

ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The proposed Northern Mountain Provinces Transport Connectivity Project will improve the accessibility of relatively underdeveloped provinces in the Northwest Region to Greater Mekong Subregion (GMS) corridor. Provinces in the proximity of GMS corridors have not fully benefited from the corridors' improvement because of lack of access to these corridors; these provinces have also shown slower growth than the rest of the country. The proposed project will expand the benefits of GMS corridors to nearby provinces with high poverty incidence. The project comprises upgrading national highways to improve connectivity of provinces in the Northwest Region, and support to the Directorate for Roads of Viet Nam (DRVN) of the Ministry of Transport in road asset management. The roads that will be improved under the project include two national highway sections (National Highway 32 and National Highway 279) and one provincial road section (Provincial Road 175), which will enhance connectivity between Yen Bai, Lai Chau, and Lao Cai provinces and the Noi Bai–Lao Cai Expressway.

B. Macroeconomic Context

2. Viet Nam's economy has been strong in recent years, with annual growth increasing from 5.4% in 2013 to 6.8% in 2017 and is projected to further increase to 7.1% in 2018. Economic growth is supported by rising foreign direct investment, vigorous export growth, strengthening agriculture, and robust domestic demand. International tourist arrivals increased by 29.1% in 2017 compared to 2016, and an annual rise of 15%–20% is forecasted for 2018 to 2019. The agriculture sector has been growing at a steady pace of close to 2.5%–3.0% per annum. The country has become a major exporter of agricultural products: it is the world's largest producer of black pepper (accounting for one-third of the global market) and the world's second largest rice exporter (after Thailand). Viet Nam is also the world's largest exporter of cashew nuts and coffee. The industry sector has shown high growth, reaching 9.6% in 2015, with sustained annual growth of about 8.0% in 2016 to 2017. The service sector grew from 6.7% in 2013 to 7.4% in 2017, with a significant contribution from the tourism subsector. As of 2016, the estimated sectoral shares of gross domestic product (GDP) were 17.3% for agriculture, 39.1% for industry, and 43.6% for services.

3. The Northwest Region, where the project is planned, is Viet Nam's poorest region. Ethnic minorities in the provinces within the project's area of influence make up 79.2% of the total population. The per capita income in the region is about 15% lower than the country as a whole, and the per capita income in the region's rural areas is \$1,335 compared to the national per capita income of \$2,100. As of 2016, the region's poverty rate was the highest in the country; compared to the national poverty rate of 9.79%, the poverty rate was 44.82% in Dien Bien province and 42.8% in Son La province.

C. Project Rationale

4. The Northwest Region is a high mountainous region and lags behind in development compared to the rest of the country, even though it has a relatively large area of land, fertile soil, and great potential for development of agriculture, forestry, hydropower, mining, tourism, and border trade. The region is prone to landslides and flooding in the rainy season, which causes local traffic congestion and disruption. As a result, infrastructure is severely damaged each year and requires large maintenance funds. The present status of the transport, tourism, and service infrastructure is still poor in the region.

5. The Northwest Region comprises six provinces. The largest infrastructure investment during 2009-2017 has been the development of the Ha Noi–Lao Cai Expressway, part of a GMS corridor, which passes through the provinces of Lao Cai and Yen Bai of the Northwest Region. The next-tier road network connecting the provinces to this expressway corridor are still underdeveloped, and the provinces near the corridor have not fully benefited from the improved GMS corridor and have generally developed at a slower pace than the rest of the country. To address this issue, the project will improve and/or upgrade two road stretches connecting several towns and/or districts in the provinces of Lao Cai, Lai Chua, and Yen Bai to the Noi Bai–Lao Cai Expressway, a total of 200 kilometers (km). These road sections are located in the most difficult terrain, crossing high mountains or large rivers, and have lower-class technical standards that do not meet the increasing transport demands and do not provide all-year accessibility. The project will upgrade the design class, ensure the standard is consistent over the entire length, and integrate climate resiliency to provide all-year accessibility, supporting the economic development of the provinces.

