

# A Study on Key Issues in the Regulatory Oversight of PPP Projects During the Operational Phase: A Case Study of the Hangzhou Bay Cross-Sea Bridge

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**Abstract:** The Public-Private Partnership (PPP) model plays a significant role in infrastructure provision. Currently, China has gradually shifted from a focus on “construction over operation” to “full life-cycle management,” yet many shortcomings remain in operational phase supervision. Using the Hangzhou Bay Cross-Sea Bridge PPP project as a case study and drawing on international experience, this paper systematically analyzes key issues in the supervision of China’s PPP projects during the operational phase. The study finds that China faces issues such as unreasonable risk-sharing mechanisms, a disconnect between performance evaluation and payment mechanisms, unclear responsibilities among regulatory bodies during the operational phase, a lack of full life-cycle management, and an imperfect legal and institutional framework. By comparing China’s approach with the UK’s PPP regulatory model, this paper proposes countermeasures including establishing a dynamic risk-sharing mechanism, improving a performance-oriented payment system, strengthening full life-cycle supervision, and enhancing the professionalization of regulatory practices. This research holds significant theoretical and practical implications for optimizing the governance of China’s PPP projects.

**Keywords:** PPP; Operational Phase Supervision; Risk Sharing; Performance Management; Hangzhou Bay Bridge

## 1. Introduction

As a key institutional arrangement for public-private partnerships (PPPs), the PPP model has remained a hot topic in the public utilities sector in recent years. The implementation of this model has injected strong

momentum for sustainable development into the public sector and has become a vital method for global infrastructure provision. However, as PPP projects gradually transition from the construction phase to the operational phase, regulatory issues have gradually come to light. In China, PPP regulation has long exhibited a structural tendency to “prioritize pre-project approval over post-project operation,” resulting in weak operational-phase regulatory mechanisms that struggle to ensure the quality of public services and the sustainability of projects. Meanwhile, as the proportion of existing PPP projects increases, operational-phase regulatory issues have become a key bottleneck constraining the high-quality development of the PPP model.

In contrast, mature PPP systems, exemplified by the United Kingdom, have established regulatory frameworks centered on performance-based outcomes, contract-based governance, and full-lifecycle management. Therefore, examining China’s operational-phase PPP regulatory challenges from an international perspective and exploring pathways for localized optimization holds significant theoretical and practical significance.

Based on this, this paper takes the Hangzhou Bay Cross-Sea Bridge as a case study and, through systematic literature review and international comparative analysis, explores the key issues and optimization pathways for the operational phase supervision of PPP projects.

## 2. Literature Review

### 2.1 Research Progress on PPP Project Operational Phase Regulation

#### 2.1.1 Research on risk sharing and dynamic management

Existing research generally agrees that risk allocation is one of the core issues in the operational phase supervision of PPP projects.

Existing literature explores aspects such as risk identification, allocation methods, and dynamic adjustment mechanisms. Rybníček et al. pointed out through a systematic review that operational risks have become a key factor affecting the performance of PPP projects, particularly in the field of transportation infrastructure [1]. Jiang et al. further found that while existing research provides a relatively comprehensive classification of risk types, there are still significant shortcomings regarding risk dynamic adjustment mechanisms [2].

Domestic scholars, on the other hand, tend to approach the issue from the perspective of institutional practice, emphasizing the rationality and adaptability of risk sharing. Wang Shouqing and Zhang Shuibo point out that risk allocation should follow the principle that “risks should be borne by the party best capable of bearing them,” but in practice, it often suffers from being fixed in the early stages and lacking dynamic adjustment [3]. Overall, existing research has recognized the importance of dynamic risk management, but further exploration is needed regarding specific implementation pathways.

#### 2.1.2 Research on performance evaluation and incentive mechanisms

In terms of performance management, research has primarily focused on the construction of evaluation systems and the design of incentive mechanisms. Du et al. developed a performance evaluation model based on service quality and operational efficiency, emphasizing the need to shift from single economic indicators to comprehensive service indicators [4]. Jokar et al., on the other hand, incorporated risk factors into the performance evaluation system using a fuzzy multi-criteria approach, thereby achieving a synergistic analysis of risk and performance [5]. Domestic research has placed greater emphasis on the interrelationship between performance evaluation and payment mechanisms. Shi et al. pointed out that in PPP projects, if the payment mechanism fails to effectively reflect performance or effort levels, it will weaken the incentive effect and may even lead to efficiency losses [6]. Liu Wei further noted that China’s PPP projects generally suffer from issues such as formalistic performance assessments and insufficient enforceability [7]. Overall, research on performance management is gradually shifting from “evaluation tools” to “incentive mechanisms.”

