

# A Paradigm on Kathmandu-Terai/Madhesh Fast Track (Expressway) Operation and Management

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## Abstract

The Kathmandu-Terai/Madhesh Fast Track (Expressway) Road Project, being constructed under management of the Nepali Army, is anticipated to be a transformative initiative for Nepal, driving rapid economic development with remarkable contribution to Gross Domestic Product (GDP). As Nepal's pioneering expressway project, there are concerns about its future operation and management. Globally, expressways are managed through various models, such as Public-Private Partnerships (PPP), Build-Operate-Transfer (BOT), and Build-Transfer-Operate (BTO), etc. However, these models need to be adapted to fit Nepal's specific conditions, economic status, laws, and regulations. Since the project is currently financed entirely by the Government of Nepal (GoN), government operation is also a possibility with the procurement of service provider. Moreover, Nepal lacks established standards for toll road operation. This paper conceptually recommends the hybrid model blending the significant element of BTO model for the operation and management of the KTFT, drawing on successful global practices and theoretical considerations for sharing financial risk between the GoN and private companies. However, special attention should be given for strengthening the local partner with priority.

**Keywords:** expressway, operation and management, public private partnership, toll.

## Background

The construction of roadways in Nepal was began in 1980 BS with the establishment of the first roadway in Kathmandu. However, the Kathmandu-Bhaise Road, also known as the Tribhuvan Rajpath, constructed in 2009 BS, is recognized as the country's first long-distance highway, connecting Kathmandu to the Terai region. Today, Nepal boasts a network of roadways, having successfully connected all seventy-seven districts with a total of 14,913 kilometers of national highway (Department of Roads, 2024). Despite this achievement, the primary focus of these highways has been geographical connectivity rather than strategic national development. In this context, the construction of Nepal's first expressway, the Kathmandu-Terai/Madhesh Fast Track (Expressway) Road Project (KTFT), marks a significant milestone. The successful completion of the KTFT is expected to be a cornerstone in advancing the government's vision of a "Prosperous Nepal, Happy Nepali," by facilitating rapid economic growth and development (Gurung & Acharya, 2023).

In the construction industry, one of the most critical and laborious milestones is establishing the procurement process, which sets the stage for moving forward. This does not imply that the procurement process encompasses the entire project; rather, it is the initial step in traversing the 70.977 kilometers of the KTFT project. The contractual procurement process for the KTFT project is nearly complete, with an impressive 92 percent of the overall process achieved. This success is attributed to a series of consistent inputs and refinements in planning and design, managed meticulously by the Nepal Army since the project's inception. Achieving this milestone is a significant breakthrough, setting a solid foundation for future progress. However, many more milestones, including various challenges, ups, and downs, remain during the implementation and

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project closure stages, which must be navigated to reach the project's completion by Chaitra 2083.

The KTFT project has achieved more than 35% progress by the end of fiscal year 080/81, establishing a strong foundation for ongoing and future construction phases, and signaling exponential progress in the coming fiscal years (Kathmandu-Terai/Madhesh Fast Track (Expressway) Road Project, 2024). The successful breakthrough of the two tunnels at Lanedanda and Dhedre marks a significant step forward.

Now is the opportune moment to consider the operation and management of the four-lane expressway, which traverses the fragile geography from the Mahabharat range to the lower Siwalik via the Chure range. This is the first project of its kind in Nepal, featuring twin-tube tunnels extending 10.055 kilometers and bridges at 89 locations with a combined length of approximately 12.885 kilometers, including an iconic extra-dosed cable-stayed bridge (KTFT Bulletin-Vol. 4, 2024).

### Statement of the Problem

The expected vehicle per day (VPD) for the KTFT is projected to be approximately 4,550 AADT in 2024 AD, increasing to 11,432 AADT by 2030, and reaching 17,738 AADT by 2035 AD (Research and Training Unit (RTU), 2024). Given the scale of traffic operation and management required for KTFT expressway, addressing the increasing traffic volumes in Nepal will be challenging. Therefore, it is essential to adopt state-of-the-art practices today to be prepared for tomorrow.

The operation modalities for expressways in Nepal is yet to be formulated, despite some highway operation policies set by the Department of Roads. Although this paper is conceptual, it aims to present possible ideas for the operation of Nepal's first expressway, the KTFT, based on global models for the operation of expressway and experiences learned during its construction.

