
Management of Highway Infrastructure Project Implementation in Nepal: A Review¹

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Abstract

The management of infrastructure project implementation is a complex task that requires extensive resources and involves diverse stakeholders and long-duration activities. Infrastructure is crucial to national socioeconomic development, but management weaknesses affect the timely achievement of infrastructure development objectives. In this context, the main aim of this review of highway infrastructure project implementation management in Nepal is to identify the policy implementation status and areas for improvement, in order to provide feedback for policymakers, project stakeholders, and planning authorities so as to achieve sustainable infrastructure development through policy environment improvements. This study applies a qualitative technique in order to analyze the content of policies, their implementation status, risk-sharing mechanisms, and issues of delays in highway infrastructure implementation management through policy documents, project review reports, and the yearly planning of government and contracting approaches adopted in several major projects in Nepal. The database of National Pride Projects (NPPs) for 2008 through 2022 was examined along with policy documents. As key areas for improvement toward the better management of highway infrastructure projects in Nepal, we identified institutional arrangements; standardized documents for new approaches to procurement, financial, and other resource management based on project priority; and project governance. This review thus supports the comprehensive examination of existing policies, practices and weaknesses in the management system that will benefit future project planning, policy review, and the adoption of best governance practices in construction projects.

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1. Introduction

Project management involves the management of the time, cost, and quality of a product through the provision of resources (Williams, 2008). Public infrastructure construction projects involve many stakeholders, each with different interests and requirements. Effective stakeholder management and the proper planning of pre-construction activities are essential for completing these projects on time (Doloi et al., 2012). In public infrastructure management, the sharing of particular risks between the contracting parties is crucial for achieving the project objectives (Naumani & Tsegay, 2011). Infrastructure implementation delays affect the economy of a country regardless of that country's economic condition, but developing countries are more affected due to resource constraints (Venkatesh & Venkatesan, 2017).

Most highway infrastructure construction in Nepal is managed using public funds. These funds are sourced from government revenue or internal and external loans. Public infrastructure acquisition involves private construction companies through different contractual arrangements. In general, the client bears the risk of planning and implementation through traditional contracting arrangements, which predominate in highway infrastructure construction in Nepal. However, new approaches such as Design-Build (DB) and engineering procurement and construction (EPC) or turnkey methods of contracting are in practice in selected projects. All those procurement and contract management activities are guided by the Public Procurement Act (PPA) and Public Procurement Regulations (PPR) of the Government of Nepal (GoN).

The GoN has made tremendous efforts to construct and upgrade highways since the establishment of the Department of Roads (DoR) and has constructed more than 36,132 km of road. Local and provincial governments have pursued new construction even more aggressively, constructing more than 67,912 km of road that provides nationwide access to transport services (MoF, 2025). However, implementation management faces several serious issues of institutional, planning, resource management, and project governance. For example, the Mid Hill Highway construction project, which was launched in fiscal 2007 as a National Pride Project and had a 10-year completion target, remains uncompleted in its 17th year. The reason, as mentioned in the final report of the DoR in fiscal 2023, is that planning, resource management, project governance, and sustainability considerations have not been properly addressed. Furthermore, investment in highway infrastructure has not supported national economic development efficiently

due to the improper management of projects from a lack of resources, policy hurdles, discrepancies in institutional capacity, and improper project governance.

The main objectives of this review of existing practices and policies of highway infrastructure implementation management are to identify the policy gaps and weaknesses in existing practices and to suggest ways forward for future projects. This review adds value by providing a holistic understanding of the risks and existing approaches associated with highway infrastructure project management. Furthermore, it has the potential to support improvements in management efficiency by the GoN from a broader project management perspective. Additionally, better policy and practice reforms could be institutionalized in the highway infrastructure sector to achieve sustainable infrastructure objectives. This review article aims to support these improvements and reforms through a review of better policies and practices whose adoption could achieve infrastructure demand with improved project performance. There are several areas that the government must focus on, such as sustainable development, construction industry development, financing requirements in the highway infrastructure sector, planning, procurement management, the institutional capacity enhancement of construction companies, measures for mitigating delays, policy options for stakeholder engagement, and the adoption of private-sector participation policies and regulations in highway infrastructure construction and management. Hence, this comprehensive review reflects a broad view of highway infrastructure management in a single frame and gives feedback for long-term improvements.

The novel contribution of this review is to clarify policy implementation issues in highway infrastructure construction and to provide support for reframing infrastructure construction policies such as to achieve sustainable development objectives. This qualitative review of policies and practices in highway project implementation management adds value by suggesting improvements to the national infrastructure development policy framework under the existing project management environment. Additionally, poor project governance aspects that are specified in several government reports can be addressed by designing a new policy framework based on this sectoral review. Finally, this review urges the government to enhance its institutional capacity and capability in order for it to adopt more sustainable and best practices in the infrastructure development sector.

2. Literature Review

2.1. General

This review draws from academic peer-reviewed articles on project management and from reports on policies and practices for managing the implementation of highway projects in Nepal. Drawing from these two fields of knowledge allows a synthesis of academic and real-life practices and informs academicians and practitioners of infrastructure projects.

The Group 20 (G20)/Organization for Economic Cooperation and Development (OECD) Principles of Corporate Governance provide guidance to help policymakers evaluate and improve the legal, regulatory and institutional framework for corporate governance, with a view to supporting market confidence and integrity, economic efficiency, sustainable growth, and financial stability (OECD, 2023). Those principles have global reach and are applicable in a wide variety of jurisdictions with varying legal systems and different stages of development. Flyvbjerg (2014) synthesized several studies on megaproject management that examined policy and implementation management issues. Flyvbjerg noted that reviewing the performance of previous megaprojects and failures in policies and policy implementation could inform the adoption of new policies.

2.2. Project Implementation Delays

Project implementation delays are not limited to any region or infrastructure project. Several review reports published by governments and studies published by academics have identified key issues of project implementation delay that affect project cost and benefit planning; these are monitoring, resource management, low bid price, unrealistic contract duration, climate change, inflation, changes in government, strikes, political and governance issues, planning and coordination deficiencies, financial resource constraints, poor management capacity of the government and contractors, non-adherence to legal provisions, negligence in pre-construction activities (land compensation and utility relocation), poor construction material management, weather conditions, and exceptional events (Bhattarai, 2023; DoR, 2022, 2023b; Dixit, 2017; NPC, 2022, 2023a, 2024; MoF, 2023a; OAG, 2021, 2024; World Bank, 2020c, 2022). Those review articles and reports have broadly covered the issues, but there is a lack of sector-specific studies to identify issues in highway project implementation delays with regard to policies and implementation practices.

2.3. Public Procurement

Not only do procurement practices in public spending for infrastructure construction provide transparency, but they also support efficiency and quality achievement during implementation (Katamuna, 2025). A questionnaire survey of industry professionals by Alzara et al. (2016) identified the major causes of infrastructure project delays as relating to construction management methods and procurement systems. A questionnaire survey by Shrestha et al. (2013) found that delays and cost overruns in public projects were greater under the Design–Bid–Build (DBB) approach than under other approaches. This also shows the importance of a new approach to risk-sharing using the proper contracting approach to improve schedule performance. An early study of construction projects by Konchar and Sanvido (1998) implemented using the DB and DBB modalities found that DB projects have better schedule and cost performance than projects implemented under the DBB approach. Specific to Nepal's perspective, Paudel and Henry (2023a) made a comparative study on how contracting strategies and institutional arrangements affect the implementation performance of bridge construction projects; they found that better risk-sharing in procurement planning achieved better implementation performance for infrastructure projects.

A similar study conducted in Kuwait to identify the time and cost performance of DB and DBB projects further clarified that the time and cost performance of DB projects was superior to that of DBB projects (Al-enezi & Al Sabah, 2024). Another study of DB and DBB project performance over two decades also showed DB to have significantly better performance for time and cost management during project implementation (Sullivan et al., 2017). These limited studies on procurement and project implementation performance suggest that proper procurement planning can lead to better risk-sharing arrangements. However, procurement policies and their implementation practices in the real world have not been thoroughly reviewed in a single framework.

2.4. Resource Management

Construction projects are resource-based temporary management institutions. Human resources, finances, materials, and equipment are key resources for the timely accomplishment of project activities. Developing nations such as Nepal always face a scarcity of resources for development. The management of finances within the available resources plays a key role in project execution. Paudel and Henry (2023b) determined that the assurance of financial resource availability during project execution plays a key role in time and cost performance management for road projects in Nepal. A systematic review of reports on construction project delays identified several key management

factors affecting time performance, including the management of human resources, equipment, materials, and financial resources (Durdyev & Hosseini, 2020). A study on materials management and its impact on construction project delays found that time management can be affected at each stage of materials supply (Khursheed et al., 2024). As a developing nation, Nepal has a high demand for highway infrastructures, yet there are no such review studies on policies and practices for effective project delivery. So, this review provides a foundation for improving project implementation performance through the standardization of existing policies and practices.

2.5. Institutional Capacity

Institutional capacity development is the continuous process of improving an institution's performance. The team that is involved from a project's initiation to the operation and maintenance of the infrastructure can be treated as a project institution. The performance of project managers, the support of stakeholders, and coordination among the entire government are also critical for improving the performance of infrastructure projects in Nepal (NPC, 2022). Similar studies around the world attest to the importance of carrying out such a study of Nepal's construction industry. As an example, the inefficient use of laws and regulations in Nigeria was found to affect contracting parties' performance in effectively managing construction projects there (Iroha et al., 2024). As does Nigeria, Nepal faces the non-performance of regulatory system and institutions. A systematic review of project performance-related studies published from 1988 to 2018 found that the capacity of institutions involved in project planning and implementation plays a key role in time and cost performance (Durdyev & Hosseini, 2020).

Several government reports and research articles have explored key institutional weaknesses in the project planning, construction, and operation of infrastructure projects in Nepal (Bhattarai, 2023; DoR, 2022, 2023b; OAG, 2021, 2024; Dixit, 2017; World Bank, 2020c, 2022; NPC, 2022, 2023a, 2024, 2025; NIRTTP, 2019; MoF, 2025; PPMO, 2022a; Rajbhandari, 1998). However, these have not covered policy and practice issues specific to highway infrastructure implementation management.

This study covers the database of highway NPPs, policies and regulations related to infrastructure planning and implementation management, and requirements for adopting best practices in the construction industry. The database from 2008 through 2022 has been explored through a qualitative analysis of that content, and planned scenarios were compared to actual scenarios for specific projects in order to identify implementation gaps. In the database of NPPs, this review focuses on major infrastructure projects. Those representative projects reflect the policy and implementation scenarios in national

infrastructure planning and management. It is necessary to review how major infrastructure projects' issues were resolved, which can provide evidence for adoption of best practices throughout the construction industry.

The Nepalese construction industry lags in applying standardized approaches to determining project durations (DoR, 2023b). Internationally accepted approaches such as the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT) are not institutionalized, even for major infrastructure projects. Through this review, gaps in institutions, policies, and practices are assessed qualitatively and recommendations are made to institutionalize best practices in the industry with due consideration of capacity enhancement measures to improve project performance.

