

**YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF ECONOMICS
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**ANALYSIS OF THE COSTS AND BENEFITS OF A ROAD
INFRASTRUCTURE PROJECT:(A CASE STUDY OF THE
MAUBIN-SARMALAUK ROAD)**

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JUNE, 2025

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INFRASTRUCTURE PROJECT: (A CASE STUDY OF THE
MAUBIN-SARMALAUK ROAD)**

A thesis submitted in partial fulfillment of the requirements for the Master of
Development Studies (MDevS) Degree

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This is to certify that the thesis entitled “Analysis of The Costs and Benefits of a Road Infrastructure Project: A Case Study of The Maubin-Samalauk Road” submitted as partial fulfillment towards the requirements for the degree of Master of Development Studies has been witnessed by the Board of Examiners.

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ABSTRACT

This study assesses the economic and social impacts of the Maubin–Samalauk Road project, implemented under a Build-Operate-Transfer (B.O.T.) model in Myanmar’s Ayeyarwady Region. The primary objectives are to identify project costs and evaluate the benefits arising from the infrastructure upgrade. Economic viability was analyzed using Net Present Value (NPV), Benefit-Cost Ratio (BCR), and Internal Rate of Return (IRR) methodologies. Traffic surveys indicate that the improved road, including the bridge approach and bypass, has enhanced transportation efficiency and accommodated increased volumes of heavy vehicles, thereby supporting regional logistics. Vehicle Operating Cost (VOC) was used as a key measure of highway user benefits. The project yielded an IRR of 8.23%, a positive NPV, and a BCR of 1.39, confirming its economic soundness. Beyond financial returns, the project delivered notable socio-economic benefits by reducing travel time, lowering VOC, and improving rural–urban connectivity, thereby contributing to local development and poverty reduction.

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AASHTO	American Association of State Highway and Transportation Officials
BCR	Benefits Cost Ratio
B.O.T	Build Operate Transfer
B.O.O	Build Operate Own
BCR	Benefit-Cost Ratio
D.O.H	Department of Highway
IRR	Internal Rate of Return
N.P.V	Net Present Value
MOC	Ministry of Construction
MUB	Maubin
P.W.F	Present Worth Factor
P.W	Present Worth
RAI	Myanmar's Rural Access Index
JICA	Japan International Cooperation Agency
VOC	Vehicle Operating Cost
VMT	vehicle-miles traveled
YGN	Yangon

CHAPTER I

INTRODUCTION

1.1 Rationale of the Study

Myanmar's geographic location—bordering India, China, and several ASEAN countries—offers significant potential to serve as a regional hub for trade and transportation. However, this potential remains largely untapped due to the underdeveloped condition of its road infrastructure. Limited road quality and connectivity restrict Myanmar's involvement in major regional trade corridors such as the Greater Mekong Subregion Economic Corridors and the India-Myanmar-Thailand Trilateral Highway (World Bank, 2020). Strengthening road infrastructure is therefore essential for improving regional integration, attracting foreign investment, and supporting economic growth, as demonstrated in countries like Vietnam and Thailand (ADB, 2019).

Over 70% of Myanmar's population lives in rural areas, many of which lack reliable year-round access to roads. This limits access to healthcare, education, and markets, particularly during the monsoon season, and deepens rural poverty and inequality (JICA, 2018). Transport infrastructure, especially rural roads, plays a key role in reducing such disparities by improving mobility and enabling access to essential services.

Road development reduces travel time, vehicle operating costs, improving road safety and economic activity. These advantages require substantial expenditure and may have environmental and social implications. Cost-Benefit Analysis (CBA) is used to assess project viability and allocate resources efficiently.

The Maubin–Sarmalauk Road in the Ayeyarwady Region, constructed in 2010, serves as a key transport corridor, linking rural communities with urban centers and major highways. Offering a more efficient and reliable alternative to waterway transport to Yangon, the road enhances mobility and communication across the region. Its strategic importance lies in facilitating local transportation, boosting agricultural trade, and driving socio-economic development. By adding landing points at the

numerous locations where waterways intersect with the road, the agricultural hinterland of this part of the delta region will become more accessible. This improved connectivity is expected to enhance the lives of many in the region's poor communities by creating greater opportunities for income generation and supporting improved rural livelihoods. By improving access to markets, education, and healthcare, it supports regional growth, strengthens the agricultural supply chain, and enhances the logistics network for both regional and national trade. Since its construction 15 years ago in 2010, the road has served as a vital corridor for commuter buses, trucks, and passenger vehicles, playing a significant role in logistics operations and facilitating trade transportation.