### Review of the Literature

Highways serve as the primary mode of road transport in developed countries, playing a crucial

role in economic development. Analyzing foreign highway management reveals several common features: firstly, governments take a leading role in highway construction and management; secondly, funding patterns align with specific sources and systems; and thirdly, there exists a comprehensive and mature set of laws and regulations governing highway planning, investment and financing, construction, operations, earnings, supervision, and management.

In China, the government is actively transforming its functions to reduce administrative intervention in highway company management, promoting independent enterprise operations. Separating construction from management allows for professional advantages, enabling the market mechanism of loan incentives to be realized. This approach enhances the efficient use of highways and revitalizes highway assets. Additionally, adopting a franchise model strengthens market competitiveness.

Host governments or affiliated entities provide a franchise agreement to the company, acting as both investors and operators who arrange financing and assume risks. Profits are generated within a specified timeframe, and the project is eventually transferred to relevant government agencies according to the agreement. This model enhances incentive and constraint mechanisms, maximizing the operator's initiative. An illustrative case of a franchise highway project is the second phase of the Beijing highway, spanning approximately 47 kilometers. The China Railway Construction Corporation collaborated with the Capital Highway Development Limited Company to form a project company for this endeavor, representing a breakthrough in investment and financing reform. The introduction of 3.6 billion yuan diversified investment, reducing the government's burden (Wenqi, Guan, & Tao, 2013).

Public-Private Partnerships (PPPs) have been widely utilized across the globe, particularly in transportation, for a considerable period. However, the names and types of PPPs have varied over time and from one country to another (U. S. Department of Transportation, 2004).

Numerous countries are adopting PPPs to enhance efficiency and effectiveness in public services, aiming not only for budgetary savings but also for improved service quality (Gil, 2013).

While many studies have focused on the construction challenges of the KTFT, there has been insufficient exploration of its operational modalities. Therefore, this paper seeks to propose an optimal operational model for the KTFT.

### **Global Approaches for Highway Operation Management**

A country's economic vitality often hinges on the efficiency and effectiveness of its strategic highways and expressways. Therefore, the planning, development, maintenance, and operation of these transportation infrastructures are paramount. Different countries have adopted diverse modalities for managing their highway operations, maintenance, and sometimes, land use development along these routes. Modalities selection mode depends upon individual country's economic status, people's societal values and norms and access to public utilities. In nations like the United States and Malaysia, expressways are typically owned and operated by the government (WB and MOC Japan, 1999), with maintenance, operation, and toll collection managed by relevant transportation agencies or departments. However, toll road projects often encounter challenges such as lower-than-expected traffic demand and higher-than-anticipated operating costs, leading to diminished profitability (Truong et al., 2019). In response, government agencies may also lead integrated land use development initiatives along transport infrastructures to boost demand and revenue. This development often includes commercial centers, residential areas, industrial zones, and recreational facilities. For instance, Japan and China have successfully integrated land use development with their expressway networks, fostering economic growth and connectivity.

Many countries have also established dedicated public corporations or government authorities, such as the Japan Highway Public Corporation (privatized in 2005) or India's National Highway

Authority (NHAI), to oversee the design, construction, operation, and maintenance of major highways (WB and MoC Japan, 1999; MoRTH, 2024). These entities not only ensure sustainable highway operation and maintenance but also facilitate integrated development approaches, including land use development, to foster economic growth and connectivity. For example, NHAI's involvement in initiatives like the Delhi-Mumbai Industrial Corridor in creating industrial nodes and logistics hubs along highway routes stimulates economic activity and enhances regional connectivity.

In several countries like Spain, Portugal, the United Kingdom, and Australia, Public-Private Partnership (PPP) modality has been practiced primarily on high-mobility road corridors (FHWA US DOT, 2009; Abiodun, 2013). PPPs allow private sector participation in financing, constructing, operating, and maintaining expressways, with governments granting concessions to private companies for specified periods. However, PPPs for highways in developing countries have not gained widespread popularity (Kerf and Izaguirre 2007; Leigland and Butterfield 2006). Most developing countries rely on toll financing and private concessions (Abiodun, 2013). These concessions entail governments awarding contracts to private companies to operate and maintain existing expressways, with toll collection and day-to-day operations managed by the concessionaires. African experiences demonstrate the initial challenges followed by successful passenger and freight traffic growth under this scheme.