Given the above literature, the several study reports, and the project evaluation reports from the Government of Nepal, a comprehensive review of policies, regulations, and implementation practices is required. To fulfil this need, this review article addresses regulatory, policy, and implementation-related issues of infrastructure construction project management in the national context. This review serves as a baseline for understanding the realities of infrastructure construction management in Nepal. Based on this critical review, future planning and resource management could be addressed by the government to achieve planned long-term development targets, such as the Sustainable Development Goals (SDGs) and the Vision 2043. From this review article, other developing nations at different levels of infrastructure development could also benefit from holistic reviews of their policies and practices.

3. Methodology

This research basically focuses on a review of existing policies, government reports published by supervisory institutions, project progress reports, research on countries with similar economic status, and best practices in infrastructure construction management. The review was performed using qualitative research methods. We focus on highway infrastructure implementation management in Nepal under the central government. However, this review could serve as a useful reference for the construction management of other types of infrastructure in Nepal. Based on this review, a comprehensive policy review and the implementation of best practices to achieve sustainable infrastructure could be achieved.

Figure 1 presents the methodological framework for this review and uses a holistic approach to identify areas for improvement in the infrastructure project management sector. The review primarily adopts qualitative approaches that use specific search terms

in national policy documents, review reports, and literature reviews focusing on project performance, risk sharing, institutional capacity, delay issues, resource management, construction planning, project governance, and the like. Policy documents such as medium-term and long-term plans of the National Planning Commission (NPC), strategic plans for the transport sector, priority investment plans, and transport master plans are reviewed to identify policy provisions and their impacts on project performance. Similarly, implementation practices are reviewed through the project reports of the DoR, the NPC, the World Bank (WB), the Asian Development Bank (ADB), the Japan International Cooperation Agency (JICA), the Office of the Auditor General (OAG) of Nepal, and other previous studies on project implementation performance specific to Nepal. In total, 48 policy documents, project evaluation reports and country-specific academic papers were reviewed. Out of these, 25 were policy documents, 13 were project evaluation reports, and 10 were Nepal-specific academic papers. Additionally, best international practices were examined through the Fédération Internationale Des Ingénieurs-Conseils (FIDIC) standards, WB and ADB standards and others to identify the gaps for improving the existing policy and implementation environment in the Country.

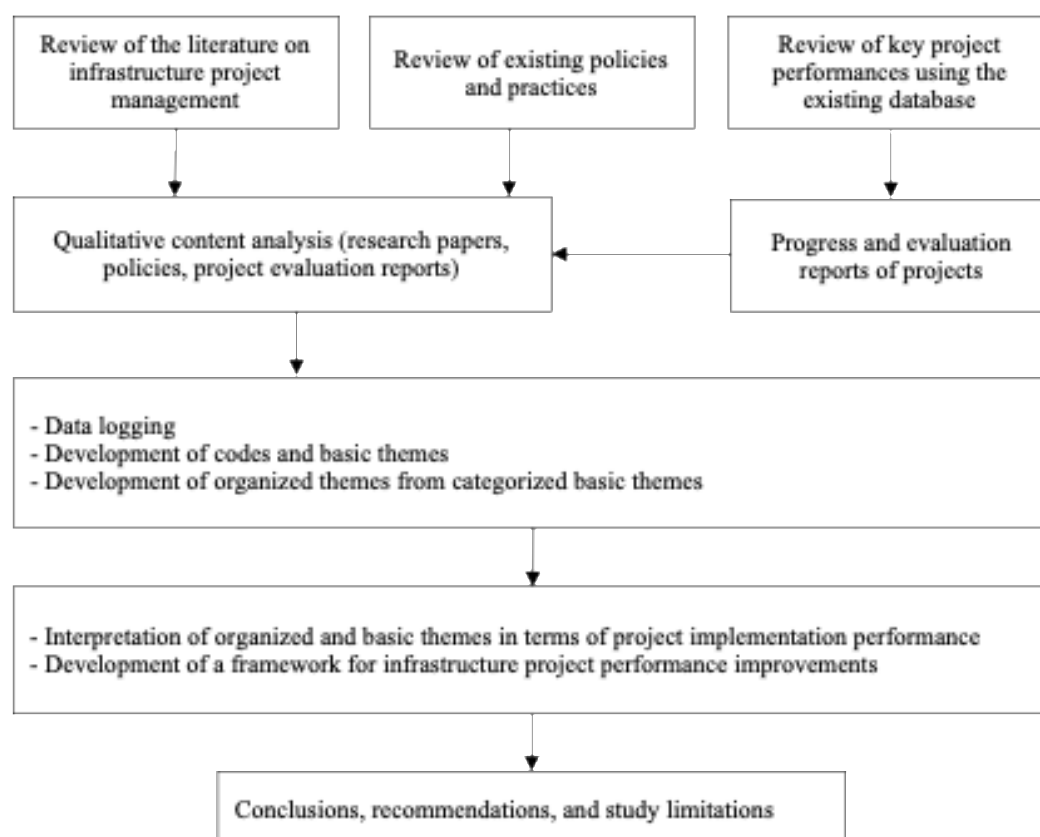


Figure 1 Flowchart of methodology

The qualitative content analysis approach was used to identify areas requiring improvement in infrastructure implementation performance. This approach is useful for examining qualitative data, interpreting it, and reaching conclusions (Mezmir, 2020). For this qualitative study framework, we considered existing policies, implementation progress and review reports, project risk-sharing standards, and previous research papers on project implementation delays. We identified the highway project status – especially project delay issues – through the project progress and evaluation reports of OAG, Ministry of Physical Infrastructure and Transport (MOPIT), DoR, NPC, MoF, WB, ADB, JICA and others. Similarly, content on implementation delays was extracted from country-specific research findings of Nepal and other countries.

We performed qualitative content analysis of textual information extracted from several policies and practices, as well as from research findings, and we prepared comprehensive lists of issues related to infrastructure project performance. Those data logs focusing on project implementation performance in the highway infrastructure sector of Nepal were coded as basic themes. Similar categories of basic themes were grouped into a broader category that was called an organized theme. For example, the procurement regulations of the GoN specify that finances must be secured before project procurement starts, and this was listed as a basic theme related to project governance. A similar approach was adopted for each of the reviewed documents and research papers. Based on basic themes, organized themes were developed, such as institutional capacity, financial assurance, resource management, project risk management, and project governance. Organized themes cover broader areas than basic themes. The ultimate goal of this review—to identify measures for improving the framework for highway infrastructure implementation management—was finally realized from a comprehensive qualitative examination of policies and practices in the construction industry of Nepal. Such a thematic network of basic and organized themes promises to help the research findings to be interpreted in a qualitative manner (Attride-Stirling, 2001).

This study begins with a review of the socioeconomic status of the country. The situation of highway infrastructure implementation management, policies, and the impact of policies and practices in project implementation performance are critically reviewed in the following sections. In Section 4, there is a thorough overview of the construction industry's contribution to the national economy, investment needs, the challenges of highway infrastructure implementation, institutional arrangements, case studies of National Pride Projects, and a long-term vision of the government in line with project performance management. In Section 5, there is a review of existing policies of highway infrastructure project implementation management. This section gives a critical

document-based examination of contractor selection criteria, qualification examination methodologies, construction company participation modalities, and project cost and time estimation approaches during the project preparation stage. This qualitative review links procurement policies and practices to project implementation performance. In Section 6, after a thorough review of policies related to contractor selection, we examine delay causes and effects. In Section 7, project risk-sharing mechanisms in standard construction contract management and national practices in Nepal's highway infrastructure construction sector are explored. Issues with implementing standard contracting arrangements such as DB, DBB, EPC, and Public–Private Partnership (PPP) in Nepal's highway project management are explored thoroughly and qualitatively. Combining national issues with best practices is explored as a way forward for improving project implementation performance.

The choice of highway projects to review is based on the availability of project data in the highway infrastructure sector and the experience of the authors in the field. The overview of highway project management for selected large projects helps identify the root causes of poor project performance in the sector. Such specific sectoral project-based experience can be utilized to assess other sectoral issues in a similar fashion.

This comprehensive review of the construction industry's capacity in Nepal, resource requirements for infrastructure development, existing policies, policy implementation statuses, and public procurement and risk management approaches and their impact on project implementation performance gives a qualitative and systematic idea of areas requiring improvement. This thorough review also opens a space for adopting international best practices of infrastructure development management in a country-specific context.

Due to lack of data on each policy issue, this research is limited to a qualitative review. Based on our review findings, future research could be confined to a database of each individual policy, such as the DB procurement modality and its performance. Hence, this comprehensive review best serves as a foundation for future policy studies on evaluating infrastructure development performance in Nepal's construction industry.

4. Review of Road Infrastructure Development in Nepal

4.1. Contribution of the Construction Industry to the National Economy

The national economy has several components that together give a picture of its size. It can be measured through the contribution of each sectoral activity, such as industry,

agriculture, services, infrastructure development, health, energy, and so forth. Among these sectors, the construction industry makes a large contribution to the Gross Domestic Product (GDP). Figure 2 shows the contribution of each economic activity to the economy of Nepal as of fiscal 2020. Construction accounts for 9.81% of the economy (MoF, 2021). We see that the construction industry plays a significant role in the national economy. Additionally, it enhances other sectors by providing quality infrastructure. Therefore, infrastructure delivery through the optimization of available resources should be the top priority of the government for the sustainable development of the needed infrastructure. It is observed that the construction industry plays a significant role in the national economy; however, there is a lack of performance evaluation for the industry. So, in the subsections below, industry performance is further examined qualitatively with respect to highway infrastructure construction management.

4.2. Infrastructure Investment Needs

Infrastructure is key to the socioeconomic development of nations (Sahoo et al., 2010). However, due to a lack of resources, the achievement of infrastructure development objectives is always uncertain. It demands a huge investment, which is always a constraint due to the high demand for infrastructure development in developing nations. In addition, the frequent inefficiencies in infrastructure development and improper resource utilization, such as time and cost overruns, demand capacity enhancement from institutions. The timely completion of infrastructure projects within budget and at the targeted quality is challenging due to the high complexity of such projects. Therefore, governments must devise policies and regulations that enable development objectives to be achieved through the efficient utilization of available resources.

Nepal, a low-income country, has been facing several problems in infrastructure development. The government has implemented policies, rules, and regulations through specialized institutions to achieve its development objectives. However, there are significant delays in infrastructure implementation, as well as in planning. Among the infrastructures, highway infrastructure development at the national level is handled by the MOPIT. This organization is responsible for making policy and executing national transport infrastructure development. The DoR, under MOPIT, is the implementing institution for national highways. The GoN has allocated about one-third of its development budget to transport infrastructure development; however, the targeted objectives have not been satisfactorily achieved (MoF, 2023b; DoR, 2022).