#### 2.1.3 Research on institutional governance and

lifecycle management

From the perspective of institutions and governance, regulatory oversight during the operational phase of PPP projects is increasingly being incorporated into a full life-cycle analysis framework. Grimsey and Lewis noted early on that a sound institutional system is key to ensuring the long-term performance of PPPs [8]. Yescombe further emphasized the foundational role of the legal environment in contract enforcement and risk sharing [9].

As research has deepened, scholars have begun to focus on lifecycle governance issues. Bao et al. noted that existing research is overly concentrated on the construction phase, while paying insufficient attention to the operational phase [10]. Ke Hong and Wang Shouqing proposed that a regulatory mechanism spanning the entire lifecycle should be established to avoid governance failures caused by fragmented phases [11]. Overall, institutional research is evolving from static institutional design toward dynamic governance mechanisms.

## 2.2 Literature Review

A synthesis of domestic and international research reveals that existing literature has conducted relatively systematic explorations of PPP project operational phase regulation from multiple dimensions, including risk management, performance evaluation, and institutional design. However, the following shortcomings remain:

First, research perspectives remain relatively fragmented, lacking a unified analytical framework;

Second, there remains a significant lack of attention to oversight during the operational phase;

Third, research on adapting international experiences to the Chinese context needs to be strengthened;

Fourth, empirical research on existing PPP projects is relatively scarce.

Therefore, building upon existing research, it is necessary to integrate the three theoretical dimensions of “risk sharing-performance management-full life-cycle governance” to construct a systematic analytical framework, and to enhance theoretical explanatory power and practical relevance through case studies of typical projects.

## 3. Analysis of the Underlying Mechanisms of the Current Status and Issues in the

## Operational Phase Supervision of China's PPP Projects

### 3.1 Structural Characteristics of the Current Regulatory Landscape

There is a marked imbalance in the allocation of regulatory resources across different stages of China's PPP projects, with oversight during the operational phase being relatively weak. This phenomenon stems from the long-term effects of institutional arrangements and governance preferences.

In practice, regulatory focus is concentrated on early-stage processes such as project approval, financing design, and construction process control, as these are highly observable and easy to evaluate. In contrast, the operational phase is characterized by long durations, high environmental uncertainty, and performance lag, making regulation more challenging.

Driven by resource constraints and a risk-averse orientation, the regulatory focus has gradually shifted toward earlier stages, creating path dependence and resulting in structural imbalances across the time dimension. From a governance perspective, the current model remains dominated by administrative control, emphasizing procedural compliance while lacking sufficient contract enforcement and market discipline, thereby weakening the institutional support for the operational phase.

### 3.2 The Internal Generation Mechanisms of Core Operational Phase Issues

From a mechanism-based perspective, this paper categorizes operational phase issues into three dimensions: risk sharing, performance incentives, and information mechanisms. At their core, these issues stem from mechanism failure and their interplay.

**3.2.1 Imbalance in risk sharing:** the conflict between contractual rigidity and environmental uncertainty

Risks in PPP projects are typically allocated through contracts during the signing phase; however, uncertainties such as demand fluctuations and policy changes during the operational phase render the original allocation unsustainable.

In the absence of adjustment mechanisms, the risk structure gradually deviates: the private sector bears risks exceeding expectations, while the government compensates through subsidies and other means, increasing fiscal pressure.

Therefore, the crux of the problem lies not in the initial allocation but in the lack of dynamic adjustment capabilities.

**3.2.2 Weakened performance management:** insufficient transmission of incentive mechanisms

The effectiveness of performance management depends on whether evaluation results can be translated into behavioral constraints; however, in reality, this transmission chain is weakened. First, performance indicators tend to emphasize quantifiable metrics while neglecting critical dimensions such as service quality. Second, there is insufficient linkage between performance outcomes and payments. Third, the enforcement of rewards and penalties is limited. Consequently, operators tend to prioritize cost control over service improvement, resulting in the failure of incentive mechanisms.

