

Good Governance in Road Infrastructure Management: A Literature Analysis of Material Misuse and Procedural Non-Compliance

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Abstrak

Kualitas infrastruktur jalan tidak hanya dipengaruhi oleh faktor teknis, tetapi juga oleh tata kelola di sepanjang siklus hidup infrastruktur tersebut. Studi ini bertujuan untuk menyintesis literatur mengenai penyalahgunaan material, ketidakpatuhan terhadap prosedur, pengadaan, pengawasan, serta akuntabilitas dalam pengelolaan infrastruktur jalan. Tinjauan pustaka kualitatif dilakukan dengan menggunakan artikel jurnal internasional yang diterbitkan antara tahun 2016 hingga 2026, yang dilengkapi dengan publikasi kelembagaan serta dokumen kebijakan yang relevan. Temuan menunjukkan bahwa kepatuhan terhadap regulasi berfungsi sebagai mekanisme sentral yang menghubungkan tata kelola dengan kualitas infrastruktur. Pengawasan yang lemah, verifikasi material yang tidak memadai, risiko dalam pengadaan, serta akuntabilitas yang tidak efektif dapat berkontribusi terhadap kerusakan infrastruktur dan kerugian publik. Oleh karena itu, penguatan tata kelola yang terintegrasi, transparan, dan berbasis risiko menjadi hal yang sangat penting.

Kata Kunci: Pelayanan Publik; Pembangunan Jalan; Ketidakpatuhan Prosedural; Penyalahgunaan Material; Tata Kelola Pemerintahan

Abstract

Road infrastructure quality is influenced not only by technical factors but also by governance throughout the infrastructure life cycle. This study aims to synthesize literature on material misuse, procedural non-compliance, procurement, supervision, and accountability in road infrastructure management. A qualitative literature review was conducted using international journal articles published from 2016 to 2026, complemented by relevant institutional publications and policy documents. The findings indicate that regulatory compliance functions as a central mechanism connecting governance with infrastructure quality. Weak supervision, inadequate material verification, procurement risks, and ineffective accountability can contribute to infrastructure deterioration and public loss. Strengthening integrated, transparent, risk-based governance is therefore essential.

Keywords : Public Services; Road Construction; Procedural Non-compliance; Misuse of Materials; Government Governance.

INTRODUCTION

Road infrastructure is a critical component of public infrastructure because it supports community mobility, regional connectivity, economic activity, goods distribution, access to public services, and territorial integration (Khanani et al., 2021; Prus & Sikora, 2021). Road quality therefore cannot be understood solely as a technical matter involving pavement strength or structural durability (Alsheyab et al., 2024). It also represents public administration because development uses public resources and involves government planning, budgeting, procurement, contracting, supervision, and accountability (Rosenbloom et al., 2022).

The strategic position of infrastructure makes governance important in determining whether public investment produces functional, sustainable, and socially beneficial infrastructure (Schwartz et al., 2020). The OECD (Chaponda, 2025; Greve & Hodge, 2010) emphasizes that infrastructure governance encompasses technical and financial aspects as well as institutional arrangements, public decision-making, procurement, implementation, and oversight. Good governance can support productivity, inclusiveness, and equitable access to services (Thelma et al., 2024).

Premature road damage raises questions beyond technical explanations. Damage may result from environmental conditions, traffic loads, drainage problems, design deficiencies, inadequate maintenance, or aging infrastructure (Milling et al., 2023; Tobby & Udoinyang, 2025). However, problems may also arise from inappropriate materials, deviations from technical specifications, improper construction methods, inadequate supervision, and weaknesses in contract administration (Coleman et al., 2025; Nuhun et al., 2024).

Research on national road construction in North Sulawesi identified improper technology, inappropriate construction methods, inadequate material quality, deficient specifications and drawings, incomplete planning documents, lack of control, inadequate project administration, low personnel competency, and deficient contracts as factors associated with quality deviations (Nofvandro & Mulyono, 2014). This finding indicates that road infrastructure quality results from an interconnected system rather than physical construction alone.