The sustainable development agenda is a global action plan for the achievement of SDGs by 2030, and the GoN is committed to achieving those objectives through its plans,

policies, strategies, and actions. Action plans are developed in each infrastructure sector, and resources are allocated to achieve the targets. It is not only the central government that is working to achieve the SDGs, but so are the provincial and local governments. However, only 20–25% of the financial resources of the government are dedicated to infrastructure development each year, out of which the expenditure efficiency of institutions is only 70–80% (OAG, 2021). This scenario gives a picture of the inefficiency of the institutions at utilizing the available financial resources. The inefficiency has been noted in monitoring reports of the DoR that focus on institutional capacity, coordination, project planning, and human resources management (DoR, 2022). Inefficiency was also noted by the NPC in its 14th plan review, which identified several key areas for improvement: project preparation, land acquisition, contract management, administrative decision-making approaches, construction materials, and coordination between stakeholders (NPC, 2019).

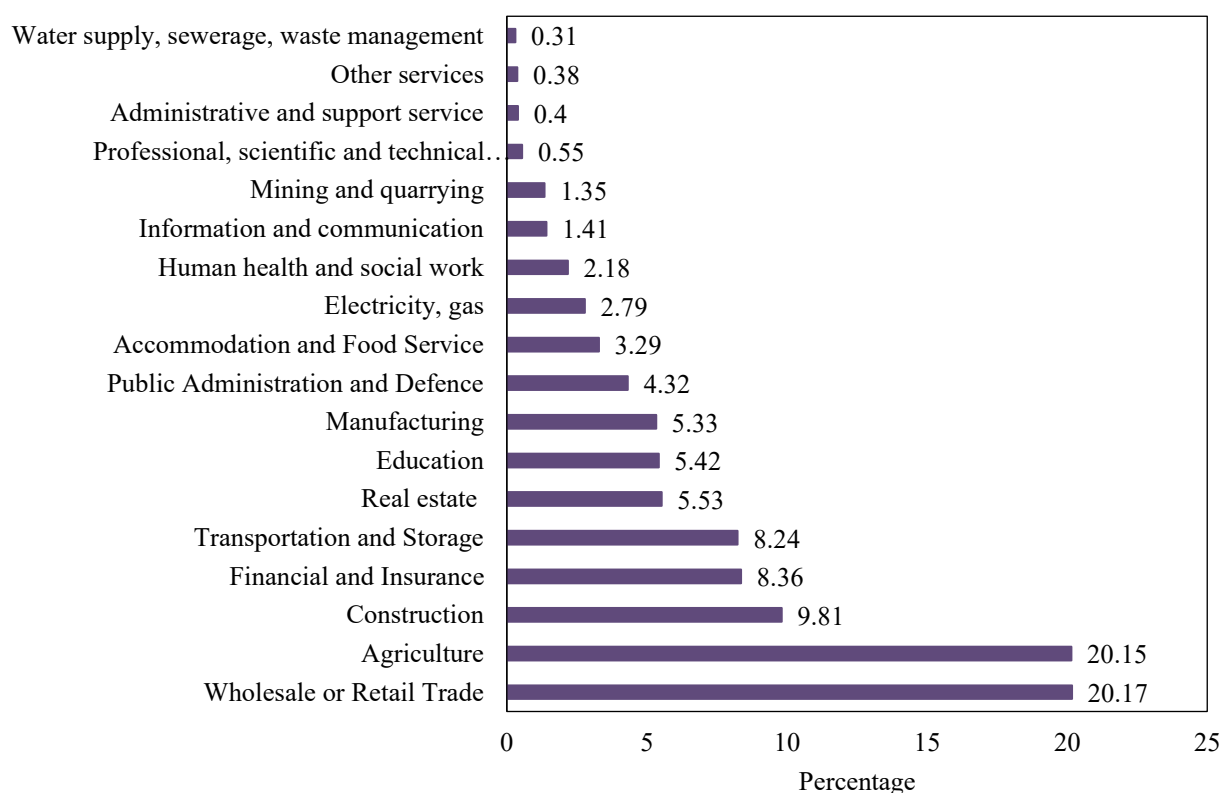


Figure 2 Breakdown of economic activities as a share of Nepal's GDP
(data source: MoF, 2021)

Regarding the financial resources that are required, the NPC conducted an assessment of infrastructure needs to achieve the SDGs by 2023. The assessment estimated that

2025 billion Nepalese rupees (hereinafter: “rupees”) per year on average would be needed to achieve the SDGs. The sources of finance were also defined: 1,111 billion rupees from the government sector, 739 billion rupees from the private sector, 87 billion rupees from the cooperative and non-governmental sectors, and 88 billion rupees from the household sector. A resource shortfall of 585 billion rupees was forecast: 218 billion rupees from the government sector, and 367 billion rupees from the private sector (NPC, 2018). The existing public financing capacity values range from 400 billion to 500 billion rupees per year from the government treasury (MoF, 2023a). This clarifies that there is huge shortfall in investment required to meet the infrastructure demand. However, a report on the government’s institutional capacity has estimated that about 15% of project costs could be saved through the implementation of institutional capacity development measures (Dixit, 2017). Through improvements to institutional capacity, new contracting approaches such as PPP might support the securing of alternative sources of financing for public infrastructure development. Figure 3 presents allocations in the infrastructure sector and requirements to meet the government’s long-term plan for the five fiscal years through fiscal 2020.

This review has helped to identify a gap between the amounts of investment needed to achieve infrastructure development objectives and the amounts secured. The review has tried to make a connection between funding inefficiencies and project management performance. Several studies on infrastructure have explored how execution delays result in cost overruns (Bhattarai, 2023; Paudel & Henry, 2023; Koirala & Shahi, 2024). Thus there is evidence that not only do project delays create financial resource constraints, but they also make it difficult to achieve the infrastructure development targets set by the government (NPC, 2025).

4.3. Highway Infrastructure Implementation Challenges

Managing infrastructure project implementation involves several challenges, such as the capacity of institutions, financial resource availability, risk sharing between parties, environmental and social impacts, and technology transfer (Wegrich et al., 2017). Nepal also has faced global infrastructure project implementation management challenges during the implementation of infrastructure projects. In the highway infrastructure construction sector, key challenges are land acquisition, utility relocation, forest clearance, financial assurance, human resource development, technology transfer, climate change, and governance (NPC, 2022).

Developing countries like Nepal face severe investment constraints due to the great need for infrastructure development. For highways, the MOPIT development plan for 2016–

2021 clarified the financial resource constraints for that period (MOPIT, 2016). Figure 4 shows the yearly allocation of budget and the yearly expenditures required to implement the highway development plan of MOPIT for fiscal year 2016 through 2020. A review of the database on investment needs and availability as a percentage of GDP showed a 4.2 percent gap between these in the infrastructure sector. Furthermore, according to reports from financing institutions, the financing gap for transport infrastructure was 163.2 Nepalese rupees (converted to fiscal 2020 rupees). It can be concluded that the transport sector also has faced financing constraints. Those financial constraints may create project management challenges that affect implementation performance. Hence, the review provides evidence of the resource management challenges in highway infrastructure development in Nepal.

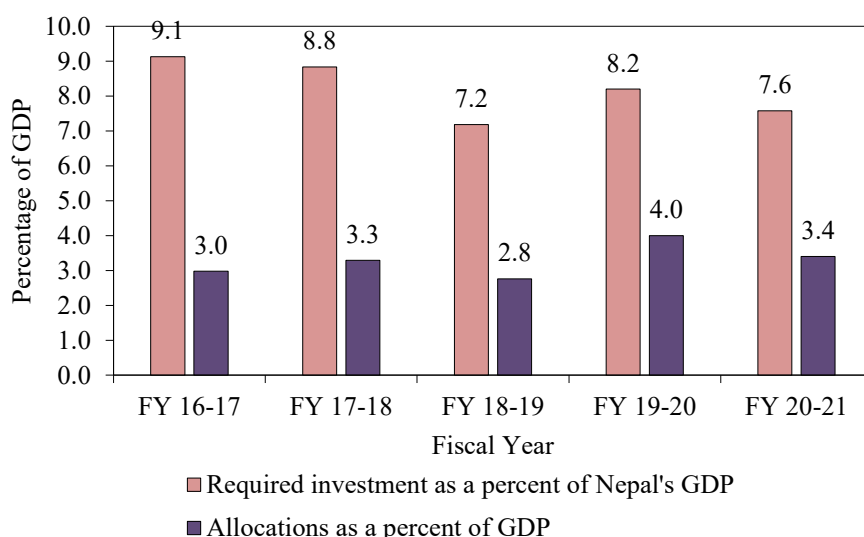


Figure 3 Infrastructure financing requirements and allocations as a percent of GDP in Nepal's infrastructure sector (data source: MoF, 2023a)

4.4. Highway Project Management in Nepal

Since 2015, Nepal has practiced a federal system of a central government, seven provincial governments, and 753 local governments, as specified in the Constitution. Responsibilities are divided accordingly, with national highway construction and maintenance management being handled by the central government (GoN, 2015). Under the central government, 80 national highways totaling 14,913 kilometers connect east to west, north to south, major economic centers, provincial capitals, and international borders (DoR, 2021). Figure 5 shows the central government's transport infrastructure

management institutions, including those for highway implementation and management. The main objective of the DoR, which is the institution responsible for highway infrastructure development and management, is to provide safe, effective, efficient, and reliable highway connectivity within the country.

4.5. Implementation Status of National Pride Highway Projects

The major high-priority highway projects under implementation as of this writing are the Mid Hill Highway, the Postal Highway, North–South Highways, and the Madan Bhandari Highway. These projects have been under way for the last 10 to 15 years and have been implemented using funds budgeted each year by the Ministry of Finance. However, the projects have fixed timelines for completion. Even when financial resources have been available, the implementing institutions have not completely utilized those funds. This has raised questions about the institutional capacity of government institutions and of private-sector organizations. Figure 6 shows the available financial resources and expenditures from fiscal 2018 through fiscal 2022 (DoR, 2023b). The yearly progress reports also raised the same issues associated with poor performance in each year, such as land acquisition, utility relocation, institutional capacity, and many more.