**3.2.3 Disrupted lifecycle:** fragmented governance due to institutional segregation

In practice, PPP projects are segmented into distinct phases, each managed by different departments. In the absence of coordination mechanisms, this often leads to poor information flow and unclear accountability. Decision-making information from the early stages fails to carry over to the operational phase, and insufficient coordination among stakeholders makes the operational period a weak link in oversight, thereby undermining the effectiveness of full-lifecycle governance.

**3.2.4 Constraints on regulatory capacity:** insufficient expertise and mismatch with complexity

PPP projects involve multidisciplinary knowledge and place high demands on regulatory capabilities; however, current deficiencies persist in terms of professional expertise and technical support. On the one hand, there is a shortage of multidisciplinary talent; on the other hand, the lack of data platform support means that regulation still relies on experiential judgment. This mismatch between regulatory capabilities and project complexity undermines the effectiveness of oversight.

**3.2.5 Insufficient external oversight:** weakening of public constraint mechanisms

Insufficient information disclosure limits public and third-party participation, thereby weakening the role of external oversight. In the absence of external constraints, internal regulatory pressure decreases, which may induce moral hazard behavior and adversely affect governance

transparency and overall performance.

### 3.3 Mechanism Integration and Analytical Framework

Issues during the PPP operational phase are essentially the result of the failure of multiple mechanisms to function in tandem. Imbalances in risk sharing affect revenue expectations and weaken incentive mechanisms; insufficient incentives lead to behavior deviating from public objectives; and defects in information mechanisms further amplify these problems, making it difficult for oversight to function in a timely manner. Therefore, it is necessary to construct an analytical framework that integrates “risk-incentive-information” to understand the logic behind the formation of these issues from a holistic perspective.

## 4. Mechanism Deepening through Case Analysis: Hangzhou Bay Bridge

### 4.1 The Logic Behind Case Selection

As one of China’s earliest large-scale transportation infrastructure projects to adopt market-oriented operations, the Hangzhou Bay Cross-Sea Bridge holds significant typological value in PPP practice. With its massive investment scale, long project cycle, and complex governance structure involving the government, private capital, and financial institutions, the project comprehensively reflects the institutional characteristics of the PPP model [8].

From a temporal perspective, the project has entered a relatively long operational phase, and issues regarding the adaptability of institutional arrangements in a dynamic environment have gradually emerged. Compared to projects in the construction phase, the operational phase is more likely to expose underlying issues in risk sharing, performance constraints, and regulatory enforcement, thereby offering greater analytical value.

At the same time, transportation infrastructure projects rely heavily on traffic forecasts, and their revenues are significantly influenced by factors such as the regional economy and travel demand, resulting in high uncertainty. Coupled with their public service nature, which demands high standards for safety and service quality, the operational phase faces multiple constraints. These characteristics enhance the representativeness of the case [9].

Methodologically, this case exhibits a certain “magnification effect,” meaning that institutional problems tend to accumulate and become more apparent over the long term. Analyzing this case not only helps understand the operational logic of this specific instance but also aids in identifying common issues during the operational phase of PPP projects [12].

### 4.2 The Practical Evolution of Risk-Sharing Mechanisms

#### 4.2.1 Traffic uncertainty and revenue volatility

Transportation PPP projects typically base traffic forecasts on macroeconomic conditions, regional planning, and population mobility; however, these forecasts inherently carry significant uncertainty [10].

During the operation of the Hangzhou Bay Bridge, factors such as regional economic restructuring, modal shift, and policy changes may all cause actual traffic volumes to deviate from expectations. When traffic falls short of projections, revenue declines, while operating and maintenance costs remain fixed, placing pressure on the revenue structure.

Consequently, the contradiction between revenue volatility and cost rigidity gradually emerges, increasing uncertainty risks for the private sector. This indicates that relying solely on preliminary forecasts for risk allocation is insufficient to account for dynamic changes during the operational phase.

#### 4.2.2 Practical constraints on risk reallocation mechanisms

In theory, PPP projects should have a certain degree of flexibility to adjust for risks in response to changes in the external environment. In practice, however, due to factors such as contractual rigidity, procedural complexity, and unclear delineation of responsibilities, relevant mechanisms often fail to function effectively in a timely manner.