The relationship between procurement and infrastructure quality is particularly important. Public procurement transforms public budgets into infrastructure and services (Hartmann et al., 2014). The Asian Development Bank identifies sound procurement as an essential component of good governance, while poor practices may cause waste, delays, inefficiency, and corruption.

The OECD also emphasizes that integrity risks may emerge throughout the infrastructure life cycle, including planning, procurement, contract execution, and implementation (M. Rahman & Farabi, 2022). These risks include fraud, collusion, corruption, undue influence, and other inappropriate practices. Because infrastructure projects involve substantial financial values and complex transactions, risk-based control mechanisms are required.

In road infrastructure, materials represent an important control point. Material specifications ensure that construction components meet project requirements (Awaad et al., 2024). Material substitution, quality reduction, inaccurate measurement, and other deviations may

reduce durability and cause premature damage (Ma et al., 2025).

The issue therefore extends beyond whether contractors use correct materials. The broader question is whether governance systems ensure that what is planned, procured, contracted, implemented, inspected, measured, and paid for corresponds with what is physically delivered (Harris et al., 2020). Infrastructure failures may occur when technical rules exist but are not effectively implemented. A study on government procurement in Baubau found that good governance principles were not implemented optimally because of overlapping regulations, limited human resources, and inadequate supporting facilities. The study recommended strengthening human resources, performance-based budgeting, and information technology for e procurement. Research on Indonesian infrastructure governance likewise indicates that formal institutional reforms do not automatically guarantee effective governance (Utami et al., 2026). Competing interests can influence institutional systems, demonstrating that infrastructure governance requires effective implementation, institutional capacity, and accountability.

Accordingly, strengthening governance requires integrating technical standards with transparent procurement, competent supervision, reliable documentation, effective monitoring, and enforceable accountability so that deviations are identified early and corrected before they compromise infrastructure performance and public value (Adam, 2024). This study aims to synthesize literature on road infrastructure quality and identify governance mechanisms that can prevent material misuse and non-compliance with construction procedures. It contributes to public administration literature by positioning infrastructure damage not merely as a technical failure but also as a potential governance issue.

METHOD

This study uses a qualitative literature review to synthesize knowledge on road infrastructure damage, material quality, construction procedures, procurement, supervision accountability, and good governance (Uddin, 2022). The literature search covered international journal articles published from 2016 to 2026, complemented by relevant institutional publications, policy documents, and reports. The analysis focuses on five themes: infrastructure quality, construction materials, technical compliance, procurement and contract management, and governance. Analysis involved literature identification, information extraction, thematic grouping, and synthesis of relationships between technical problems and governance dimensions. Thematic categories included material and procedural compliance, supervision, procurement, contract administration, accountability, transparency, and integrity. The study distinguishes technical causes from governance-related risks, recognizing environmental conditions, traffic, design, drainage, maintenance, and aging as alternative causes.

RESULT AND DISCUSSION

Regulatory Compliance as the Foundation of Good Governance in Road Infrastructure

The literature analysis demonstrates that regulatory compliance is a fundamental component of good governance in road infrastructure management. Regulations do not merely

function as administrative instruments; they establish the institutional framework through which planning, procurement, construction, supervision, and accountability are expected to operate. Mwelu et al. (2018) demonstrate that compliance with regulatory frameworks is an important determinant of the implementation of public road construction projects. Their findings indicate that non-compliance can undermine project objectives and affect the effectiveness of public road construction. This finding suggests that the existence of regulations alone is insufficient. Regulations must be translated into actual compliance throughout project implementation.

In the context of road infrastructure, compliance involves consistency between planning documents and implementation, technical specifications and materials used, approved construction methods and actual work practices, and completed outputs and established quality standards. The relationship can therefore be conceptualized as:

**Regulatory Framework → Compliance → Supervision → Construction Quality
→ Infrastructure Quality → Public Service Delivery**

When one component of this chain is weakened, the risk of infrastructure failure increases. Premature road deterioration should therefore not automatically be interpreted as a technical problem alone. It may also indicate weaknesses in the institutional mechanisms designed to ensure compliance.