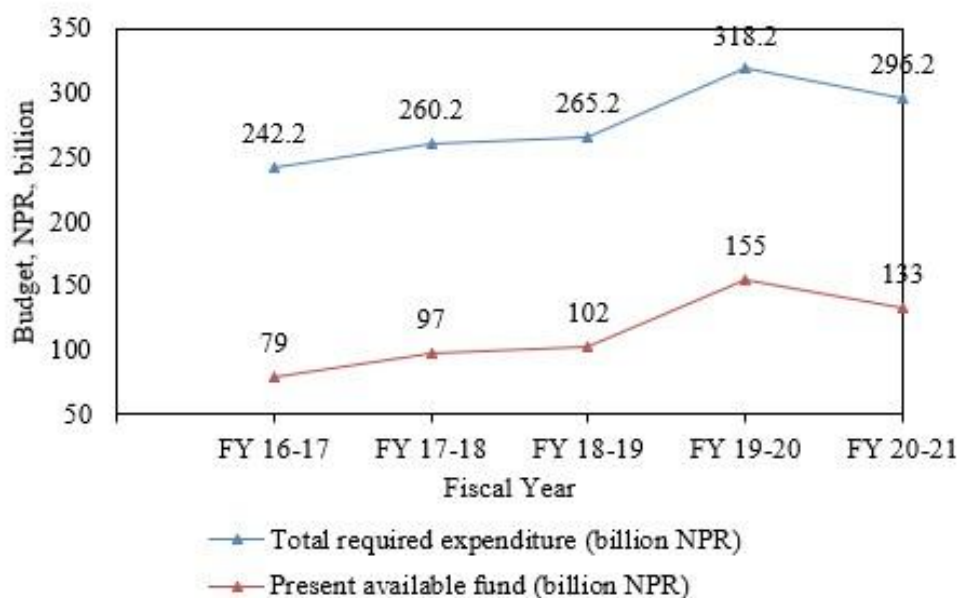


Figure 4 Funds required to implement the strategic plan of MOPIT, and funds available
(data source: MOPIT, 2016)

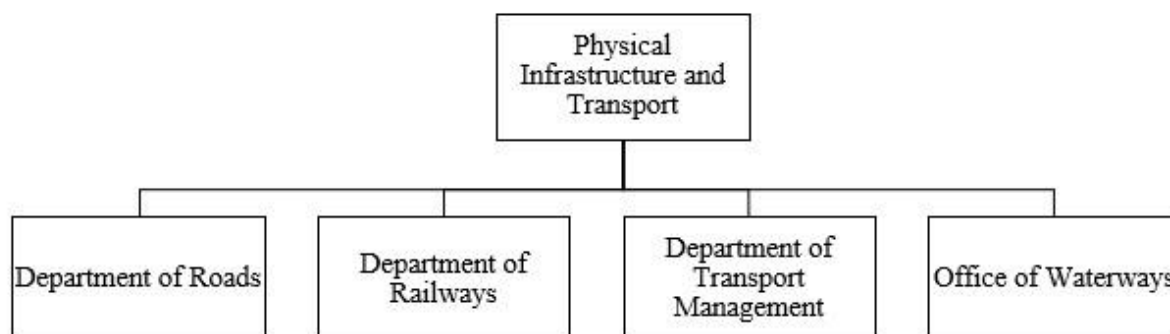


Figure 5 Organizational structure of MOPIT under the central government of Nepal
(adapted from MOPIT, 2024)

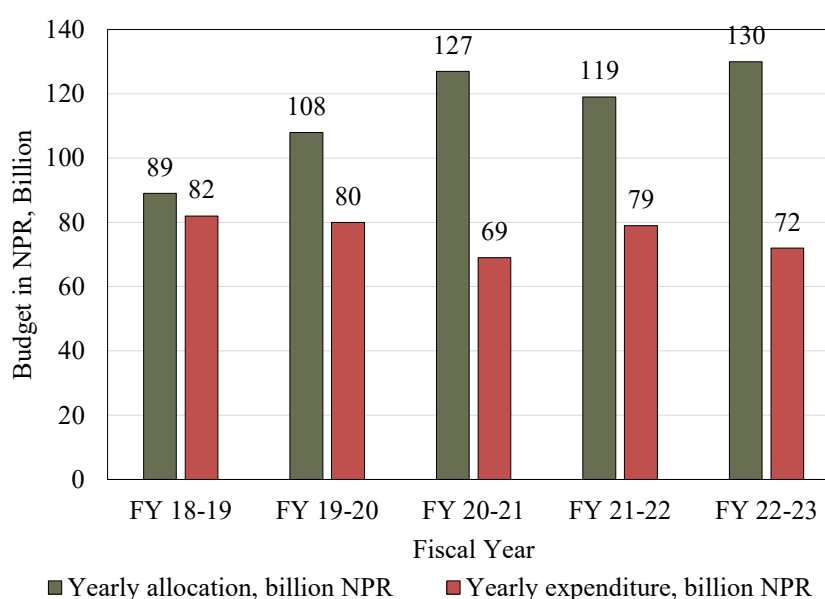


Figure 6 Yearly allocations and expenditures of the DoR for the five fiscal years through FY2022 (data source: DoR, 2023b)

The GoN has emphasized highway transportation and has prioritized three key projects as NPPs. In principle, NPPs receive prioritized resources for implementation, toward enhancing implementation performance. Three projects in the highway sector have been designated as NPPs, based on their socioeconomic impacts: the Mid Hill Highway, the Postal Highway, and the North–South Highway. However, the mobilization of resources

during the last 15 years has not supported this policy direction. Not enough resources have been allocated to NPPs to allow for their completion within the defined time frame, which has led to huge delays for each project. Figure 7 shows the progress called for in the original plan and in the revised plan, and the actual achievement per year. We see that even under the revised plan, none of the three projects will be completed on schedule, requiring further time extensions that will increase the costs of the projects. The progress report published by the DoR in fiscal 2022 notes that completion is roughly 72% for the Mid Hill Highway, 91% for the Postal Highway, and 46% for the North-South project (averaging the three north–south corridors) (DoR, 2023b). Figure 8 shows the originally planned durations and revised duration statuses as of fiscal 2022. The progress statuses clarify that each project needs a few extra years for completion. By highlighting the planning and utilization of resources in major projects, the report raises questions about institutional capacity, project governance, and resource management by the responsible government authorities.

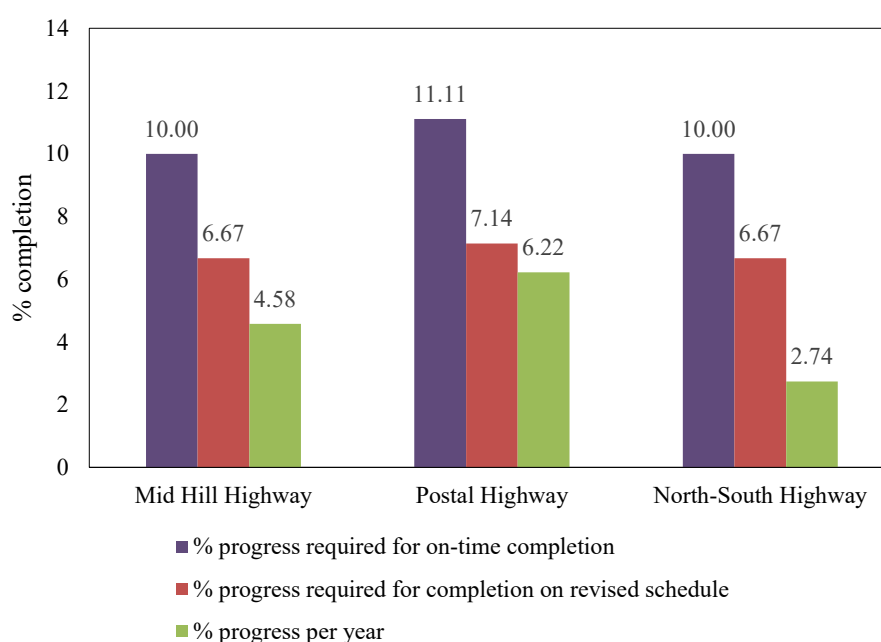


Figure 7 Original, revised, and actual progress for the three National Pride Projects of Nepal

(data source: DoR, 2023b)

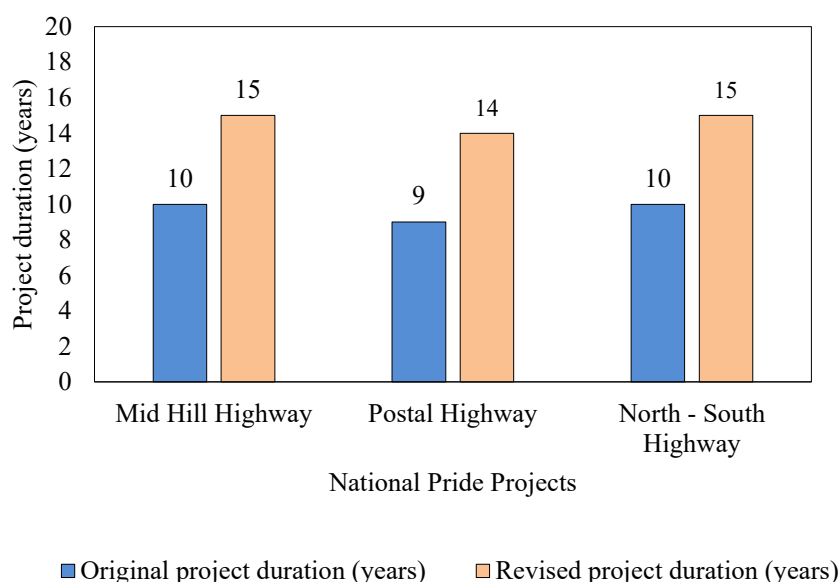


Figure 8 Original and revised durations for the three major National Pride Projects
(data source: DoR, 2023b)

Projects that were implemented through the Department of Roads were reviewed, and the existing database and project management reports showed significant delays in major highway projects. The yearly budget allocations and expenditures also highlight the institutional inefficiencies in resource utilization and implementation performance management. Table 1 summarizes physical progress on NPP highway projects and the main reasons for delays. Every project was delayed by at least 50%. The major issues of poor performance, as mentioned in progress reports, were those of pre-construction preparation and resource management. These figures suggest that highway project management may face issues of low institutional capacity and poor project governance and resource management. This demands a comprehensive data-driven analysis of the project management system for the sector. The qualitative review findings clarify that project delays added extra burdens to financial resource allocation by the government (NPC, 2018).

Table 1 Summary of projects reviewed (as of 2023)

Project	Start year	Planned duration, years	Current completion, %	Primary causes of delay	Financing modality
Mid Hill Highway	2008	10	87.73	Financial constraints, issues of land compensation, issues of utilities relocation, construction material scarcity, disputes in alignment, issues of environmental clearances	GoN financing
Postal Highway	2008	9	72.75		GoN financing
North–South Highway	2008	10	53.84		GoN financing

4.6. Long-Term Vision for Nepal

The GoN has targeted the achievement of its long-term development objectives through five-year periodic plans. The 15th five-year plan includes a long-term vision that extends to 2043 and aims to raise Nepal's status as a developed country (NPC, 2018). This long-term vision was prepared by the NPC, which is a government institution that advises on policy development and monitors infrastructure development. The GoN has implemented several development plans, starting from its first five-year development plan in 1956. This planning process has continued until now, with a few years of plan holidays; however, the implementation of the plans has always lagged behind the targets. From fiscal 2024, the 16th five-year plan began to be implemented, along with the long-term vision. The long-term vision document calls for the SDGs to be achieved by 2030 and for the country to upgrade its status to “middle-income country” by 2030 and to “developed country” by 2043.

It is not only the five-year plans that have given high priority to transport infrastructure development that supports the socioeconomic development of the nation by distributing benefits to society; the long-term visions also have given high priority to such development (NPC, 2019). The long-term vision focuses on infrastructure, institutional development, and governance enhancement through the achievement of the following objectives.