Therefore, analyzing the economic benefits of this road is essential to study for future investment decisions and infrastructure planning.

1.2 Objectives of the Study

The main objectives of the study are:

- (1) To identify the costs involved in the improvement project.
- (2) To evaluate the economic benefits of the upgrading road infrastructure

1.3 Method of Study

The descriptive analysis focuses on providing a detailed overview of the Maubin–Samalauk Road through the collection and examination of both primary and secondary data. For primary data, traffic survey was conducted to collect daily traffic volume and revenue of toll plaza. Financial/commercial expenses and advantages of the route are calculated analytically. Analysis uses Net Present Value and Benefit-Cost Ratio. For secondary data, Maubin-Samarlauk road profile information is collected from the Ministry of Construction at Maubin District, ministry of construction website, and other relevant articles and textbooks.

1.4 Scope and Limitations of the Study

The benefits of Sarmalauk-Maubin road from 2010 to 2025 are examined in this study. Economic analysis, particularly public sector financial costs and benefits, is used to evaluate the road's benefits. It aims to analyze the road's economic impact, traffic patterns, and regional connectivity within the Ayeyarwady Region. The research primarily considers government data, toll collection records, and limited field surveys to evaluate the road's performance and its influence on local communities and trade. Due to regional security concerns, access to some areas for in-depth fieldwork and

interviews was restricted, limiting the amount of firsthand data collected from local residents and road users.

1.5 Organization of the Study

Five chapters make up this thesis. Chapter 1 introduces the study's motivation, objectives, research techniques, scope, and method. The literature review and theoretical and conceptual underpinnings of the study are in Chapter 2. Chapter 3 explores background history of Ma U Bin- Sarma Lauk Road Development Project. Chapter 4 analyses the Cost and Benefits analysis of upgrading road infrastructure. Chapter 5 provides finding and suggestions.

CHAPTER II

LITERATURE REVIEW

2.1 Role of Transport Infrastructure in Economic Growth

Road connectivity promotes regional economic integration by linking rural areas to urban centers and markets. Hernandez and Parrado (2015) show that better transport links increase trade volume and enhance economic opportunities in peripheral regions. Miller and Blair (2009) note that transport infrastructure supports socioeconomic development by facilitating labor mobility and access to goods and services.

The link between transportation infrastructure and economic growth has been studied across disciplines. Numerous studies affirm that well-developed transport systems are pivotal for facilitating trade, reducing transaction costs, and enhancing market accessibility (Banister & Berechman, 2001; Lakshmanan, 2011). Road, waterway, and civil aviation networks are particularly critical in supporting freight logistics, industrial supply chains, and regional integration (Rodrigue et al., 2020). Freight transport, as highlighted by Laird and Venables (2017), has a more pronounced impact on economic productivity compared to passenger transport, due to its direct role in the movement of goods and raw materials.

While passenger mobility also contributes to economic outcomes, its effects are often more indirect, relating primarily to labor market efficiency, urbanization, and access to services (Litman, 2010). Passenger turnover, though less impactful than freight volume, is essential for enabling workforce mobility and improving accessibility in urban and peri-urban areas (Graham, 2007).

Spatial econometric models have increasingly been employed to examine the geographically heterogeneous impacts of transportation investment. Moran's I index and LM tests, as used by Anselin (1988), help identify spatial autocorrelation in economic activity, ensuring that regional spillover effects are properly accounted for. Studies using Hausman and LR tests (Baltagi, 2005) support the selection of optimal models for policy analysis and infrastructure planning.

2.2 Public-Private Partnerships (PPPs) in Regional Road Development

Public-Private Partnerships (PPPs) have increasingly become a vital mechanism for financing and managing road infrastructure development at the regional level, particularly in contexts where public funding and institutional capacity are limited. Regional road networks play a critical role in fostering interconnectivity, trade integration, and equitable access to markets, yet many developing and transition economies face substantial deficits in road infrastructure. PPPs offer a framework to bridge these gaps by leveraging private sector expertise, financing, and efficiency.