Compliance as a Mediating Mechanism between Regulation and Project Success

Mwelu et al. (2020) provide an important theoretical basis for understanding the role of compliance. Their study identifies compliance as a mediating mechanism linking regulatory familiarity, monitoring activities, sanctions, contractor resistance to non-compliance, and the success of public road construction projects.

This finding is particularly relevant to good governance because it demonstrates that governance does not produce successful infrastructure outcomes merely through the existence of formal rules. Rules require mechanisms that encourage, monitor, and enforce compliance. In road construction, technical specifications can only improve infrastructure quality when they are effectively implemented. This requires:

1. adequate understanding of regulatory and technical requirements;
2. verification of construction materials;
3. monitoring of construction methods;
4. testing of completed work;
5. documentation of deviations;
6. corrective actions for non-compliance; and
7. accountability for decisions and outcomes.

Accordingly, compliance can be positioned as an important mechanism connecting governance quality with infrastructure quality.

This perspective also changes the interpretation of material misuse. Material deviation should not be viewed exclusively as an isolated technical failure. It may reflect a breakdown in the broader compliance chain, including procurement, inspection, supervision, documentation, and contract enforcement.

Material Non-Conformity as a Governance Risk

Construction materials constitute a critical component of road quality. From a technical perspective, materials must satisfy requirements concerning composition, strength, quantity, testing, storage, transportation, and application.

From a public administration perspective, however, materials are also part of the procurement and contract accountability chain.

When materials fail to comply with specifications, several governance questions arise:

1. Who selected or approved the material?
2. How was the material verified?
3. Was appropriate testing conducted?
4. Who was responsible for supervision?
5. Was the deviation documented?
6. Was a formal variation or approval issued?
7. Was payment based on work that actually complied with the contract?

Consequently, material non-conformity can be regarded as a governance risk because it involves transparency, compliance, supervision, and accountability.

Mwelu et al. (2018) demonstrate the importance of compliance in the implementation of public road projects, while Ruwanika & Maramura (2024) emphasize the importance of transparency, accountability, trustworthy procedures, competence, and monitoring in ensuring effective service delivery.

Material control should therefore be understood as part of good governance throughout the infrastructure supply chain, rather than merely as a technical laboratory procedure.

Procedural Non-Compliance and Weak Supervision

In addition to material quality, compliance with construction procedures is essential for ensuring infrastructure quality. Construction procedures translate technical designs and specifications into physical work. Procedural non-compliance may involve inappropriate construction methods, inadequate quality control, failure to perform required testing, inappropriate sequencing of activities, or deviations from approved technical specifications. Mwelu et al. (2018) emphasize the importance of compliance in public road construction, while Mwelu et al. (2020) demonstrate the importance of monitoring and sanctions in promoting compliance. These

mechanisms help ensure that technical requirements are consistently implemented, deviations are identified promptly, and responsible actors remain accountable throughout project implementation.

These findings indicate that supervision is not merely an administrative activity. It is a governance instrument for ensuring that contractual requirements are translated into actual physical outcomes. When supervision focuses predominantly on ministrative documentation, physical quality may receive insufficient attention. Conversely, quality-oriented supervision should ensure that physical progress is accompanied by evidence of compliance with technical requirements.

Thus:

Physical Progress $\neq$ Quality Progress

A project may reach 80% physical completion while simultaneously accumulating quality problems if compliance is not adequately monitored.

Corruption and Integrity Risks in Public Construction

The literature further demonstrates that infrastructure quality is closely associated with integrity risks in public construction.

Shan et al. (2017) investigate the underlying factors associated with corruption in China's public construction sector. Their study is important because it demonstrates that corruption risks in construction arise within a complex institutional environment involving multiple actors and interactions. Infrastructure projects are particularly vulnerable because they generally involve large financial resources, complex technical specifications, multiple contractual relationships, information asymmetry, discretionary decision-making and extensive interaction between public and private actors.

Dimuna (2023) similarly discusses corruption as a significant challenge to infrastructure development in developing countries. From a good governance perspective, these findings imply that infrastructure management should not merely respond to corruption after it occurs. Governance mechanisms should be designed to reduce opportunities for misconduct before damage occurs by strengthening preventive controls, transparency, oversight, accountability, integrity, and early detection across infrastructure project stages.