In this case, when project operations deviate from expectations, risks cannot be reallocated through institutionalized channels. On the one hand, the private partner bears significant operational pressure; on the other hand, the government may provide support through subsidies or other means.

Such adjustments rely more on non-institutional arrangements than on established rules, leading to a shift in the risk-sharing structure during operation. This reflects a lack of flexibility in the mechanism, making it difficult to adapt to

environmental changes [1].

### **4.3 Behavioral Feedback Pathways in Performance Management Mechanisms**

#### **4.3.1 Discrepancies between performance indicators and public objectives**

In the operation of the Hangzhou Bay Bridge, although a performance evaluation system has been established, the design of performance indicators remains limited. Existing indicators focus primarily on easily quantifiable aspects such as traffic efficiency and toll levels, while paying insufficient attention to critical dimensions such as service experience, safety management, and long-term maintenance [2].

Due to the uneven coverage of evaluation dimensions, performance results struggle to comprehensively reflect the project's operational status. As a result, the operating entity tends to prioritize meeting assessable indicators while underinvesting in areas with strong public service attributes but that are difficult to quantify, leading to a divergence between performance objectives and public goals.

#### **4.3.2 Limited impact of performance results on revenue distribution**

Whether performance management can serve as an effective constraint depends crucially on its linkage with revenue distribution. Although this project has established a performance evaluation mechanism, its results have a relatively limited impact on revenue, resulting in insufficient constraints.

Under this institutional arrangement, the impact of different performance levels on revenue is not significant, thereby weakening the incentive function of performance evaluation. In the long term, this will reduce the operator's motivation to continuously improve service quality, reflecting the inadequacy of the performance mechanism in transmitting incentives [5].

#### **4.3.3 Insufficient long-term incentives and behavioral convergence**

Given the long operational cycle of PPP projects, the effectiveness of performance constraints will diminish over time in the absence of stable, long-term incentive mechanisms. In this case, as operations progressed, the marginal impact of performance evaluations gradually weakened.

Against this backdrop, operators tend to maintain the minimum compliance standards rather than continuously optimize service quality, resulting in a "compliance-oriented" behavioral pattern. This trend indicates that without

sustained incentives, performance management struggles to establish long-term behavioral constraints.

### **4.4 The Logical Basis for Information Mechanisms and Regulatory Lags**

#### **4.4.1 Lags in information acquisition methods**

Current regulation primarily relies on information obtained through periodic reporting and on-site inspections. While this can reflect basic operational conditions, there is a significant time lag [4]. For transportation projects where operational conditions change rapidly, untimely information updates will affect the assessment of project status, thereby reducing the effectiveness of regulatory decisions. Therefore, the lag in information acquisition methods is a key factor constraining regulatory efficiency.

#### **4.4.2 Data dispersion and difficulties in information integration**

Operational data for PPP projects is distributed across different entities, and the lack of a unified integration platform results in limited information sharing. In this case, although various types of operational data objectively exist, insufficient cross-departmental integration capabilities make it difficult for regulatory agencies to obtain complete information, thereby limiting the depth and efficiency of regulatory analysis.

#### **4.4.3 Information asymmetry and potential behavioral bias**

Operators hold an advantage in accessing information, while regulators have relatively limited sources, creating a structure of information asymmetry. Under these circumstances, regulators struggle to promptly grasp the true operational status, and operators may make strategic adjustments based on their own interests, such as lowering maintenance standards or delaying investments [13]. This mechanism not only affects the effectiveness of regulation but may also have adverse effects on the long-term operation of the project.

### **4.5 Coordination Dilemmas in Multi-Stakeholder Governance Structures**

4.5.1 Coordination issues within the government  
PPP projects involve multiple government departments with clearly defined responsibilities at different stages; however, in the absence of a unified coordination mechanism, overlapping responsibilities and unclear boundaries are likely

to arise. In practice, this manifests as complex decision-making processes, inefficient information flow, and even instances of buck-passing, thereby undermining the effectiveness of regulatory enforcement.

#### 4.5.2 The Impact of the government's dual role in government-enterprise relations

Under the PPP model, the government assumes both regulatory responsibilities and, to a certain extent, shares in risk-bearing. This dual role may influence regulatory behavior. When a project faces operational pressures, the government must balance maintaining project stability with strict regulation, which may weaken regulatory independence and consequently affect the effectiveness of institutional enforcement.