- 10.5% average economic growth
- the strengthening of project preparation and implementation to achieve the SDGs
- partnership with the private sector
- the capacity development of institutions, including of the construction industry
- governance enhancement in each sector

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- policy stability
 - cooperation between the three levels of government
 - construction material management
 - financial management and operational efficiency
 - improvements in contract management
 - interagency coordination
 - improved monitoring and evaluation

The main objectives set by the long-term vision document envisage the importance of infrastructure development and pinpoint the key weaknesses in the management system. The concerns raised by the vision document relate to infrastructure development policies, regulations, institutions, governance, planning, and resource management. The priority areas identified in the plan document show the government's commitment to improving existing management capabilities through plans, policies, strategies, and specific targets. This qualitative content analysis of the GoN's long-term vision published by National Planning Commission also suggested key areas of improvement for the achievement of the long-term vision of infrastructure development (NPC, 2018). Based on this policy document, the following sections review the implementation status of infrastructure-specific policies and the impact of those policies on project performance.

5. Review of Existing Policies for Managing Project Implementation

5.1. General

Infrastructure project planning and management involves many policies, regulations, and acts in Nepal. However, major key aspects are governed by the PPA and the PPR, which support the planning and implementing projects through public funding (GoN, 2007). Most importantly, the PPA and the PPR address cost estimation, procurement, and construction management-related issues covering several procurement approaches. They are linked to several other acts and regulations, such as the Environmental Protection Act and Regulation and the Forest Act and Regulation. Therefore, the PPA and the PPR include broad aspects of infrastructure project planning and implementation that support the sustainable achievement of the infrastructure development objectives.

For example, new projects should have greater socioeconomic impacts than their alternatives and should be in priority areas of national development (NPC, 2023b). However, project prioritization is influenced politically and policy guidance is not followed when budgets are allocated. Ultimately, constrained resources are allocated to multiple projects without assessments of the needs for those projects nor of their contributions to

the national economy (DoR, 2023a). Not only does scattering limited resources across several projects raise issues of resource allocation, but it also affects the implementation time performance. In this context, foreign-financed projects may not have such issues of financial arrangement, because fixed funds are available for a particular project. And so, foreign-financed projects have no issues with fund availability during the implementation phase.

The apex body enforcing the PPA and the PPR is the Public Procurement Monitoring Office (PPMO) of the GoN. It has the authority to develop policies, guidelines, standard procurement documents, and directives to regulate each project and its related activities (PPMO, 2022a). However, there is no stability in policies related to the PPA or the PPR, which is evident from the PPR having been amended three times in a single year (Rajbhandari, 2019). Those amendments also do not address the key project management challenges that have arisen during the last several years. The key aspect addressed during the amendment was pre-construction preparation work, which was made mandatory. However, this legal provision is not adhered to before major highway projects begin their implementation (KTFT, 2022; DoR, 2022). Furthermore, some of the revisions in the government regulations called for contracts to include best practices, such as provisions for time extensions and contract termination. It would be beneficial for the industry to examine the problems within the infrastructure sector and to incorporate solutions into policy revisions. Frequent revisions to procurement policies, regulations, and standards have exacerbated the issue of project delays. Therefore, this review also suggests that expert oversight is necessary when existing policies and practices are reviewed, given that policies and practices are consistently lacking in the Nepalese construction industry.

5.2. Evaluation and Qualification Criteria for the Selection of Contractors

Construction companies are key stakeholders in public infrastructure construction in Nepal. The involvement of private construction companies is guided by the PPA and the PPR. Public institutions set the selection criteria based on the project requirements, which is a globally accepted standard procedure (World Bank, 2020b; PPMO, 2022b). In Nepal, the procedure is standardized by the PPMO and implementing institutions follow that procedure based on the project requirements. Financing institutions working in the highway infrastructure sector of Nepal are the WB and the ADB, whose methods of selecting contractors are very similar to those of the government. However, those banks include advanced options that address social and environmental factors when the performance of construction companies is assessed.

As defined in the standard procurement documents, the average annual construction turnover and specific construction and contract management experience are two major qualification requirements (PPMO, 2022b; World Bank, 2020b). The annual construction turnover measures the yearly monetary value of work performed by a particular construction company in the past. Furthermore, specific construction and contract management experience in highways, bridges, or tunnels indicates the management capacity of construction companies in terms of money and quantity of work. Those key areas are related to time performance measures that help evaluate past performance and provide a foundation to judge future performance in the existing management environment. However, implementation may involve future uncertainty that could affect the implementation time performance, thereby affecting the capacity of the construction company. In that situation, the construction company is compensated based on the type of delay and its impact on project implementation. Evaluating the effects of uncertainty during project implementation depends on contract agreements between the client and the contractor. For large contracts, standard contract documents of the FIDIC, which are well recognized in the construction industry around the world, tend to be used (FIDIC, 2017).

This review of procurement practices in Nepal's infrastructure sector notes that standards adopted by the government need to align with international best practices, such as the standards of FIDIC and financing institutions. The alignment of such procurement standards may foster an environment that is conducive to international participation as well as to private financing for public infrastructure development. Therefore, this review suggests that policy makers and practitioners review procurement standards in order to achieve value for money and sustainability.

5.3. Contractor Selection Process in Public Construction

For public infrastructure construction, contractor selection methods are defined by the PPMO based on the PPA and the PPR. The standard procurement documents developed by the PPMO specify the criteria for the selection of a capable construction company based on the project requirements (PPMO, 2022b). Furthermore, projects financed by international institutions use standard procurement documents. These documents are used in all the countries that receive funding from the financing institutions, such as standard procurement documents of the World Bank and the Asian Development Bank (FIDIC, 2017; World Bank, 2023). Before selecting a construction company for a particular project, the public entity defines the scope, time frame, and resources required to accomplish the work within the defined timeframe.

Based on the scope, resource requirements, and duration of the project, selection criteria are defined, such as financial turnover and specific construction and contract management experience. As an example, the World Bank uses a standard procurement document. The requirements similar to those stipulated in PPMO documents as the major selection criteria, such as the bidder's yearly financial turnover in construction work and its specific work experience (World Bank, 2023; PPMO, 2022b).

Financial turnover indicates the value of work performed in a year by a particular company. Specific work experience is measured in terms of the volume and scope of work similar to the proposed project. Furthermore, experience in key construction activities serves as experience that a company can apply to key areas of the project. For example, a construction company should have experience on an expressway construction project valued at United States Dollar (USD) 1 billion or the equivalent in a defined period in order to be considered for a project equivalent to USD 1 billion. For experience in key activities, the yearly performance rate in the past is evaluated by combining the production rate in the most recent defined period. For example, if a project calls for 9,000 cubic meters of concrete work to be finished within 3 years, then the construction company should have experience of 3,000 cubic meters of concrete work per year in any one year (World Bank, 2023; PPMO, 2022b). In addition to these key criteria, there are several other requirements, such as equipment and labor to perform the work and a statement of the methods to be used. The government agency/employer evaluates the proposals submitted by the construction companies to check their ability to meet the technical and financial requirements of the project. After all the requirements are examined, the construction company that presents the lowest bid while meeting the requirements is awarded the opportunity to build the proposed infrastructure. This methodology is generally applied in DBB and DB contracts. However, with some modifications, other contracting approaches have used a similar approach to contractor selection in public infrastructure acquisition. The most important aspect for selection is the bidder's time frame-related experience in specific sectors, such as highways, bridges, tunnels, and so forth. Time has value as a measure of performance, and construction companies that fail to show favorable time performance could see their bids adversely affected.

This thorough process of examining construction companies' qualifications highlights the importance of selecting construction companies with sufficient qualifications. However, the most qualified firms are not always awarded contracts, due to lax enforcement of the mentioned legal provisions. This review also suggests that national regulations need to include more detailed provisions for the examination of qualifications and performance capabilities. Recently, international financing institutions have developed more robust

qualification examination methods, such as rated criteria or merit-based criteria, for selecting the most qualified construction companies (World Bank, 2023). So, the government needs to review its legal framework and standards and needs to incorporate and implement such comprehensive approaches to construction company selection in its national standards. In this manner, the government may benefit from the timely completion of construction projects and may support the enforcement of better-performing regulations.

5.4. Construction Company Participation Arrangements

Public procurement has basic principles focusing on value for money, transparency, economy, competition, efficiency, integrity, and fit for purpose (World Bank, 2017a). To achieve those objectives through the use of public money, the GoN passed the PPA in 2007 and the PPR in 2008. Furthermore, financing agencies have the flexibility to use national standards because they can use their own regulatory standards depending on financing agreements and project requirements. As an example, the WB uses the Procurement Framework for IPF Borrowers. This framework has provisions that call for contractors/suppliers/consultants to be procured according to basic procurement principles (World Bank, 2020b). Whatever the financing arrangement, the principles to which participating construction companies should adhere are more or less similar. A provision sets the terms for single participation and joint venture participation based on the scope of work and the capabilities of the construction companies. This provision allows companies to form joint ventures with national companies and international companies depending on the scope of the work and their individual capacity. A construction company is allowed to participate as a single bidder if it is able to meet the bidding requirements for a project. If a company examines the bidding requirements and finds its individual capacities to be insufficient, it forms a joint venture with other companies to meet the requirements of the project (PPMO, 2022b).

Furthermore, the number of joint participation companies is limited by the standard procurement document of Nepal to a maximum of three (PPMO, 2022b). In the case of Nepal's construction sector, due to the limited capacity of domestic construction companies, technically complex, high-risk projects require joint ventures with international construction companies to meet the construction project requirements. Joint participation with international construction companies not only enhances the capacity of the domestic construction industry, but also supports technology transfer. However, international partners are not permitted on contracts of less than 5 billion rupees, under the assumption that domestic companies can meet the needs of such projects (GoN, 2007). Furthermore, high-capacity international companies might not be attracted to low-

value projects. Before provisions that restrict international construction companies are implemented, the capacity of the national construction industry needs to be assessed. The provision excluding international partners from contracts of less than 5 billion rupees does not apply to foreign-financed projects. For projects financed in that way, foreign construction companies can enter into joint ventures regardless of the project value. However, foreign construction companies have tended not to be involved in implementation management onsite, despite such involvement being stipulated in the bidding requirements (FIDIC, 2017; PPMO, 2022b; World Bank, 2023). Domestic construction companies have formed joint ventures with international construction companies solely for the purpose of winning certain bids by highlighting the experience of their international construction partners (NIRTTP, 2019). International joint venture partners were not involved in 33% of projects financed by the ADB in Nepal's highway infrastructure construction sector in 2018 (Miyao & Chand, 2023). This shows that government agencies do not strictly enforce regulatory provisions, an issue that has been raised several times by the audit authority of Nepal (OAG, 2021). However, there have been no significant improvements in resource sharing by international joint venture partners during project execution due to poor governance in implementing existing regulations. Therefore, the non-involvement of international joint venture partners during the execution period has to be evaluated in the existing project management environment, toward the adoption of measures for the enforcement of legal provisions. Due to the lack of enforcement of regulatory provisions for joint ventures with international companies, intended capacity development and technology transfer may not materialize, which affects the development of the capabilities of domestic construction companies.