This includes transparency, segregation of duties, conflict-of-interest controls, independent verification, audit trails, contractor monitoring, and effective sanctions. Importantly, the present study does not assume that every instance of road deterioration represents corruption. Rather, corruption and integrity failures are treated as governance risks that may contribute to poor

infrastructure outcomes when control mechanisms are ineffective.

Public Procurement as a Critical Governance Point

Public procurement is a critical stage because it determines how public resources are transformed into infrastructure outputs.

M. K. Rahman (2020), through a case study of the Roads and Highways Department in Bangladesh, identifies challenges associated with public procurement in the road sector. The study demonstrates that procurement problems can affect the efficiency and effectiveness of infrastructure implementation. Nkolola et al. (2025) similarly examine factors contributing to non-compliance with public procurement procedures in Zambia. These studies support the argument that compliance must begin at the procurement stage rather than only during physical construction. The infrastructure governance cycle can therefore be conceptualized as:

Needs Assessment → Planning → Technical Specifications → Procurement → Contracting → Material Procurement → Construction → Supervision → Payment → Maintenance

Weaknesses at an early stage can generate consequences throughout the subsequent stages. Good governance must therefore be applied throughout the **entire infrastructure life cycle**.

E-Procurement, Transparency, and Accountability

Digital procurement represents another important theme in the literature.

Lewis-Faupel et al. (2016) found that e-procurement was associated with improvements in infrastructure outcomes. In India, e-procurement was associated with higher road quality, while in Indonesia it was associated with reduced delays in public works projects. These findings suggest that digital procurement can contribute to good governance through: improved access to procurement information, greater transparency, reduced opportunities for discretionary intervention, broader competition, improved traceability; and stronger auditability.

However, digitalization does not automatically create good governance. A digital system may still reproduce institutional weaknesses if users manipulate information, bypass procedures, fail to verify physical outputs, or lack integrity.

Therefore:

Digitalization can strengthen governance, but digitalization cannot replace governance. This distinction is important for road infrastructure management because digital procurement should be connected with physical verification, material testing, contract monitoring, and post-construction evaluation.

Contractor Capacity and Performance

Contractor performance is another important dimension identified in the literature. Ruwanika and Maramura (2024) emphasize the importance of service providers in effective public service delivery and highlight the importance of monitoring, compliance with specifications, and human-resource capacity. This perspective is particularly relevant to procedural errors. Not every deviation should automatically be interpreted as intentional misconduct.

Some deviations may result from:

1. Inadequate technical competence. Particularly in applying construction standards, interpreting technical requirements, conducting quality control, and implementing appropriate construction methods.
2. Insufficient managerial capacity. Especially in coordinating resources, managing construction activities, controlling project schedules, and ensuring compliance with contractual requirements.
3. Limited understanding of specifications. Potentially causing incorrect materials, improper practices, inaccurate measurements, and technical non-compliance.
4. Inadequate quality-control system. Resulting in insufficient testing, weak inspections, poor documentation, and delayed corrective actions.
5. Insufficient experience. Potentially affecting decision-making, problem-solving, supervision, risk management, and responses to technical construction challenges

Good governance should therefore combine compliance-based governance with capacity-based governance. The first ensures that actors follow established rules, while the second ensures that actors possess the competence necessary to implement those rules. Both dimensions are necessary.

Contractor Supervision as an Infrastructure Governance Instrument

Contractor supervision represents a critical connection between contractual requirements and infrastructure outcomes. Zees et al. (2026), in their analysis of infrastructure-governance-based contractor performance supervision in road maintenance projects, reinforce the importance of viewing contractor supervision as part of infrastructure governance. Contractor supervision should encompass: contractual compliance, technical quality, work progress, material conformity, resource utilization, corrective actions, documentation; and performance accountability. Consequently, contractors should not be evaluated solely on whether they complete projects. Their performance should also be assessed based on compliance, quality, integrity, responsiveness, and accountability throughout the contract life cycle.