The government invests the public finance to build various types of infrastructure development in the country. As most infrastructure projects have the characteristics of large-scale investment and long payback period, the public finance used for developing infrastructures has been becoming a fiscal burden on the government. The PPPs have been provided as solutions to reduce the government's fiscal burdens by encouraging private-sector participation in the financing, construction, operation, and maintenance of infrastructures.

Of the various forms of PPPs, Build Operate and Transfer (BOT) agreement is based on the idea that

infrastructures are constructed by using the private finance instead of the public finance (Shen and Wu 2005), the public sector will guarantee the private sector for the ownership of infrastructures and the minimum revenue guarantee (MRG) during the concession period. For this reason, BOT agreement has generally been applied to the development of profitable infrastructures, such as toll-road projects.

Risks are transferred to the private sector by a contractual agreement and the public sector tends to transfer them as many as possible (OECD, 2008). Benefit of each sector looks different. In the view of the private sector, the benefit from the PPP is making a profit while the benefit to the public sector is to achieve high service quality and save the cost the public sector has to burden to provide the public service. In these three factors, the most important thing looks the benefit of each sector. Thus, such benefit is the key factor to initiate and improve the partnership between the public and the private sectors. Resources and risks are just negotiated and shared between the public and the private sectors to maximize the benefit of each sector. It means that resources and risks are tools for the PPP to meet the interest of each sector in the PPP. Therefore, the PPP can be defined as a cooperative working between public and private sectors to provide high quality public services which are affordable to the public sector and are profitable to the private sector by sharing skills, expertise, finance of each sector and risks from construction to operation.

**South Korea:** In South Korea, over 170 highway service areas (HSAs) were primarily developed by the public enterprise Expressway Corporation and later leased to private operators. Up until 2011, the Expressway Corporation had delivered 28 HSA projects through Build-Operate-Transfer (BOT) agreements. Unlike traditional BOT projects, HSA BOT projects do not offer minimum revenue guarantees (MRGs) to private operators. This BOT model has proven to be economically viable for expressway projects (Gil, 2013; Jeong, Ji, & Hong, 2015).

In BTO model, private companies recover their investments by directly charging the end users, thus taking on the risk associated with traffic demand.

PPPs have been utilized in over 100 countries worldwide for public service projects (PPIAF, 2011). In South Korea, the formal use of PPPs began with the enactment of the PPP Act in 1994, although private sector involvement in public projects existed prior to this legislation.

It has been determined that the Build-Transfer-Lease (BTL) model may be more suitable for road projects in South Korea compared to the BTO model. In the BTO model, the private sector assumes the traffic demand risk and can achieve higher profit margins. Conversely, in the BTL model, the public sector bears the traffic demand risk and compensates the private sector based on performance assessments related to availability. In many BTO scenarios, it is often highlighted that the public sector pays little to no subsidy to the private sector. However, in the BTL model, the public sector can generate profit from the same revenue (Gil, 2013).

**United Kingdom (UK):** The UK leads in private sector involvement in public services, whether through direct private provision or PPPs. Out of a total of 898 PPP projects in the UK, 68 are related to transport. Among these, 22 projects focus on street lighting, shipping, and bus services, while the remaining 46 are dedicated to transport infrastructure. Of the 46 infrastructure projects, 29 are for roads, 16 are for rail systems including underground, tram, or light rail, and 1 project is for an airport terminal (Gil, 2013).

**China:** The Chinese government initiated its national expressway system with the construction of the Shenyang-Dalian Expressway on June 7, 1984. By the end of 2020, China's expressway network had become the largest in the world, spanning 161,000 kilometers. This network further expanded to 177,000 kilometers by the end of 2022.

The Xi-San Expressway (XSE) is a 34.5 km highway from Xi'an to Sanyuan in Shaanxi province, managed by the Shaanxi Provincial Communications Department under a Government-Build-and-Operate model.

The Fo-Kai Expressway (FKE), spanning 79.8 km from Foshan to Kaiping in Guangdong province, is supported by a World Bank loan and private capital

through a joint venture with a foreign company, following the Market Model.

The Hang-Yong Expressway (HYE) is a 145 km route from Hangzhou to Ningbo in Zhejiang province. It operates as Toll Road Company and Toll Road Operation Company Model, with 33% of the Company's stock listed on the Hong Kong Stock Exchange since 1997 (PING, SANLI, TALVITIES, & YUFU).