#### 4.5.3 Insufficient public oversight

Although PPP projects possess public attributes, the level of participation by the public and third-party institutions remains limited, and insufficient information disclosure constrains the effectiveness of external oversight [14]. In the absence of external oversight, regulation relies primarily on internal government systems, reducing the diversity and effectiveness of constraints. Therefore, enhancing information transparency and the level of public participation is of great significance.

### 4.6 Comprehensive Analysis of Case Mechanisms

Through a systematic analysis of the Hangzhou Bay Cross-Sea Bridge, the issues during its operational phase can be attributed to the coupling failure of three core mechanisms:

#### 4.6.1 Risk mechanism: the cumulative effect of risk in the absence of dynamic adjustment

In the case of the Hangzhou Bay Cross-Sea Bridge, the core of the risk issue lies not in an unreasonable initial allocation, but in the lack of a dynamic adjustment mechanism. When changes occur in traffic volume, regional development, and the policy environment, the original contract struggles to be revised in a timely manner, leading to risks gradually deviating from the initial allocation structure. Specifically, this manifests as follows: deviations in traffic forecasts lead to declining revenues, while cost rigidity causes risks to continuously concentrate on the social capital; simultaneously, the government assumes part of the ultimate liability through implicit means, creating a pattern where "explicit risks are marketized, while implicit risks are

governmentized."

Therefore, the essence of this mechanism lies in the fact that static contracts cannot adapt to a dynamic environment, causing risks to accumulate and become unbalanced during operation.

#### 4.6.2 Incentive mechanism: behavioral deviations under weak performance constraints

The failure of the incentive mechanism is primarily manifested in the lack of substantive linkage between performance evaluation and revenue distribution. In this case, although performance evaluations exist in form, their results have limited impact on payments, making it difficult to establish effective constraints.

Against this backdrop, the operating entity tends to adopt a "cost-control-oriented" strategy—that is, reducing inputs while meeting basic assessment requirements, rather than proactively improving service quality. This behavioral choice is not an individual error but the result of the incentive structure. Therefore, the core issue of this mechanism lies in the breakdown of the incentive transmission chain, which prevents performance from being translated into behavioral constraints.

#### 4.6.3 Information mechanism: regulatory lag amid information asymmetry

Issues with the information mechanism primarily manifest in two aspects: delayed information acquisition and data fragmentation. Regulatory authorities primarily rely on periodic reports for information, lacking real-time data support, which results in significant lag in regulatory actions.

At the same time, operational data is scattered across different entities, and the absence of a unified integration platform further exacerbates information asymmetry. Under these conditions, regulators find it difficult to identify problems in a timely manner, while operators may exploit their information advantage to engage in strategic behavior.

Therefore, this mechanism essentially manifests as: insufficient information-gathering capabilities undermine the timeliness and effectiveness of regulation.

### 4.7 Case Mechanism Model Diagram

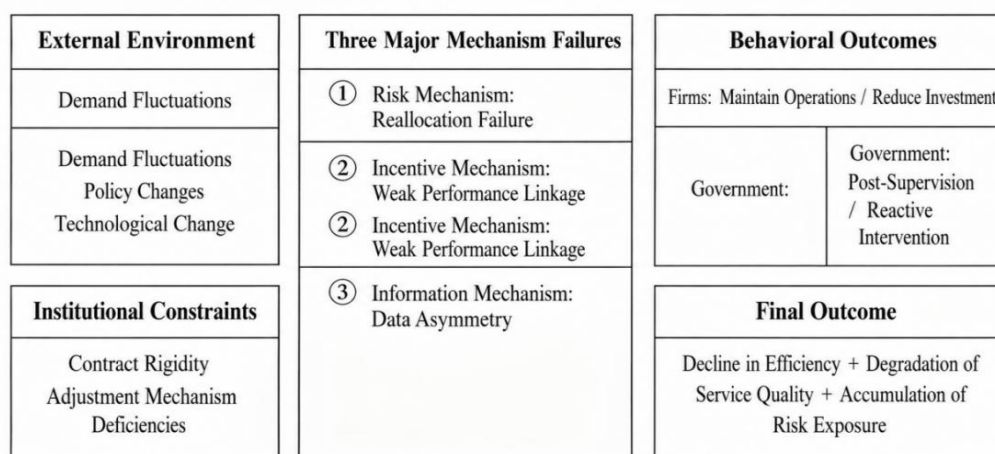
To illustrate more intuitively the relationships among the issues faced by the Hangzhou Bay Bridge during its operational phase, Figure 1 has been created. The figure categorizes relevant issues into three aspects—risk sharing,

performance management, and information acquisition-and demonstrates their mutual influence in actual operation.