Regarding resource mobilization by construction companies in project implementation, construction companies in single-participation contracts have not performed well. Construction companies are legally permitted to subcontract up to 25% of their contracted work with the approval of project manager (PPMO, 2022b). But this legal provision is not adhered to by contracting parties. Work is transferred to low-capacity subcontractors whose capacities are not assessed. Furthermore, without the approval of the responsible government agency, subcontracting is practiced in the Nepalese construction industry. This has raised questions about project governance in Nepal, which was also criticized in an OECD study of 25 developing nations on the achievement of their sustainable infrastructure development objectives (OECD, 2017).

In the case of joint participation, each member of the joint venture should be jointly and severally liable to the public entity for the accomplishment of the construction activities as stipulated in the contract agreement (PPMO, 2022b; FIDIC, 2017). However, this principle of joint arrangement tends to be violated by the joint venture partners after the

construction contract is awarded. Single members of the joint venture take responsibility for all the work without the support of the other members (NIRTTP, 2019). The absence of international joint venture partners at local construction sites has also raised practical questions about the enforcement of the joint venture principle (Miyao & Chand, 2023). Whatever is the construction company arrangement, the issue of resource mobilization by the companies needs to be reevaluated in order for the legal provisions to be implemented and for construction company participation arrangements to be improved. Having reviewed the available policies, project reports, and practices at the project site, we can conclude that the joint venture partners lack the capacity to mobilize resources. The mobilization of a single partner at a site with only that partner's own resources is a serious violation of the contract agreement, and this is predominantly observed in Nepal's construction industry (Miyao & Chand, 2023). This may cause delays in project implementation from the inability to secure sufficient resources within the stipulated time. Another study by Paudel and Henry (2024) on Nepal's highway infrastructure sector showed that contractually required joint-venture partnerships are not established at sites. Due to a lack of resources, highway projects frequently face delays and cost overruns. Therefore, the full enforcement of joint participation at the execution level and proper monitoring may enhance the implementation performance of projects. Additionally, national–international joint participation adds further value by enhancing the capacity of the local construction industry through technology transfer. Therefore, this review recommends the development of an enforcement framework.

5.5. Project Cost Estimation Approach

Not only does the project cost reflect the cost of activities, but it also includes the cost of risk during implementation. Estimating infrastructure project costs considering the future risk of the project is a complex task (Tan & Makwasha, 2010). Many risk factors may arise during implementation, such as price inflation, extreme weather, scope changes, compensation claims, environmental and social impacts, changes to interest on loans, and fluctuations in construction material prices. When the project costs are estimated during the project planning stage, all these components should be included, in addition to the base cost of the project. In this complex management environment, proper risk analysis of projects provides a clear picture of the impact of particular risk factors on project activities; accordingly, the costs of risks can be estimated so that the project cost can reflect those risks. However, available resources are limited, so they need to be efficiently utilized in order to achieve the infrastructure development objectives of the nation. Therefore, governments have developed policies and regulations for streamlining project cost estimation that incorporate all the risk factors for more realistic project cost

estimates. Future planning, such as the contractor selection process, is based on the estimated project cost.

The GoN has implemented the PPA and the PPR as basic regulatory guidelines for project cost estimation that incorporate all the risk factors (GoN, 2007). For highway construction projects, guidelines developed by the DoR are applied to the estimation of project base costs estimation that incorporates construction activity costs and quality management costs (DoR, 2019a). However, not much discussion has addressed ways of incorporating the impact of future risk factors into the base costs of a project. Future risks of projects include scope changes, price variations due to inflation, and other uncertainties that may hamper project implementation management by introducing time and cost overruns. Neglecting these risks can affect project implementation performance (World Bank, 2020c). Without an identification of the costs posed by risk factors, disputes may arise during the project execution period that lead to project delays. A review of existing practices of project cost estimation suggests that even risks with minimal effect on the project schedule should be considered.

5.6. Approaches to Estimating Project Duration

Infrastructure projects have long implementation durations that involve several uncertainties. Therefore, it is difficult to estimate the project duration without knowing several components of projects. For the project duration to be properly estimated, past project evaluations, risk factors, resources, project scope, risk-sharing mechanisms, and other information must be in hand (Thornton, 1988; Irfan et al., 2011; Hancher & Rowings, 1981). There is a break-even point between project duration and cost. Figure 9 clarifies resource optimization for achieving the project objectives in time. Any increases or decreases in time from the optimum point add costs to the project. The basic principle for estimating the project duration is activity duration estimation: the sequencing and identification of the critical path for the project. For such estimation, widely used techniques are CPM and the PERT, which provide activity durations and their linkages and allowances for risk factors (Poltnick & O'Brien, 2009). While implementing new approaches, the institutions should have the ability to handle the system such as to achieve efficiency. Furthermore, project complexities and government priorities are important aspects in estimating a project's duration (Nakayama et al., 2012; Dao, 2016). Inaccuracies in estimating the project duration may affect extensions of that duration (Haseeb et al., 2011).

In Nepal's highway infrastructure construction sector, there is no systematic approach to project duration estimation. Typically, small projects are for a single year, and large

projects require multiyear approval from the relevant government authority (NPC, 2023b). However, multiyear projects are set to run between two and five years, without consideration of resource availability, contractor capabilities and availability, and future risks in infrastructure implementation management (DoR, 2022). Foreign-financed projects also do not follow standardized methods for project time estimations, such as CPM or PERT. They focus only on the financing agreement with the government, define the scope of work in general, and agree on three years of construction period in general (World Bank, 2020a).

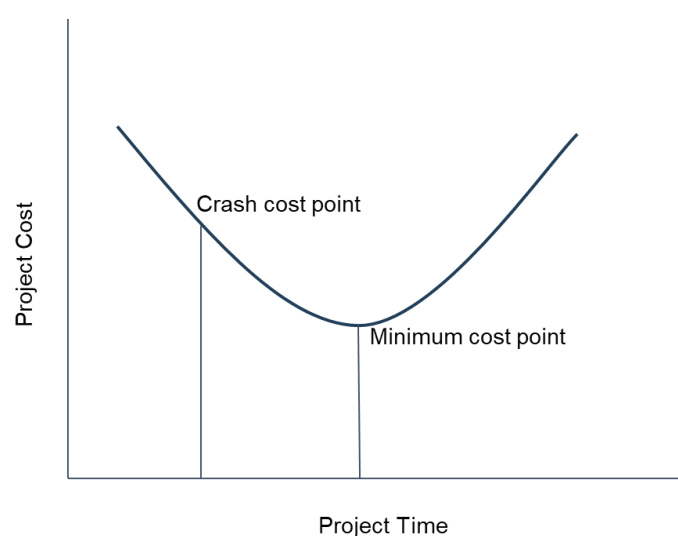


Figure 9 Relationship between project time and project cost in infrastructure construction projects (adapted from Thornton, 1988)

In reviewing and planning financial resources, the GoN has applied the Mid Term Expenditure Framework (MTEF) (NPC, 2023c). However, it does not use a standardized methodology to assess the appropriateness of the project duration when forecasting financial resources. This shows an arbitrariness in decision-making on project resource estimation that ultimately creates resource constraints. Due to this haphazard estimation of the construction duration in highway infrastructure projects, there are always uncertainties about resources, risk management, and project success. Not only does this practice adversely affect individual projects, but it also affects institutional capacity development for future projects in Nepal. Hence, this review suggests that standardized time-estimation techniques need to be followed with due consideration of available resources, the capacity of institutions, the requirements of particular project outcomes, and so forth. Resource optimization techniques must be followed for the efficient use of scarce resources in developing nations such as Nepal.

6. Review of Delays in Construction Project Management

Infrastructure construction projects always involve uncertainty due to their high complexity and long duration of implementation (Assaf & Al-Hejji, 2006). Not only does this complexity affect management, but it also affects the timely achievement of development objectives with the minimization of adverse impacts on society and the environment. Several country-specific studies in the developing world have identified key deficiencies in the implementation of infrastructure projects that affect time and cost performance (Alsuliman, 2019; Alzara et al., 2016; Amare et al., 2017; Anuar Othman et al., 2006; Bhattarai, 2023).

“Delay” is the common term in construction projects for a lengthening of the originally planned duration that affects the critical path of the project. In the case of delays arising due to events beyond the control of the construction companies, standard contract documents in Nepal provide for the extension of the intended project duration (PPMO, 2022b; FIDIC, 2017). This contract provision is supported by national regulations of the Nepalese government through the PPA and the PPR, which also demand that every aspect be carefully examined when decisions on project duration extension are made (GoN, 2007).

The government of Nepal has endeavored to efficiently meet the demand for infrastructure through policies, planning, and resource mobilization (NPC, 2019; MoF, 2023b). However, many management issues remain, such as institutional inefficiencies, coordination failures, the lack of delegation of authority to the project manager, unrealistic contract durations, and frequent changes in regulations, project teams, and so forth. These have not been addressed for the past three to five decades due to lack of significant improvement interventions (OAG, 2021; Rajbhandari, 1998; Wildavsky, 1972). So, inefficiencies in infrastructure implementation management might be improved through the proper evaluation of existing practices and policies. A review study of infrastructure project delays in Nepal identified institutional, financial, political, and governance issues as the key primary factors affecting project implementation time performance and the socioeconomic development of the country (Bhattarai, 2023). However, issues for each sector have not been evaluated using a project database, as no dataset exists. To evaluate the implementation performance of projects and to incorporate measures to mitigate project implementation delays into future projects, it is necessary to create a project database.

Most issues of infrastructure implementation management in developing nations are held in common by those countries (Mejía et al., 2020). However, there may be country-

specific and infrastructure sector-specific issues. Nepal faces issues of implementation management that are similar to those of other developing nations; however, no comprehensive studies have identified sector-specific issues. There are only reports on project evaluations and monitoring from implementing institutions and monitoring institutions. Several reports have highlighted resource constraints, a lack of institutional capacity, improper planning, political influence in project selection, and weaknesses in construction material management and in the utilization of construction company resources at construction sites (OAG, 2021; NPC, 2023a; DoR, 2022). Therefore, to enhance the implementation performance of infrastructure projects, microscopic and macroscopic aspects of implementation management need to be addressed within the constraints of the resources.

Furthermore, key concerns of the implementing institutions include improperly handled project preparatory work in Nepal's highway infrastructure sector, such as work on land acquisition, utility relocation, and environmental risk mitigation measures in the early phases of a project (OAG, 2021; DoR, 2022; NPC, 2023a). The intent of standard contract documents and GoN regulations is that the work site should be free of obstructions before construction starts (FIDIC, 2017; GoN, 2007). However, this legal provision is frequently disregarded due to external influences from the political sector, urgency imposed without resources, and resource constraints on pre-construction activities. Therefore, there are extreme implementation delays in highway projects that affect investment costs, benefits achievement, increasing disputes among the parties, and legal complexities within the construction management sector (DoR, 2022).