The China Construction Sanmenxia City National Highway 310 project in Sanmenxia City, Shaanxi Province, has been successfully implemented using the PPP model. The government holds a 60% stake, while the China Construction Consortium holds the remaining 40%. The project spans 164.5 kilometers and includes three toll gates, three service areas, and one office area. Initially estimated at a total investment of 12.356 billion yuan in April 2017, the project had a construction period of 42 months and an operation period of 30 years. The trial operation began in 2021, and by 2023, the project successfully secured a settlement of 8.34 billion yuan. The project's success has been widely praised, setting a benchmark in the infrastructure construction industry (China state Construction Engineering Corporation, 2024).

**Kazakhstan:** On December 18, 2018, a pre-operation consultancy service agreement was signed between Korea Expressway Corporation (KEC) and BAKAD Investment and Operation Limited Liability Partnership, a Kazakhstani organization. Under this agreement, KEC and its participants will provide consultancy services for the necessary preparatory work for operating the 66-kilometer motorway ring road around Almaty, Kazakhstan. This project, known as the Big Almaty Ring Road (BAKAD), includes bridges and interchanges.

### Potential Expressway Operation Models in the Nepalese Scenarios

The PPPs involve collaboration between public and private sectors to meet public needs and maximize mutual benefits by sharing skills, expertise, finances, and risks in construction or operation. The interests of the different parties for the project can be described by the trinity model as below.

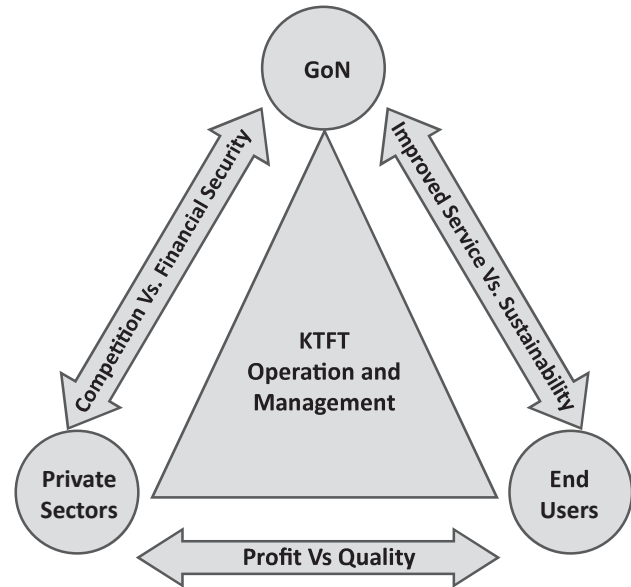


Figure 1: Trinity Model for the operation of expressway

The government aims to share financial risks and burdens with the private sector through competitive processes, while the private sector seeks financial security from the government. End users desire improved services from the government, which in turn strives for sustainable service delivery. Additionally, private sectors and end users are interconnected by the relationship between profit and quality.

After the above studies, following potential models are listed for the expressway operation in Nepal.

**Build, Own, Operate and Transfer (BOOT):** During initial planning phase for the construction and operation of KTFT, the BOOT model was proposed. The government of Nepal initially partnered with the Indian company Infrastructure Leasing and Financial Services (IL&FS) to implement this system. However, the agreement with IL&FS was terminated prematurely. On October 9, 2015, the Supreme Court issued an interim order to maintain the project's status quo (Pahadee, 2022). Consequently, on November 20, 2016, the Nepalese government canceled all the agreements with IL&FS and, in 2017, handed over management and execution of the project to Nepali Army.

**Government Build and Operated Expressway:** Since the construction of the KTFT is funded entirely

by the Government of Nepal (GoN), the government has the option to operate it independently. The government's physical infrastructure development agency will own the road, while the planning, construction, maintenance, and operation will be managed directly by the relevant government department.

**Toll Road Operation Company:** In this model, after completion of the project, government highway authorities may offer the road operation rights to an investor for a limited period. Such Toll Road companies typically hold the rights to toll revenue for an extended duration, often around thirty years.