As shown in the figure, the lack of flexibility in risk sharing allows risks to gradually accumulate over the long term, thereby affecting project returns; although performance evaluation exists, its limited connection to returns results in a

restricted constraining effect on operational behavior; simultaneously, the relatively lagging methods of information acquisition also impact the timeliness of regulatory judgments. These factors interact in actual operation, causing project issues to exhibit a pattern of continuous accumulation.

**Configuration Model**



**Figure 1. Mechanism Model of Operational Issues in the Hangzhou Bay Cross-Sea Bridge PPP enforcement constraints [12].**

## 5. The Institutional Essence of International Experience: An Analysis of the Logic Behind the UK PPP Model

### 5.1 The Institutional Logic of the UK PPP Regulatory System

As one of the key birthplaces of the PPP model, the UK has gradually developed a relatively mature regulatory framework for the operational phase through long-term practice. Essentially, this system does not rely on a single institutional advantage but rather builds a complete governance loop through the coordinated operation of multiple mechanisms [8].

First, at the institutional foundation level, the UK provides a stable institutional environment for PPP project operations through a comprehensive legal framework and standardized contract templates. This institutional arrangement effectively reduces uncertainty and provides reliable support for contractual governance [9].

Second, in terms of governance approaches, the UK has gradually shifted from a traditional administrative control model to a “contract-based governance model,” which centers on contracts. This model achieves continuous regulation of operational conduct through ex ante rule design and ex post

### 5.2 Analysis of Core Mechanisms

5.2.1 Contractual governance mechanisms: from legal tools to governance vehicles

In UK PPP practice, contracts serve not only as legally binding instruments but also play a central role in project governance. By clearly defining risk allocation, performance standards, and liability for breach in the contract, the behavior of all participating parties is incorporated into an institutionalized framework, thereby reducing the impact of uncertainty on project operations [10].

Unlike approaches that rely solely on administrative oversight, this contract-based governance model emphasizes regulating behavior through ex ante rule design and establishing continuous constraints during implementation. Within this framework, contracts are no longer merely static documents but serve as vehicles for governance throughout the entire project lifecycle, helping to enhance the stability and predictability of the system’s operation.

5.2.2 Performance-based payment mechanisms: the integration of incentives and constraints

Regarding payment mechanisms, UK PPP projects generally adopt payment methods directly linked to service performance, such as

“Availability Payments” or performance-based payment models [1]. Government payment levels are adjusted based on the project’s actual operational performance, thereby establishing a close link between revenue and service quality. Under this institutional arrangement, the operator’s revenue no longer depends solely on a fixed return stipulated in the contract but is directly linked to its service performance. When service quality changes, payment levels are adjusted accordingly, and these changes further impact the operator’s revenue. In the long term, this arrangement encourages operators to prioritize service quality while pursuing revenue, thereby establishing a relatively balanced relationship between incentives and constraints.

### 5.2.3 Dynamic adjustment mechanism: adaptive institutional design

Given the long operational lifecycle of PPP projects, the UK has incorporated flexibility into its institutional design to address the impacts of changes in the external environment [2]. Under specific conditions, project parties may adjust or renegotiate contract terms in accordance with established procedures, thereby enabling the institutional framework to adapt to new operational environments.

Such adjustments do not negate the original contractual relationship but rather constitute limited modifications within the existing regulatory framework. By maintaining a balance between stability and flexibility, this approach avoids the uncertainty caused by frequent changes while preventing the system from becoming overly rigid and losing its adaptability. Consequently, this mechanism plays a crucial