D. Project Alternatives

6. The construction and upgrading of roads in the Northwest Region are in line with the Viet Nam Transport Strategy to 2020 and vision to 2030 (the Viet Nam Road Master Plan to 2020 and vision to 2030) and the Transport Infrastructure Plan for the Northern Midland and Mountainous region to 2015 and vision to 2020 (the Medium-Term Transport Investment Plan of the Government and Provincial Transport Master Plans). A region-wide analysis of the Northwest Region road network was carried out as part of ADB's project preparatory technical assistance study. The study undertook a multi-criteria analysis of roads in the Northwest Region to verify that the selected subproject roads represented the priority roads for improvement in the region. The criteria included (i) inclusion in national development plans (mid-term master plans) and strategies, (ii) poverty incidence, (iii) economic viability, (iv) accessibility to GMS corridors, (v) environmental and social impact, and (vi) interconnection integrity of the network. The multi-criteria analysis identified Provincial Road 175 as having the highest priority and National Highway 279 having the second highest priority. These road sections provide direct links to the Noi Bai–Lao Cai Expressway from the surrounding provinces and contribute to the project's main aim of improving connectivity of the provinces in the Northwest Region to GMS economic corridors. The other project roads were of a lower priority, because they generally run parallel to the Noi Bai–Lao Cai Expressway.

E. Methodology and Data

7. The economic analysis was carried out using the Highway Development and Management Model (HDM-4), which computes road users' economic costs for each section of road for each year of analysis. The inputs to the HDM-4 were adapted and calibrated to enable vehicle speeds and operating costs to be estimated as accurately as possible in the context of the road network in the Northwest Region.

8. The with-project scenario involved improvement of two project roads in Yen Bai, Lai Chau, and Lao Cai provinces connecting to Noi Bai–Lao Cai Expressway. The without-project scenario assumed that the roads would remain largely unchanged, with the same cross section and deteriorating road conditions over time. The economic benefits of the proposed improvements included in the analysis are as follows: (i) vehicle operating cost (VOC) savings, (ii) time savings, and (iii) crash cost savings. To calculate changes in VOCs, the initial international roughness

index¹ values were collected from road condition surveys in 2017 under the project preparatory technical assistance, with values recalculated annually by the HDM-4.

9. The project costs and benefits were calculated over a 26-year appraisal period (2018–2043), after which a residual value was considered.² The economic appraisal was based on a 5-year construction period (2021–2025) with the project fully opening in 2026, followed by 20 years of economic life. Benefits were calculated separately for generated traffic. Anticipated generated traffic was estimated at 20% of existing traffic volume, with benefits per user assumed to be equal to 50% of the benefits of existing users, applying the rule of half, as is standard in economic analysis of transport projects. Road crash savings were estimated by analyzing actual crash and casualty data for 2015 and 2016 on the project roads in Lao Cai province. Based on the traffic data and the number of fatal and injury casualties, casualty rates were developed as the number of casualties per 100 million vehicle-kilometers. Based on research carried out by TRL³ into the effects of road improvements to a higher standard, a mid-range 25% reduction in the calculated fatal and injury casualty rates was assumed after improvement. The value of each casualty saved was based on a recent research study in Viet Nam.⁴ The valuations developed in this study were updated to 2017 values in line with GDP growth, and rounded estimates of average casualty costs were estimated at \$48,000 for each fatal casualty and \$19,000 for each injury casualty.

10. **Economic costs.** The base civil works costs for the proposed works are estimated at \$107.82 million for the road from IC16 to Lai Chau and \$44.74 million for the road from Mau A (IC14) to Nghia Lo. The economic analysis of the road improvement component includes (i) capital investment costs comprising civil works costs, construction management costs, land acquisition and resettlement costs, and environmental impact mitigation costs; and, (ii) net operation and maintenance costs in the with- and without-project scenarios. Costs related to taxes, duties, and financing charges during implementation were excluded, but physical contingencies were added. Costs and benefits were converted from financial to economic prices in line with Asian Development Bank (ADB) guidelines.⁵ The land acquisition cost was valued at the net economic value addition from agricultural production over a 30-year period. The economic analysis was conducted using the domestic price numeraire. The cost estimate was adjusted for the unskilled labor component using a shadow wage rate factor for unskilled labor of 0.684 and for the traded goods component using a shadow exchange rate factor of 1.026.

11. Unit rates for maintenance of both sealed and unsealed pavements were estimated based on prevailing unit rates in Viet Nam adjusted for the shadow wage rate factor and shadow exchange rate factor. Periodic maintenance was assumed to be applied every 7 years.