**Joint Venture with a Foreign Company:** In this format, the company will be responsible for fund raising and managing everything from planning to operation of the expressway. Foreign partners contribute funds for highway construction and may receive priority access to toll revenues. National counterparts provide capital in the form of highways, land rights, and possibly cash. The division of shares between foreign and national companies depends on their respective investments in toll road construction and operation. This model is assumed to be the means for technology transfer and capacity building for the Nepalese partners.

### **Prominent Problems for the Operation of the First Expressway**

The behavior and level of familiarity among road users significantly impact operational procedures. It's a reality that we still have much to learn about modern transportation advancements. Traffic discipline and necessary improvements in road usage systems are still in the developmental stage. In this context, several challenges are expected for the operation of KTFT, Nepal's inaugural expressway.

**Lack of Uniform Highway Standards:** As the country's maiden expressway, KTFT must anticipate road user behaviors and the current highway operation systems. Various road operation systems exist nationwide, requiring time for upgrading to an access and speed-controlled semi-automatic expressway.

**Regional Development:** The KTFT connects varied geographical regions, spanning from the Terai to mountainous areas, each with differing development standards for highway facilities. The roads linking to KTFT may not adequately match the speed and dispersal capabilities of expressways, particularly around Kathmandu. Therefore, upgrading these connecting roads must be considered before commencing expressway operations.

**Technological advancement for the toll collection systems:** Semi-automatic toll collection is proposed for the KTFT toll gates. However, most vehicles expected on the expressway lack digital record systems, posing a challenge for digitizing vehicle records during toll collection. The distribution of embossed plating systems, initiated in 2016, serves as an example, with only a fraction of vehicles adopting it. Similarly, the prolonged procedural time for distributing smart licenses highlights the delayed technological progress in transportation systems (Ministry of Physical Infrastructure and Transport, 2024).

**Information Systems:** The Department of Roads has implemented the Emergency Information System (EIS) exclusively on the BP Highway (Sindhuli road). This service allows users to access crucial road condition updates in advance through smart phones or the web. It provides information on incidents such as heavy rainfall, floods, landslides, and road accidents along the highway, enhancing user safety and preparedness (Khatiwada, 2019).

The expressway operation needs rapid flow of information to know the condition of the road in advance and to implement maintenance facilities. The development of easily accessible channels for positioning of the vehicles and information flow system may require significant time which may affect the effective operation of the expressway.

### **Recommendation for the KTFT Operation and Management System**

The KTFT expressway represents a groundbreaking infrastructure project in Nepal, aimed at revolutionizing connectivity between Kathmandu

and the terai region. Given the government's ongoing planning and construction efforts for the KTFT expressway and the unique challenges posed by the Nepalese context, a hybrid concession agreement model looks appropriate for the operation and management phase. This model should blend elements of Build Transfer and Operate (BTO) with a strong emphasis on local capacity building though it needs detailed study and economic analysis.

Initially, the concessionaire should take the responsibility for operation and maintenance, gradually transitioning these duties to local authorities or companies over time with certain percentage of right share. This phased approach will ensure that local entities are equipped to independently manage the expressway in the future. Additionally, the government should proactively facilitate the planned development of surrounding areas to support the expressway's long-term sustainability. The establishment of a National Highway Authority could streamline coordination among stakeholders and ensure holistic infrastructure development. Given the absence of established standards for operating and maintaining expressways in Nepal, there's a necessity for technology transfer from countries with ample experience in successfully managing expressways. Before engaging to the expressway operation and management (O&M) companies, it's advisable to appoint a service provider for consultancy services, taking the example of Kazakhstan model of KEC, which would encompass the following scopes of work.