In managing resources for projects, most planning institutions in Nepal focus only on financial resources. There is little discussion on the management of human resources, materials, and equipment when infrastructure projects are planned. In the highway infrastructure construction sector, GoN-financed projects have longer delays than foreign-financed projects have (Paudel & Henry, 2023b). However, while foreign-financed projects are lacking in pre-construction activities, resource mobilization, and proper decision-making, as reflected in the implementation time performance, such projects have greater concern for project preparatory work, such as social and environmental risk mitigation, and a comprehensive framework is applied to address the concerns of stakeholders (World Bank, 2017b). The applicability of advanced approaches in the local context remains questionable due to the limited capacity of institutions and governance within the country. Learning from the foreign financing institutions and relying on their continuous support, the GoN also has implemented an environmental and social framework to address environmental and social concerns during the planning and implementation of highway projects (DoR, 1993). Still, the

adoption of measures suggested by the regulations has been lacking. There is the need for continuous improvement to enhance the capacity of institutions. Furthermore, institutional best practices in the international construction sector might add value to national construction industry capacity enhancement.

Table 2 presents an overview of the average delay and the financing modality for each major highway project. Every project shows at least a 50% delay, regardless of the financing modality. This summary highlights that, whatever is the financing modality, other issues such as those of pre-construction preparation, institutional matters, governance, and resource management may be critical in the overall performance of an infrastructure project.

Table 2 Overview of delays for major highway projects

Project	Start year	Planned duration, years	Revised duration, years	Delay, %	Financing modality
Mid Hill Highway	2008	10	15	50.00	GoN financing
Postal Highway	2008	9	14	55.56	GoN financing
North–South Highway	2008	10	15	50.00	GoN financing
Average delay of GoN-financed projects				51.85	
Road Development Sector	2008	5	8	60.00	Foreign financing

This section has given an overview of issues identified as being associated with delays in highway construction projects and other infrastructure projects in Nepal. The qualitative content analysis of previous research articles, project review reports, and progress reports of government institutions have identified a long list of micro issues. These micro issues are broadly classified as relating to planning, resource management, financial constraints, project governance, and institutional capacity. This type of qualitative examination can be utilized for reviews of broader aspects of project management as well as for reviews of micro-level issues on basic themes. Further evidence can be provided by making available the sectoral database of projects.

7. Review of Project Risk-Sharing Mechanisms

7.1. General

Risk-sharing mechanisms are defined in construction contracts between the contracting parties to improve the implementation performance of infrastructure projects. Certain risks that can be efficiently managed by private construction companies are transferred to them for the better management of risk by harnessing the efficiency of the private sector (Marques & Berg, 2011). There are several arrangements of contracts that determine the level of risk borne by the construction company, such as DBB, DB, EPC, and PPP. Nepal's highway infrastructure construction sector mostly uses risk-sharing through DBB contracting, in which all design and construction-related risks are borne by the government agency (PPMO, 2022b; World Bank, 2016). When risk is transferred, each party's ability to handle it should be assessed for the better management of risk factors. However, in some instances, some construction risks that are the responsibility of client organizations are handed over to the contractors. For example, utility relocation risk is transferred to the construction company, but such relocation should be handled by the client and completed before the contract is awarded (GoN, 2007). Even in foreign-financed projects that use DBB contracting, this risk is transferred to the construction companies, which may affect the implementation performance of those companies. In some bridge construction contracts, DB contracting has been used since 2013, especially in long-span bridge construction. In such contracting, the risk of design is transferred to the construction companies for the better management of design risk, as the construction companies may be more efficient than government institutions.

Recently, to improve risk-sharing mechanisms, the EPC approach has been initiated in the DoR. Furthermore, in the past, a few PPP contracts were initiated, but they were unsuccessful due to a lack of institutional capacity and improper risk sharing between the parties. From the use of these risk-sharing mechanisms, several issues and learning points have been identified. The following sub-sections explore existing risk-sharing mechanisms associated with contracting methods and their impact on project implementation performance.

7.2. DBB/Item Rate Contract

DBB is a contracting approach for public infrastructure acquisition in which all the risks of design and construction are borne by the public institutions (Allen, 2001). This approach to contracting is generally termed an item rate contract, with activities listed in the contract being carried out by the construction companies within the timeframe defined

in the contract. In adopting this approach, the implementing institution hires a team of experts or uses in-house experts to prepare the detailed design. Then, the construction company is contracted to implement the design. The construction company does not take any risk related to design or unforeseen events during the implementation phase.

The highway infrastructure construction sector of Nepal has predominantly used DBB contracts. This approach is adopted by financing institutions such as ADB, WB, and JICA. In the government's procurement regulations, the DBB approach is specified for routine work in which the design and construction involves low risk (PPMO, 2022b). However, most highway projects use DBB contracting, so issues of design or uncertainties arise during implementation that may lead to conflicts or disputes between the contracting parties. The regulation has specified several other approaches to contracting, but fully developed standards are not available for implementing the new approach to contracting. There are several issues related to scope change during implementation that can be easily incorporated into DBB contracting through changes to the scope of work. Therefore, implementing institutions favor this approach and are not ready to adopt alternatives. There are several issues related to delays and cost overruns in DBB contract implementation, which demand a review of the contracting approach based on the complexity of the project (OAG, 2021; DoR, 2022).

When the DBB approach is used to review project implementation, there is the chance of scope change or unforeseen events/situations during such implementation. Additionally, force majeure events can happen at any time. All those circumstances create a platform for delays and disputes between the contracting parties that can lead to cost overruns. Therefore, this review suggests the adoption of better risk-sharing concepts that transfer design and other specific site-related management risks to the construction companies (Wu, & Zhang, 2020; Grimsey & Lewis, 2004). Specifically, activities with high technical and management capacity-related risks may be better managed by private parties than by public institutions. A comparative study of bridge projects implemented under the DoR of Nepal showed that transferring design risk to private parties led to better performance during construction (Paudel & Henry, 2023). Hence, we conclude that meeting the demand for infrastructure in Nepal requires further study based on situation of the private sector.

7.3. Design–Build Contracts

The contracting arrangement in which the design-related risk is transferred to the construction company in public infrastructure construction is termed DB contracting (Allen, 2001). DB contracts afford several benefits in terms of achieving value for money

by harnessing the efficiency of construction companies. Such contracts are adopted to minimize the burden on the client of design and to best utilize market efficiency in optimizing design preparation (Ling & Kerh, 2004). However, the capacity of the private sector should be examined before design risk is transferred to the construction companies. In this global market, construction companies have more flexibility to involve experts for the optimization of designs considering value for money. In adopting a new approach to contracting, such as the DB approach, each contracting party should have capacity enhancement measures in place so that risks can be better understood and managed during implementation.

In Nepal, DB contracting was started in 2013 for the construction of long-span bridges under the DoR, utilizing the capacity of domestic construction companies (Timilsina et al., 2020). However, these companies are largely dependent on international designers in the initial phase. Standard procurement documents still have not been standardized to implement this approach under GoN financing. International financing institutions have standard documents, but these institutions do not use this approach, which may be due to the inability of the local construction industry to properly adopt this new approach. The experience of the DoR since 2013 in bridge construction implementation using the DB approach, future improvements in standards, and the adoption of these standards in a wider range of infrastructure construction need to be explored for the better arrangement of risk toward enhanced implementation performance of construction projects.

By designating a single point of responsibility for design and construction, DB contracting affords the benefits of minimizing design errors, reducing changes in scope, and optimizing the utility of the final output (World Bank, 2021). A study of bridge construction projects in Nepal compared DB-contracted projects, which are managed by Project Offices (POs), to DBB-contracted projects, which are managed by Division Road Offices (DROs). The DB-contracted projects were found to have significantly better implementation time performance (Paudel & Henry, 2023a). This study comparing DB and DBB contracting explored the role of the DB contracting approach and dedicated institutional arrangements in the implementation management of national highways (DoR, 2019b).

To execute infrastructure projects, a team of experts are required that exercise specified duties throughout the implementation period, which may be lacking in DRO management due to the multiple responsibilities of maintenance and new construction management. POs were established under the concept of improving the implementation performance of projects by properly utilizing human resources. However, there are issues of time and cost overruns in the DB approach, which may be due to a lack of knowledge and

experience of this approach by the contracting parties. Therefore, approaches to developing institutional capacity should be continuously adopted to improve implementation performance for future DB-contracted projects (Alzara et al., 2016). The improved institutional capacity of institutions further supports the initiation of advanced risk-sharing approaches such as EPC and PPP. It is emphasized that to improve the time and cost performance of construction projects, better risk-sharing arrangements need to be explored (Shrestha et al., 2013).

This subsection, which focused on the Design–Build contracting modality in the implementation performance of construction projects, clarified that transferring the design risk to construction companies could improve implementation time performance. However, public institutions should have enough institutional capacity to institutionalize new approaches to procurement and implementation management in the infrastructure development sector. Therefore, the government should focus on implementing projects with better risk management and institutional development. The review reports and the policies in DB contracting showed a lack in terms of the application of international best practices and of guidelines and standards for implementing new contracting approaches in high-value infrastructure development.

7.4. Engineering Procurement and Construction

The EPC approach to contracting further transfers the design and construction risks to the contractors by defining key performance indicators (Tsolas, 2020). The client is largely uninvolved in detailed design preparation, meaning that the contractors have greater flexibility in preparing detailed designs. EPC contracting, referred to as “turnkey contracting” by FIDIC, defines performance indicators and cost and schedule risks solely borne by the construction partner (FIDIC, 2022). The key to implementing this approach is for the contracting parties to have sufficient capacity and to observe fair management practices. Otherwise, mistrust may arise between the parties that ultimately creates disputes during implementation. The authority in Nepal that is responsible for procurement, the PPMO, has recently developed a standard procurement document for implementing EPC contracts in Nepal (PPMO, 2022b). The standard document developed by FIDIC, which is widely accepted in civil infrastructure construction around the world, is also used (FIDIC, 2022).

EPC contracting for highway infrastructure construction has recently been initiated in the DoR for tunnel and flyover construction projects (DoR, 2023b). Furthermore, one expressway project connecting the capital of Nepal to the southern part of the country is under construction using EPC in several contracts. The Kathmandu–Terai/Madesh Fast

Track Project (KTFTP) has used the EPC approach in road, bridge, and tunnel construction work that involves several geological complexities (KTFT, 2022). Most of the work is being done by international construction companies, which is key to enhancing the capabilities of the local construction industry through joint ventures or subcontracting. However, there is limited involvement by domestic construction companies, which may limit technology transfer and the capacity enhancement of local industry. Therefore, the government needs to focus on enhancing the capacity of public and private institutions to better manage the EPC modality so that future projects can be handled by local companies. The largest transport project in Nepal, the KTFTP has created several opportunities for capacity enhancement in infrastructure implementation management through new approaches to contracting. No highway infrastructure projects have been completed under EPC. Therefore, the performance evaluation of EPC in a local context requires a database of completed projects.