Governance Quality and Public Service Delivery

The ultimate purpose of road infrastructure is not merely to complete a construction project but to **provide** effective, safe, accessible, and sustainable public services. Ruwanika and Ruwanika

& Maramura (2024) demonstrate the importance of service providers and governance mechanisms in effective service delivery. Zulu et al. (2026) further highlight the relationship between governance quality and service delivery performance at the local-government level.

These findings support the following relationship:

Good Governance → Good Infrastructure → Effective Service Delivery → Public Value
Conversely:

Weak Governance → Non-Compliance → Poor Construction Quality → Premature Deterioration → Poor Service Delivery → Public Loss

Road deterioration therefore creates consequences beyond physical repair costs. Poor road quality can increase travel time, vehicle operating costs, logistical costs, safety risks, and barriers to accessing public services. Road infrastructure quality is therefore an important component of public value creation.

Sustainable Procurement and Social Dimensions of Road Infrastructure

Treviño-Lozano (2021) broadens the discussion by connecting public procurement with sustainability and human rights in road infrastructure projects. This perspective indicates that road projects should not be evaluated solely according to whether construction is completed within budget and schedule. Infrastructure should also be assessed according to its social and sustainability implications. Kahangirwe & Vanclay (2024) similarly demonstrate that road infrastructure projects in Sub-Saharan Africa can produce significant social impacts, including physical displacement, economic displacement, and disruption of livelihoods.

These findings expand the meaning of good governance. The relevant question is therefore not simply:

“Was the road successfully constructed?”

A more comprehensive governance question is:

“Was the road constructed in accordance with regulations, using public resources responsibly, meeting quality standards, minimizing social harm, and generating sustainable public benefits?”

This shifts the analytical focus from **physical output** toward **public value and sustainable development**.

Political and Administrative Interactions in Project Implementation

Maximilian & Damian (2025) highlights the interaction between political and administrative actors in project implementation and management, particularly in relation to transparency, accountability, rule of law, and efficiency. This issue is relevant because road infrastructure



Figure 1 Integrated Good Governance Framework for Road Infrastructure
Source: processed data (2026)

This framework places compliance at the center of infrastructure governance.

1. Regulations without compliance cannot guarantee quality.
2. Compliance without monitoring may not be sustainable.
3. Monitoring without sanctions may have limited corrective power.
4. Sanctions without transparency may create uncertainty.
5. Digitalization without integrity merely transfers administrative processes into a digital environment without necessarily improving outcomes.

Therefore, good governance should be understood as an integrated institutional system, rather than as a collection of independent principles.

Good Governance as a Preventive Mechanism

The overall synthesis suggests that good governance should function primarily as a preventive mechanism against infrastructure quality failure. The proposed relationship is:

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Figure 2 Good Governance as Preventive Mechanism Source: processed data (2026)

This framework provides a more nuanced interpretation of road deterioration. Road damage should not automatically be treated as evidence of corruption or material misuse. Such conclusions require empirical investigation. However, repeated material deviations, inadequate testing, weak documentation, procedural violations, ineffective supervision, and recurring premature failures can constitute governance warning signals requiring further investigation.

Thus, the central proposition of this literature review is:

Road infrastructure quality is not determined solely by technical specifications but by the capacity of the governance system to ensure that those specifications are implemented, verified, documented, monitored, and held accountable.

Main Findings from the Literature Synthesis

The references provided in this study can be synthesized into six major findings.

Table 2 Finding from The Literature Synthesis

No	Main finding	Key literature	Governance implication
1	Regulatory compliance is fundamental to project quality	Mwelu et al. (2018)	Regulations must be translated into practice
2	Compliance mediates governance and project success	Mwelu et al. (2020)	Compliance is a central governance mechanism
3	Monitoring and sanctions strengthen compliance	Mwelu et al. (2020); Zees et al. (2026)	Supervision must be followed by corrective action
4	Corruption and procurement risks threaten infrastructure quality	Astuti et al. (2026); Dimun (2023); Shan et al. (2017)	Integrity controls are needed throughout the project cycle

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