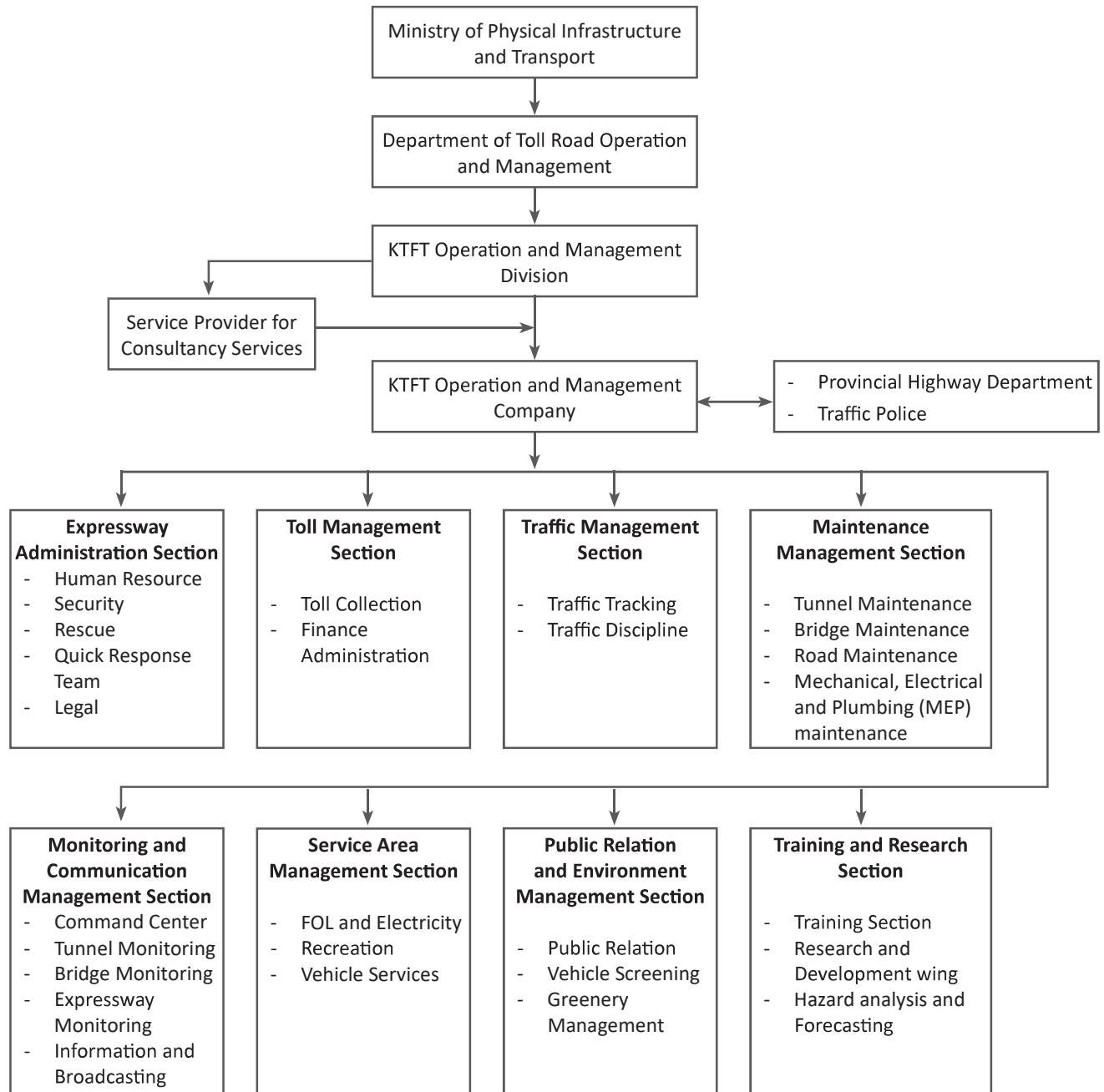
- Meeting and Negotiation with the O&M Grantors.
- Preparation of comprehensive plans including Operation and Maintenance Plan, Repair Plan, Environmental Management Plan, Health

Management Plan, and Safety Management Plan.

- Ensure that the scope of services aligns with relevant laws and standards.
- Financial analysis.
- Establishment of recording and reporting systems.
- Development of the O&M organization.
- Develop various manuals and plans including O&M plan, annual services plan, pavement maintenance plan, structure maintenance plan, auxiliary facility maintenance manual, traffic management manual, disaster and emergency action management manual, toll collection manual, emergency response plan, environment and waste management plan, community relations and health management plan, and research and report plan.
- Assurances to recruit and training to the O&M company staffs.

Once the O&M modalities are finalized, expressway operation companies could be appointed in collaboration with local firms with the assurance of right share. These companies would be responsible for toll collection and overall operation and maintenance of the KTFT, adhering to expressway operation standards set by the National Highway Authority. They will be selected for a designated period, during which they will pay a base rate to the National Highway Authority for initial years. Subsequently, the return could be determined through negotiation with the operation company after conducting market analysis. Based on the reviewed studies and analysis, the following conceptual organization for the operation of the KTFT is proposed.

## Conceptual Organization for KTFT Operation and Management





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