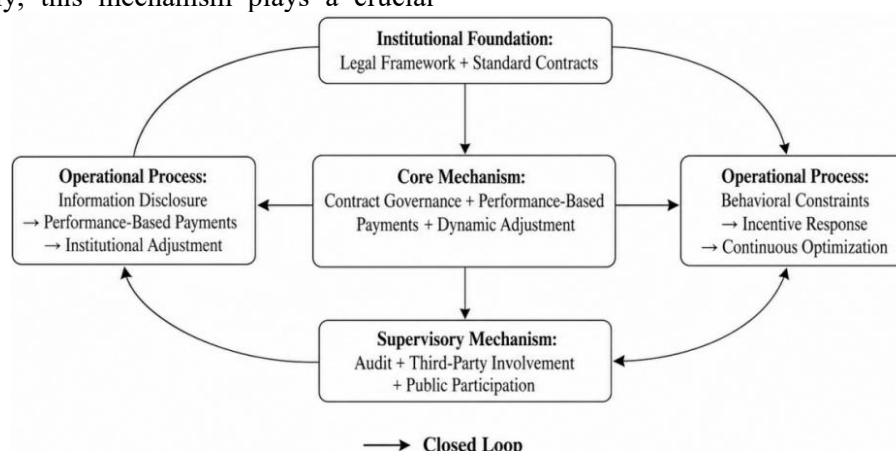
role in ensuring the long-term operation of projects.

### 5.2.4 Multi-stakeholder oversight mechanism: strengthening external constraints

In terms of the regulatory framework, the UK has established a relatively comprehensive, multi-tiered oversight system by introducing various entities, including audit bodies, independent regulatory agencies, and public participation [5]. These different entities each have distinct characteristics regarding information access and oversight methods, which helps foster complementary relationships. With relatively comprehensive information disclosure, project operations become accessible to a wider range of stakeholders, providing the foundational conditions for external oversight. As the number of participating entities increases, oversight sources become more diverse, which can to some extent compensate for the potential limitations of a single regulatory body. At the same time, multi-stakeholder participation strengthens constraints on potential non-compliant behavior, thereby enhancing the overall effectiveness of regulation.

## 5.3 The “Closed-Loop Mechanism Model” of UK PPP Regulation

To summarize the regulatory practices for UK PPP projects during the operational phase, this paper has compiled Figure 2 to present an overview of the key institutional arrangements. The figure primarily covers contract management, performance-based payments, dynamic adjustments, and external oversight.



**Figure 2: Closed-Loop Model of the UK PPP Operational Phase Regulatory Mechanism**

As shown in the figure 2, UK practice places greater emphasis on clarifying the responsibilities of all parties through contracts and directly linking performance outcomes to

payments, ensuring that service quality influences revenue levels. At the same time, a certain degree of flexibility is maintained during project operations to adapt to changes in the



external environment. Furthermore, constraints on project operations are strengthened through various means, such as audit bodies and public oversight. The combined effect of these practices helps maintain the long-term stable operation of projects.

#### 5.4 Comparison Between China and the UK: The Essence of Mechanism Differences

A comparison reveals that the differences in PPP operational phase regulation between China and the UK primarily manifest at the institutional level, rather than in individual regulatory elements [4]:

**Table 1: Differences in Mechanisms Between China and the UK**

| Dimension           | UK                              | China              |
|---------------------|---------------------------------|--------------------|
| Governance Logic    | Contract-based                  | Administrative-led |
| Risk Mechanism      | Dynamic Adjustment              | Static Allocation  |
| Incentive Mechanism | Strong coupling                 | Weak Association   |
| Lifecycle           | Integration                     | Segmentation       |
| Supervisory System  | Multi-stakeholder participation | Government-led     |

As shown in Table 1, the UK places greater emphasis on regulating project operations through contractual arrangements and demonstrates greater flexibility in risk sharing and performance management; China, on the other hand, relies more heavily on administrative management approaches and still has room for improvement in risk adjustment and performance constraints.

Overall, the UK places greater emphasis on the coordination between different systems during project operations, ensuring that various arrangements work in tandem; whereas in China's actual implementation, the links between some systems are not sufficiently tight, which to some extent affects the effectiveness of supervision.

#### 5.5 Implications for China's Mechanisms

Based on the above analysis, the regulation of China's PPP operations during the operational phase requires a fundamental shift in governance logic-transitioning from an "administrative control-oriented" approach to a "mechanism-driven" one. The core pathways for this transformation include: strengthening contractual governance, establishing a closed-loop system of incentives and constraints,

introducing dynamic adjustment mechanisms, and promoting a diversified supervision system. This transformation is not merely a matter of institutional optimization but also a shift in governance philosophy [13].

