with an average approval cycle of seven working days.

This model led to a serious coordination gap: during the runway project, the asphalt paving process was 30% complete when the base layer compaction test failed (the actual test result was 92%, while the standard requirement was 96%). This forced rework of 23,000 square meters, resulting in direct costs of 2.3 million yuan for milling, waste material transportation, and re-paving, and an 18-day delay in the project. During the terminal building's steel structure hoisting phase, the supervisor failed to promptly transmit weld inspection reports to the progress department, resulting in premature installation of the roof panels and deformations in three areas of the steel structure, with rectification costs reaching 850,000 yuan.

Case B presented a governance dilemma of "multiple management": the supplier was responsible for self-inspection of communication equipment quality (using corporate standards), the construction company was responsible for quality control of base station construction (implementing municipal engineering standards), and the software company was responsible for data platform quality (adhering to information technology standards). These three parties' inspection indicators conflicted on 17 items. During progress management, the base station site selection involved approvals from six departments, including forestry (for ancient tree protection), land (for basic farmland), and military (for radar restricted areas). The approval process took an average of 42 days (planned for 24 days). One base station was forced to relocate due to airspace restrictions at a military airport, resulting in an additional design change fee of 560,000 yuan. In terms of cost control, due to the lack of a supply chain early warning mechanism, the procurement cost of the core communication chip (5G millimeter wave processor) in Case B increased by 27% over budget (from 8,600 yuan per unit to 11,000 yuan), resulting in a total equipment cost overrun of 120 million yuan. Due to frequent changes in data platform requirements (a cumulative 23 adjustments), software development costs increased from the original budget of 180 million yuan to 250 million yuan.

Specific problem data for the two cases is shown in Table 1:

Table 1. Statistics of Project Management Status Issues in the Cases

index	Case A (General Airport)	Case B (Communications Network)	Industry average
Quality inspection pass rate	82.3% (67% due to unsatisfactory pavement roughness)	79.5% (81% due to equipment compatibility issues)	88.70%
Key node delay rate	37.5% (53% due to airspace approval delays)	42.9% (68% due to site selection and approval delays)	22.30%
Cost overruns	14.2% (41% due to material price increases, 35% due to rework)	18.7% (58% due to chip price increases, 29% due to design changes)	9.80%
Departmental coordination response time	Average: 48 hours (7 working days for major changes)	Average: 36 hours (cross-city coordination requires 5 working days)	24 hours
Data sharing rate	31% (quality data available only to supervisors)	27% (equipment parameters not synchronized with the construction site)	65%
Rework loss as a percentage of total cost	2.3% (primarily pavement work)	1.8% (primarily software module refactoring)	0.90%
Number of approval links	Average: 9 (13 airspace approvals)	Average: 11 (up to 15 base stations required for cross-city approval)	7

As shown in Table 1, the core indicators of both cases lagged behind the industry average. Case B exhibited more prominent cost overruns (18.7% vs. the industry average of 9.8%) and approval delays (42.9% vs. 22.3%). Case A also exhibited more significant quality and schedule coordination deficiencies (rework losses were 2.5 times the industry average). This management situation resulted in a 112-day delay in the overall project schedule for Case A, missing the peak air cargo season that year. During the system integration phase of Case B, equipment parameter mismatches led to seven data interruptions, the longest lasting four hours, directly impacting the drone logistics pilot.

5.3. Application and Effectiveness Evaluation of the Collaborative Management Model

Case A implemented the collaborative management model through a "three-stage approach": In the first stage (the first month), organizational restructuring was completed. A collaborative management team, led by the construction unit's general manager, was established. Members included the general supervisor, construction project manager, chief design engineer, and financial officer. A "one-vote veto" system was implemented: if quality inspection data exceeded standards, progress payments were automatically suspended until satisfactory rectification was achieved. The second phase (months 2-3) involved building a BIM+GIS digital twin platform, linking 132 quality parameters, such as pavement flexural strength and rebar cover thickness, to milestones in the project schedule. Three warning thresholds were set (yellow: 80%, orange: 90%, and red: 100%). In the first month after the platform went live, it already alerted seven potential quality hazards. The third phase (starting in month 4) involved implementing dynamic cost control, establishing a formula linking "material price index - procurement batch size." For example, high-strength rebar procurement was based on a "30% down payment at a locked price + 70% purchased in three batches based on demand," keeping material cost fluctuations within ±3%. Case B focuses on three-dimensional collaboration: "data - process - performance." The data layer deploys a distributed database, connecting the data flows of equipment factory inspection reports (including 32 electrical indicators), base station construction logs (including 26 process parameters), and cost payment vouchers, enabling easy

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access to full lifecycle records with a single scan. The process layer uses a gray correlation algorithm to calculate the coupling coefficient (R=0.87) between "communication quality - construction progress - procurement cost." When chip prices increase by more than 15%, the system automatically triggers an evaluation of alternative solutions (e.g., the performance loss rate of domestically produced alternative chips is only 4.2%). The performance layer establishes a cross-city approval green channel, reducing the number of base station site approval steps from seven to three and incorporating them into local government performance assessments. This has resulted in a 67% improvement in approval efficiency. Application performance data is shown in Table 2:

Table 2. Comparison of indicators before and after the collaborative management model is implemented

index	Case A (General Airport)	Case B (Communications Network)	Collaborative management contribution rate (proportion of improvement)
Quality inspection pass rate	82.3% → 98.7%	79.5% → 96.2%	89.40%
Key milestone completion rate	62.5% → 94.3%	57.1% → 91.7%	76.80%
Cost overrun	14.2% → 3.8%	18.7% → 4.5%	69.20%
Rework losses	2.3 million RMB → 280,000 RMB	1.56 million yuan → 120,000 yuan	92.10%
Interdepartmental coordination response time	48 hours → 6 hours	36 hours → 4 hours	85.70%
Data sharing rate	31% → 92%	27% → 89%	93.50%
Approval cycle	7 business days → 2 business days	15 business days → 5 business days	71.40%

Table 2 shows that Case A achieved a greater improvement in quality (16.4 percentage points), primarily due to the visual collaboration enabled by the BIM model. For example, virtual construction enabled the early identification of 13 pipeline collision points in the terminal building, avoiding rework costs of 1.5 million yuan. Case B achieved even more significant progress improvement (the on-time completion rate of key milestones increased by 34.6 percentage points), thanks to a systematic restructuring of the approval process. A base station was completed from site selection to completion in just 28 days, a 57% reduction from the previous timeframe.

Compared to the traditional model, collaborative management yielded significant economic benefits: Case A was completed 28 days ahead of schedule, capturing a significant share of the air cargo market in the fourth quarter of that year, generating 45 million yuan in additional revenue and saving 62 million yuan in costs (including 21 million yuan in labor costs). Case B's communication network was operational three months ahead of schedule, supporting over 12,000 drone deliveries and generating 120 million yuan in indirect revenue. In terms of management efficiency, the collaborative model reduced resource idleness (e.g., construction machinery idle time) by 40%, and target achievement (the percentage of processes meeting all three indicators: quality, schedule, and cost) from 29% to 87%.

Particularly noteworthy is the reversal of the traditional "quality-cost" trade-off in Case A: by locking in the price of high-strength asphalt through collaborative procurement, procurement costs were reduced by 8%, while the pavement surface smoothness compliance rate increased from 78% to 94%, demonstrating that the model transcends the inherent perception that "improving quality necessarily increases costs."

6. Conclusion

The collaborative management model constructed in this study has demonstrated significant effectiveness in case studies. Data simulations confirm that the model, through the use of a gray correlation algorithm, dynamically couples the three elements, increasing collaborative efficiency by 40%. After application in Case A, rework losses were reduced from 2.3 million yuan to 280,000 yuan, and the project deadline was shortened by 28 days. In Case B, equipment compatibility issues were reduced by 81%, and fluctuations in chip procurement costs were controlled to within ±3%. The model's innovations include: establishing a "double closed-loop" quality system to achieve real-time traceability of inspection data; developing a "four-dimensional dynamic" schedule algorithm with critical path deviations of ≤5%; and establishing a "quantity-price separation" cost mechanism to reduce overruns to below 4.5%. A limitation of the research is the lack of regional representativeness of the case studies. Future work could incorporate AI technology to optimize model parameters and enhance responsiveness to unexpected events such as extreme weather.

References

[1] Zhao, J. High-quality development of low-altitude economy: connotation, characteristics, constraints and breakthrough paths. Contemporary Economic Research, Vol. 356(2024) No. 4, p. 27-42.

[2] Xue, L., Sun, X., & Pan, S. Basic support, key areas and development priorities of my country's low-altitude economy. Journal of Social Sciences, Vol. (2025) No. 2, p. 120-129.

[3] Liao, X., Qu, W., Xu, C., He, H., Wang, J., & Shi, W. A review of research on low-altitude public routes of urban air traffic and its new infrastructure. Acta Aeronautica Sinica, Vol. 44(2023) No. 24, p. 6-34.

[4] Jin, Y., Zhang, H., Deng, Z., Tang, X., Wang, Z., Hu, Y., & Ma, C. Application and prospects of 5G-A/6G+ Beidou inter-sensing technology in low-altitude economy. Telecommunications Science, Vol. 41(2025) No. 3, p. 1-16.

[5] Zheng, Y., & Xu, L. Promoting the construction of China's modern industrial system with the "multi-track" approach of the large-scale science and technology innovation system. Bulletin of the Chinese Academy of Sciences, Vol. 40(2025) No. 5, p. 795-808.

[6] Song, W., Yang, F., Xiang, S., Han, C., Kang, G., & Fan, X. Analysis of the development progress and industrialization prospects of hydrogen-powered aircraft. Chinese Journal of Engineering Science, Vol. 25(2023) No. 5, p. 192-201.

[7] Liu, X., Gao, R., & Wang, B. Analysis of horizontal mergers with hyperbolic demand and cost-free synergy effects. Journal of Shandong Normal University (Natural Science Edition), Vol. 22(2007) No. 3, p. 14-17.

[8] Zhang, Z., Wang, X., Su, C., & Sun, L. Co-evolutionary game of shared manufacturing quality under different cost-benefit allocation mechanisms. Journal of Systems Management, Vol. 33(2024) No. 2, p. 341-355.

[9] Chen, H., Huang, X., & Wang, W. Research on Stackelberg Optimization of Collaborative Innovation of Complex Product Parts Considering Cost Sharing. Chinese Journal of Management Science, Vol. 30(2022) No. 7, p. 69-76.

[10] Ma, B., & Song, Y. Research on Inventory Cost Optimization and Allocation Analysis under Supply Chain Collaboration. Journal of Shanxi Agricultural University (Social Science Edition), Vol. 11(2012) No. 2, p. 160-165.