¹ The International Roughness Index (IRI) is the roughness index most commonly obtained from measured longitudinal road profiles. It is calculated using a quarter-car vehicle math model, whose response is accumulated to yield a roughness index with units of slope (in/mi, m/km, etc.).

² The residual value was calculated using a straight-line depreciation method. Salvage values for the main road improvement works were set at 25%, assuming a life of 20 years for pavement components and 40 years for structures and earthwork.

³ Transport Research Laboratory (TRL) Ltd, UK; Overseas Road Note 5 – A Guide to Road Project Appraisal, produced by TRL with funding by the Department for International Development of the United Kingdom, 2005. It was first published in 1988 in order to provide guidance on carrying out feasibility studies for road projects in developing countries.

⁴ Government of Viet Nam, Ministry of Transport, Transport Development and Strategy Institute. 2010. *Study on Criteria for Determining Black Spots and Criteria for Assessment of Socio-economic Losses Caused by Road Traffic Accidents*, 2010. Ha Noi.

⁵ ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

12. **Economic benefits.** The benefits considered in the economic reassessment are savings in VOCs, improvements in travel time, and reduction in accidents. The project includes a new alignment, with time savings based on a reduction in vehicle-km traveled, and also expected increases in average speed because of the increased capacity of the existing highway after the improvement to the existing alignment. Savings in VOCs are calculated for the project and derive from improvements to the surface conditions and roughness on the upgraded sections, relative to the existing substandard sections. The VOCs, which vary with the international roughness index, were calculated using the HDM-4. Average speeds used in the economic analysis were also calculated within the HDM-4 based on road condition, geometry, and traffic intensity.

13. The economic analysis used the hourly values of time of \$1.83 for work travel and \$0.41 for nonwork travel for car passengers, and \$0.73 for work travel and \$0.16 for nonwork travel for bus passengers; these were estimated based on wage rates in Viet Nam.⁶

14. **Traffic demand estimation.** The demand analysis was based on (i) estimates of annual average daily traffic derived from traffic counts taken in 2017 and (ii) historical traffic count data from the DRVN and provincial departments of transport. Traffic was forecast to grow in line with changes in real GDP. Based on the statistical traffic data and the project survey results, and the volume of goods and passenger transport in recent years, after 1990s, the elasticities between transport growth and real GDP growth were derived. The GDP growth targets set by the government in the national socioeconomic development plans (6.5%–7.0% per year) and Northern Midlands Mountainous Region Economic Development Plan (9% per annum) are on the upper end or higher than the projected GDP growth rate for the country. The GDP growth rate in 2016 was 6.21% and 6.81% in 2017, and it is projected to be 7.10% in 2018 and 6.80% in 2019. The average annual GDP growth rates assumed for the traffic projection were 6.30% during 2016–2020, 5.80% during 2021–2025, 5.30% during 2026–2030, and 4.80% from 2031 onward considering a slightly lower growth rate for the Northern region and a decreasing growth rate over time. Based on the calculated elasticities, the normal annual traffic growth rates are set out in Table 1. Table 2 shows forecast traffic demand on the project roads.

Table 1: Normal Annual Traffic Growth Rates
(%)

Period	Passenger Transport	Goods Transport
2016–2020	7.4	7.6
2021–2025	6.8	7.0
2026–2030	6.1	6.4
2031–2035	5.5	5.8
2036–2041	4.9	5.2

Source: Project Preparatory Technical Assistance Consultant's Report.

Table 2: Forecast Demand on the Project Roads
(Annual Average Daily Traffic or AADT)

Road Section	2024	2031	2036
NH279 Project Start (IC16)–Khanh Yen	5,712	7,134	8,312
NH279 Khanh Yen–Khanh Co	6,205	7,732	8,994
NH32, Ban Bo and Dong Pao–Lai Chau	7,628	9,873	11,775
Mau A (IC14)–Nghia Lo (PR175)	1,487	1,925	2,296

IC = interchange, NH = National Highway, PR = Provincial Road.

Source: Project Preparatory Technical Assistance Consultant's Report.

⁶ ADB. 2018. *Greater Mekong Subregion (GMS) Corridor Connectivity Enhancement Project*. Consultant's report. Manila (TA 9252-VIE).

F. Results of the Economic Analysis

15. The results of the economic analysis covering the project investment over the analysis period are given in Table 3. The economic indicators provided are net present value, benefit–cost ratio, and economic internal rate of return. The results indicate that the project investment has a rate of return well above the opportunity cost of 9%. The cash flow streams for the project are given in Table 4.