The review findings show that the GoN has tried to implement the EPC contract modality without first establishing the proper institutions and policy documents. The government reports highlight that a transition from traditional contracting modalities to EPC requires better policy guidance and institutional capacity. The first experience in KTFTP implementation could be a benchmark for gaining experience and could provide the foundation for institutional development. Recently, the government has revised its procurement regulations such as to incorporate the EPC modality and has started a few projects under that modality. However, the procurement documents and regulations do not match the international standard developed by FIDIC. So, this review suggests that standards and regulatory mechanisms be developed in line with FIDIC or similar international standards. Private parties need to accept greater risk when implementing high-value, high-risk infrastructure projects such as tunnels and dams.

7.5. Public–Private Partnership

The PPP modality of infrastructure development is an advanced approach to infrastructure delivery that harnesses the efficiency of the private sector and develops a partnership by sharing resources, risks, responsibilities, and rewards between the public and private sectors (ESCAP, 2011). This approach is key to complex infrastructure development that requires huge resources, high technology, and the capacity to manage them efficiently. Economies facing severe financial constraints for infrastructure development can utilize this approach to recruit private finance for public infrastructure acquisition for the public benefit. This long-term contracting arrangement has several forms, such as build–own–operate–transfer, build–operate–transfer, build–own–operate, design–build–finance–operate–maintain, design–build–finance–operate, and the like.

Implementing this complex approach requires an efficient PPP legal framework, capable institutions, transparency within those institutions, an efficient risk-sharing mechanism, transparency in the decision process, standardized procedures, and specifications for output measures (Abdel Aziz, 2007).

The GoN proactively searched for a new approach to contracting and drafted the Private Investment in Construction of Infrastructure Act in 2006 through PPP to meet the growing demand for infrastructure in the country. The GoN started PPP contracting on two highway projects: the Kathmandu–Hetauda Tunnel Road Project (NPBCL, 2014), and the KTFTP (KTFT, 2022). In the case of the Kathmandu–Hetauda Tunnel Road Project, the failure of the project before financial closure was due to a lack of financing assurance from the private sector (NPBCL, 2014). Before investing in a megaproject, investors may need to evaluate the risks related to legal and institutional arrangements, because their investment continues for long period. The next project, the KTFTP, was started in 2008 using PPP contracting. This PPP approach did not conclude successfully due to several issues that arose during the selection of a private-sector partner for the project, and the GoN abandoned PPP in this project and reinitiated the procurement process under the EPC method with government self-financing in 2017 (KTFT, 2022).

An analysis of institutional failures for highway projects under the PPP modality also noted the failure of the KTFTP in the PPP modality due to a lack of legal and regulatory standards, which are linked to the institutional capacity of the nation (Munakarmi, 2020). The reasons for failure have yet to be properly evaluated, but in 2019, the government realized the legal and institutional weaknesses of PPP project delivery and formulated the new PPP Act. This act incorporates several regulatory frameworks and institutional arrangements to reassure private investors (IBN, 2019). Still, several institutional setups are pending for a fully functional PPP approach within GoN institutions. The GoN has come to realize the importance of the PPP modality in managing resources and meeting infrastructure demand, and there have been discussions with financing agencies about the adoption of the PPP approach in highway infrastructure development (World Bank, 2020a).

This review of PPP contracting arrangements identifies weakness in institutions, policies, and standards. The example of a failed highway project clarifies that policies and standards were not fully developed to attract private-sector financing. Furthermore, the government has not established institutions to manage large-scale highway development projects under the PPP modality. To attract private-sector investment in highway infrastructure development, the GoN launched the Hybrid Annuity Model (HAM), which had been successfully implemented in India (World Bank, 2020a; Jagannathan, M., &

Soneji, J., 2019). Finally, it can be concluded that financial resource requirements and contractual risk-sharing strategies should be followed by the government to enhance project performance through market-based efficiency and rational public infrastructure development and management.

Through the review of risk-sharing mechanisms in infrastructure acquisition by the public entities, the summary of the risk matrix along with mitigation measures to improve the overall system has been presented in Table 1. Mostly, the DBB contracting approach is used in highway construction projects, which are dominated by the Employer's design. There are several changes during the implementation and the Employer's risk events leading to project delay and cost overrun. To mitigate design risk, the DB approach is started in bridge construction projects; however, there are still the Employer's risk events triggering project delay and cost overrun. Further to risk sharing with private sector, EPC method is started but limited experience with the industry requiring capacity development of parties to institutionalize. Design, construction and operation risk transfer to private party in PPP has very limited application in Nepal which demands highly capacity development and legal review to incorporate risk management approaches. In summary, GoN has to review its planning through overview of available resources, capacity development of public and private sectors to manage infrastructure projects, assure the rule of law in project management and apply best practices in the industry to adopt standards available internationally. Table 3 summarizes the findings for each procurement method, as well as their failure modes and mitigation measures, in the context of Nepal's infrastructure development sector.

8. Conclusion and Recommendations

In conclusion, policies, practices and resource management gaps are observed in infrastructure implementation management for Nepal's highway construction sector. It was found that existing policies and procedures in Nepal do not meet international best practices for the management of large-scale infrastructure projects. Therefore, this review has provided feedback for the government to improve the implementation performance of highway infrastructure projects through policies, regulations, and institutional capacity development measures within the constraints of resources. Project implementation management faces many issues, such as the planning and mobilization of human and financial resources and the adoption of advanced risk-sharing mechanisms such as EPC or PPP. Hence, this review provides feedback on ways the construction industry can enhance its capabilities by adopting advanced risk-sharing mechanisms. The top five findings are summarized in Table 4.

Table 3 Risk matrix of procurement methods adopted in Nepal

Aspect	DBB	DB	EPC	PPP
Design	Employer	Contractor	Contractor	Contractor/ Developer
Construction	Contractor	Contractor	Contractor	Contractor/ Developer
Finance	Employer	Employer	Employer/Contractor	Contractor/ Developer
Operation and maintenance	Employer	Employer	Employer	Contractor/ Developer
Capacity requirements	Employer/Contractor	Employer/Contractor	Employer/Contractor	Employer/ Contractor
Typical failure modes	Design changes, employer's risk events, contract management	Delayed decisions, employer's risk events, contract management	Delayed decisions, change/contract management	Financing, contract management
Mitigation measures	Resource planning and mobilization, Project governance, Risk analysis, Capacity development of the parties, Adoption of best international practices such as FIDIC standards, Standardization of delay analysis and contract claim management			

Table 4 Major findings of this review

• There is a lack of compliance with and enforcement of existing regulations • Project performance may be enhanced by reexamining risk-sharing in contracting approaches • Policies for international participation and resource mobilization should be reviewed • It is necessary to standardize how project delays are evaluated • Management capacity and capabilities in both the private and public sectors need to be upgraded • Public procurement laws and regulations should conform to international best practices • More research is necessary on policies and practices in infrastructure project management

The main issue observed was the lack of compliance with existing regulations that are intended to achieve sustainable development objectives by maximizing the utility of limited resources. On the other hand, advanced contracting approaches with risk-sharing mechanisms need to be reexamined to enhance implementation performance on projects that are under way. Technology transfer through international participation is equally important for countries like Nepal that need to review existing policies of international participation and resource mobilization. The qualitative content analysis approach adopted in this research led to a review of available project policies, progress and

evaluation reports, best international practices, and literature related to project performance in the construction industry. The major issues in highway infrastructure implementation management in Nepal that this review has identified are institutional capacity, project governance, resource management, and planning approaches, which are key concerns in the developing world. Furthermore, approaches to standardizing how delays are evaluated are lacking, and remedying this lack would support affected parties by providing for fair practices in compensation and support under construction contracts.

Increased fairness is also a key to attracting international financing in national development (Dollar et al., 2006). Therefore, this overview of policies and practices in the highway infrastructure construction management sector of Nepal has provided in-depth guidance and support that promises to help administrators assess risks while mobilizing private resources for infrastructure development in Nepal. Finally, the study promises to add value to a review of policies and practices, capacity development, resource management and project governance.

This review is a qualitative study of existing policies. It has broad implications for policy review, amendment, and new policy formulation. Human resources need improvement. To achieve high-value construction projects, their management capacity and capabilities must be upgraded. The capacity of the private sector also needs strengthening. Private-sector parties include consultants and contractors. Their management practices should be streamlined through existing procurement and contract management frameworks. Policies must be revised toward the adoption of new national and international innovations. This will help reduce resource waste. Public procurement laws and regulations should be reviewed. They should conform to international best practices. This will help better-performing policies to develop. New procurement policies, standards, and expertise should be developed by the government's apex procurement body. Overall, this review promises to contribute to improved procurement and contract management policies. It also supports the development of new policies with a focus on capacity building in infrastructure project implementation management.

It was found that existing policies and regulations have not been properly implemented. Institutions are inefficient, and policy-level authorities show limited willingness to enforce regulations in project implementation. The review suggests that existing regulations be strictly enforced. Continuous monitoring mechanisms are needed. A system of rewards and penalties should be established. There is also a need to identify hurdles in the current system through in-depth investigations. These will help improve policy implementation. Once existing policies are fully implemented, they can provide a basis for further review.

This will support improvements in the policy environment for infrastructure project management.

Policy and implementation issues in highway infrastructure project management were also examined. A qualitative approach was used due to the lack of data for each policy option. The study highlights the need for future research on how policies affect time and cost performance. Further studies can combine qualitative and quantitative methods. These can capture the views of policymakers, practitioners, and other stakeholders. The review also draws insights from a few critical highway projects. It recommends future research on resource management, institutional capacity-building, project governance, and planning methodologies. Overall, this review has devised combined approach of policy and practice review in infrastructure project management. Further research on individual policy options with a robust dataset will enrich project management in Nepal's infrastructure sector.

Finally, several recommendations are derived from this thorough review of policy and practices in Nepal's infrastructure sector. These measures are categorized as a road map of immediate, near-term, mid-term and long-term recommendations (Table 5). Immediately, the DoR can implement the pre-construction clearance regulations that are already in place under the PPA/PPR. In the near term, standardized procurement documents, such as merit-based selection criteria for construction companies that consider the value-for-money approach that is enacted by the World Bank in high-value bank-financed projects, need to be institutionalized in the national procurement system by the PPMO (World Bank, 2025). Midterm interventions may be those of institutional capacity and arrangements to implement megaprojects with consideration of project governance. Several practices that have been tested, such as the development of a project authority, project company, board, or development committee, could be adopted depending on project requirements. Long-term plans to implement high-value complex infrastructure projects may consider PPP arrangements for project governance. For example, the Investment Board Nepal (IBN) could consider the Delhi Metro model to propose arrangements for implementing PPP projects in Nepal's infrastructure development sector (Bon, 2015; IBN, 2019) with due consideration of project governance arrangements (Mann & Banerjee, 2011).

Table 5 Roadmap for the implementation of policy measures

Activity/policy measure	Implementation timeframe	Responsible agency
Secure pre-construction clearance	Immediate and continuous	DoR
Standardize procurement documents and introduce merit-based qualifications	6–12 months	PPMO
Make institutional arrangements for megaprojects	2–3 years	PPMO/NPC/MoF/GoN
Develop PPP-enabling institutions and fiscal risk frameworks	3–5 years	NPC/MoF/IBN/GoN

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