### 6. Policy Recommendations and Research Conclusions

#### 6.1 Policy Recommendations: Optimization Pathways Based on Mechanism Reconstruction

As the preceding analysis indicates, the primary issues in the operational phase of China's PPP projects center on inflexible risk-sharing, weakened incentive mechanisms, and insufficient information support, with these three factors interacting during project implementation. Therefore, it is necessary to conduct systematic optimization centered on key mechanisms.

##### 6.1.1 Establishing an adaptive risk-sharing mechanism

To address the issue of static risk allocation, a dynamic adjustment mechanism should be introduced to allow risk allocation to be revised in response to environmental changes. Clear adjustment clauses can be included in contracts, using factors such as changes in traffic volume, revenue, or policy as trigger conditions to initiate redistribution procedures. At the same time, the renegotiation process should be standardized, and the boundaries of rights and responsibilities clarified to enhance the enforceability of the system. Through these measures, risk allocation can be transformed from a one-time configuration to dynamic optimization, thereby alleviating the problem of risk accumulation.

##### 6.1.2 Strengthening the linkage between performance evaluation and payment mechanisms

Performance management should strengthen the constraining effect of evaluation results on behavior, with the key lying in enhancing the link between performance and revenue distribution. On the one hand, the indicator system should be optimized to include assessments of service quality and long-term operational performance; on the other hand, the impact of performance outcomes on payments should be increased, and the enforcement of rewards and penalties should be strengthened. By establishing a stable incentive mechanism, operators can be guided to shift their focus from

cost control to improving service quality.

#### 6.1.3 Promoting the development of an integrated full-life-cycle regulatory system

To address the issue of institutional fragmentation, regulatory oversight should be transformed into an integrated, full-lifecycle system. This can be achieved by establishing a unified coordination mechanism to strengthen the connection between different stages and by creating a cross-departmental data-sharing system to ensure information continuity. Through institutional integration, stage-specific fragmentation can be reduced, thereby improving overall governance efficiency.

#### 6.1.4 Enhancing regulatory capabilities and digitalization

Given the complexity of PPP projects, regulatory expertise must be enhanced and technical support strengthened. On one hand, the cultivation of multidisciplinary talent should be prioritized; on the other, an information-based regulatory platform should be developed to enable real-time data collection and analysis, thereby improving risk identification capabilities and the scientific basis of decision-making.

#### 6.1.5 Establishing a multi-stakeholder external oversight mechanism

Information disclosure and public participation should be strengthened to improve the external oversight system. By introducing third-party evaluations and expanding channels for public participation, the objectivity and diversity of oversight can be enhanced, thereby increasing the overall effectiveness of governance.

### 6.2 Research Conclusions

This paper analyzes regulatory issues during the operational phase of PPP projects from an institutional perspective and validates the findings through case studies. The research indicates that these issues stem from the failure of multi-mechanism coordination: the lack of dynamic adjustments in risk sharing leads to risk accumulation; insufficient performance incentives and constraints result in behavior deviating from public objectives; and imperfect information mechanisms weaken the timeliness of regulation. Furthermore, there are interactions among these mechanisms: risk imbalances weaken the effectiveness of incentives, while information asymmetry exacerbates the vicious cycle. A comparison with the UK's PPP model reveals that its strength lies in the formation of a closed-loop mechanism integrating contracts,

performance, adjustments, and oversight, which holds significant implications for China.

### 6.3 Theoretical and Policy Implications

At the theoretical level, this paper focuses on the operational phase of PPPs, constructing a "risk-incentive-governance" analytical framework from a mechanism-based perspective. This addresses the fragmentation of elements in existing research and emphasizes the interdependent relationships among mechanisms. At the policy level, the study suggests that regulatory models should shift from an administrative control orientation to a mechanism-driven approach, strengthening contract enforcement, incentive-constraint mechanisms, and information support to enhance overall governance capabilities.

### 6.4 Research Limitations and Future Directions

This study still has certain limitations. Methodologically, it primarily employs normative analysis and case studies, lacking large-scale empirical testing; in terms of scope, a single case study cannot fully account for differences across project types; regarding data, insufficient information disclosure has limited the depth of the research. Future research could be expanded in three areas: first, introducing econometric methods to conduct empirical analysis; second, conducting multi-case or cross-regional comparative studies; and third, examining the application of digital technologies in PPP regulation and their impact on regulatory mechanisms.

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