16. In addition to quantified benefits, the project will have intangible benefits, as it will contribute to the economic growth of the relatively poor populations in the project areas and in the vicinity by providing improved access to income opportunities, as well as social, health, and education facilities. Carbon dioxide reduction benefits are calculated as \$0.07 million per annum as a climate mitigation impact of the project.

Table 3: Results of Economic Analysis

Road	EIRR (%)	ENPV (\$ million)
Lai Chau–Noi Bai Expressway	12.2	40.0
Mau A–Nghia Lo Road	18.7	56.9
Both roads	14.2	96.9

EIRR = economic internal rate of return, ENPV = economic net present value.

Source: Estimates by the PPTA consultants.

Table 4: Economic Costs and Benefits Summary Statement
(\$ million)

Year	Capital Costs	Operation and Maintenance	VOC Benefits	Benefits			Net Benefits
				Travel Time Benefits	Crash Benefits	Total Benefits	
2019	1.24						(1.24)
2020	4.96						(4.96)
2021	13.01						(13.01)
...2022	46.46		(2.10)	(0.81)	(0.43)	(3.35)	(49.81)
2023	46.46		(4.54)	(1.73)	(0.45)	(6.72)	(53.18)
2024	55.75		(3.46)	(1.32)	(0.28)	(5.06)	(60.81)
2025	27.88		2.50	0.95	(0.30)	3.15	(24.72)
2026		0.02	20.94	4.71	0.60	26.25	26.23
2027		0.02	22.56	5.02	0.65	28.23	28.21
2028		(0.02)	24.22	5.34	0.70	30.27	30.28
2029		(0.14)	26.19	5.70	0.76	32.65	32.78
2030		4.02	28.27	6.08	0.82	35.16	31.14
2031		(8.66)	30.46	6.38	0.87	37.70	46.36
2032		0.32	31.14	6.76	0.93	38.82	38.50
2033		12.66	33.09	7.17	0.99	41.25	28.60
2034		0.02	35.51	7.61	1.06	44.17	44.15
2035		0.03	38.64	8.13	1.13	47.90	47.88
2036		(0.09)	44.04	9.05	1.28	54.37	54.46
2037		4.02	46.54	9.96	1.36	57.86	53.83
2038		(8.66)	50.79	11.12	1.43	63.35	72.01
2039		0.18	55.51	13.13	1.52	70.16	69.98
2040		12.66	58.21	14.04	1.60	73.86	61.20
2041		0.02	63.35	15.92	1.69	80.96	80.94
2042		0.03	66.52	16.72	1.78	85.01	84.99

Year	Capital Costs	Operation and Maintenance	VOC Benefits	Benefits			Net Benefits
				Travel Time Benefits	Crash Benefits	Total Benefits	
2043		(0.09)	69.84	17.55	1.87	89.26	89.35
2044		4.02	73.34	18.43	1.96	93.73	89.70
2045	(48.94)	(8.66)	77.00	19.35	2.06	98.41	156.01
EIRR =							14.2%
NPV (discount rate of 9%) =							96.9

EIRR = economic internal rate of return, NPV = net present value, VOC = vehicle operating cost.

Source(s): Estimates by the PPTA Consultants.

17. Sensitivity tests and calculations of switching values were carried out to determine the effect of variations on key input parameters on the key economic indicators. The sensitivity analysis demonstrates that the economic appraisal results are robust across the range of variations in the main parameters considered (Table 5).

Table 5: Result of the Sensitivity Analysis

Scenario	NPV (\$ million)	EIRR (%)	Switching Value (%)
Base case	96.9	14.2	
Construction costs +15%	76.7	12.8	72.1
Vehicle operating costs –15%	69.4	12.9	(53.0)
Value of time –15% ^a	90.7	13.9	
Value of casualties not considered ^a	91.7	14.0	
Construction costs +15% and benefits –15%	42.2	11.2	26.5/(26.5)

() =negative, EIRR = economic internal rate of return, NPV = net present value.

^a Switching values for value of time and value of casualties were not considered and are not indicated since a 100% reduction of these benefits still shows an EIRR above 9%.

Source: Estimates by the PPTA Consultants.

G. Financial Sustainability

18. The Government of Viet Nam established the National Road Maintenance Fund (NRMF) and local road maintenance funds in 2012 for better management of road maintenance in the country. The NRMF's revenue comes from road user fees and national budget allocations. Table 6 includes Ministry of Transport data on the road maintenance requirement and fund allocation during 2013–2017, showing that NRMF funding increased by about 13.5% annually (commensurate to the increases in requirements and the budget allocated) to keep pace with the increases in the projected maintenance requirements when increases in road user fees were insufficient.

19. Table 6 also shows that only about 42% of maintenance fund requirements were met during 2013–2017. However, the denominator of the coverage ratio is the desired maintenance fund requirements for the entire national road network in Viet Nam without segregation of the requirements of maintenance budget for regular maintenance and investment budget for major rehabilitation or reconstruction. The per km maintenance cost increased by about 70% from about \$11,430 in 2013 to about \$19,090 in 2016, covering 17,344 km (or 82% of national roads), indicating the appropriate budget allocation for the regular maintenance of priority roads.⁷

⁷ Government of Viet Nam, Ministry of Transport, DRVN. 2017. *Vietnam Road Asset Management Project – Draft final report*. Ha Noi.

20. With the sustained economic growth and increase in the number of vehicles, the government targets to achieve full coverage of the required costs for all national roads in Viet Nam, including major rehabilitation costs, in the longer term. Table 7 provides the estimation of the road maintenance funding gap until 2024, showing that the funding gap will gradually narrow during 2018–2024. This estimation assumes no additional fund sources for road maintenance, but with the government's plans to gradually expand the base for road user charges for the sustainability of the NRMF, the estimation is considered conservative. The effective utilization of the NRMF for this purpose is being supported by the World Bank.

Table 6: Maintenance Fund Requirement and Revenue, 2013–2017

Item	2013	2014	2015	2016	2017	Total
Revenues						
Total amount (\$ million)	304.41	324.90	387.97	435.79	473.64	1,926.71
- Tariff from road users (\$ million)	239.53	217.01	251.34	281.53	310.58	1,300.00
- National budget supplement (\$ million)	64.87	107.89	136.62	154.25	163.07	626.71
Budget Allocation						
- National roads (\$ million)	220.54	248.92	300.00	337.24	364.96	1,471.66
- Provincial and/or district roads (\$ million)	83.83	75.94	87.97	98.55	108.68	454.96
Actual Expenditures Needed for O&M						
- National roads (\$ million)	523.84	591.27	712.60	801.06	866.90	3,495.68
- Budget as share of required expenditures (%)	42.10	42.10	42.10	42.10	42.10	42.10

O&M = operation and maintenance.

Note: The table figures were converted using the exchange rate of \$1 = D22,690.

Source: Government of Viet Nam, Ministry of Transport.

Table 7: Estimation of Fund Gap for National Road Maintenance, 2018–2024

Year	2018	2019	2020	2021	2022	2023	2024	Average annual rate of increase or decrease (%)
Desired Fund Requirements for Road Maintenance								
A. National roads (\$ million)	819	868	922	978	1,034	1,094	1,160	5.97
Provincial and/or District roads (\$ million)	441	468	496	527	557	589	625	5.98
Total fund requirement (\$ million)	1,260	1,336	1,418	1,505	1,591	1,683	1,785	5.98
Revenues								
National budget (\$ million)	207	240	278	322	373	433	502	15.91
Tariff from road users (\$ million)	314	338	364	392	422	455	490	7.70
B. Total revenues (\$ million)	521	578	642	714	795	888	992	11.33
Fund gap (A–B) (\$ million)	(298)	(290)	(280)	(264)	(239)	(206)	(168)	(2.46)

() = negative.

Source: Government of Viet Nam, Ministry of Transport, Directorate for Roads of Viet Nam.

21. Along with the efforts to increase the funding provision for annual national road maintenance, the DRVN has implemented various measures to reduce the funding requirements for national road maintenance. Examples include the use of lump-sum contracts for regular maintenance in the 3-year period, and the implementation of pilot performance-based contracts. The project will help reduce the immediate needs of road maintenance by attending to backlogs, with marginal incremental maintenance costs over the project's life.⁸ The project's support for axle load control and road asset management of the project roads are expected to contribute to the reduction of overall maintenance requirements after project completion, which is not qualified in the analysis.

⁸ The annualized incremental maintenance requirement for the project roads is estimated at about 0.5% of the current maintenance funding.