According to the Asian Development Bank (2008), PPPs in regional road development help governments overcome fiscal constraints while promoting long-term investment in transport infrastructure. These partnerships range from service and management contracts to complex arrangements such as Build-Operate-Transfer (BOT), Design-Build-Finance-Operate (DBFO), and concessions. Such models distribute risk and responsibilities between the public and private sectors, often improving cost-efficiency and accountability in service delivery (Skilling & Booth, 2007).

Empirical studies demonstrate that PPPs in regional road projects lead to improved road quality, reduced travel time, and increased traffic volumes, which in turn stimulate regional economic growth and productivity (Estache & Serebrisky, 2004; Queiroz & Gautam, 2012). For example, Hodge and Greve (2010) note that when well-structured, PPPs can enhance the value-for-money of road investments through lifecycle cost savings and innovation in project execution. The success of PPPs in regional road development often depends on a strong legal environment, transparent procurement processes, and effective project monitoring (Yescombe, 2011).

Public-Private Partnerships (PPPs) in regional road development have emerged as a preferred approach in many developing countries due to their ability to mobilize private capital, reduce fiscal pressure, and bring in technical expertise. However, despite these advantages, significant equity and accessibility concerns persist—particularly related to the imposition of user fees or tolls, which disproportionately affect low-income populations and communities in remote areas.

Several studies (Estache & Serebrisky, 2004; Hodge & Greve, 2010) have noted that toll-based financing in PPP road projects often leads to social resistance, particularly when road users perceive that the benefits do not justify the costs or when toll roads create economic exclusion. Accessibility issues are most acute in poorer and

rural regions where traffic volumes are lower, making such areas less attractive to private investors without public subsidies or viability gap funding mechanisms (Foste& Briceño-Garmendia, 2010). As such, scholars argue for the integration of equity-focused provisions in PPP contracts, such as toll exemptions for essential service vehicles or cross-subsidization mechanisms to ensure universal access (World Bank, 2017).

In developing regions like Sub-Saharan Africa and South Asia, regional road PPPs are increasingly promoted as part of broader regional integration strategies. Programs such as the Programme for Infrastructure Development in Africa (PIDA) and the South Asian Subregional Economic Cooperation (SASEC) initiative serve as key institutional platforms that facilitate transnational road corridor development using PPP frameworks. These initiatives aim to reduce transport bottlenecks, lower trade costs, and enhance the movement of goods and people across borders, especially in landlocked and low-income countries (ADB, 2020; AUDA-NEPAD, 2021).

2.3 Key Sectors for Public-Private Partnerships (PPPs)

Many sectors worldwide have successfully used Public-Private Partnerships (PPPs). Power generation and distribution, water supply and sanitation, waste management, pipeline infrastructure, healthcare facilities like hospitals, educational infrastructure like schools and teaching facilities, sports stadiums, air traffic control systems, correctional facilities, railways, roads, billing and IT systems, and housing projects are examples of sectors where PPPs have been successful. This wide range of applications highlights the flexibility and adaptability of PPP models in meeting diverse infrastructure and service delivery challenges across both economic and social domains (Asian Development Bank, *Beyond Boundaries: Extending Services to the Urban Poor*, 2005).

2.3.1 Prerequisites of PPP Options

A diagnostic analysis is essential for assessing the current condition of a sector undergoing reform and for determining its readiness for Public-Private Partnership (PPP) implementation. Each PPP model has distinct prerequisites that must be satisfied to ensure effective and sustainable execution. More complex PPP forms, which entail substantial risk transfer to the private sector, necessitate robust legal and regulator frameworks, institutional capacity, and skilled human resources capable of managing

and overseeing transactions. Common constraints may include inadequate cost recovery mechanisms, insufficient system data, or substandard technical performance. If the diagnostic assessment reveals that these prerequisites are lacking, it may be advisable to initiate a more limited form of PPP. Alternatively, governments can use the preparatory phase to address such gaps—through legal and regulatory reform, targeted infrastructure investment, and the establishment of necessary institutional structures—thereby laying the groundwork for successful PPP implementation (see table 2.1)

Table 2.1 PPP prerequisites

Option	Political Commitment	Cost Recovery Tariffs	Regulatory Framework	Information Base	Government Capacity for Contracting Management, and Analysis
Service Contract	Low	Low	Low	Low	Moderate
Management Contract	Moderate	Moderate	Moderate	Low	Moderate
Lease	Moderate	High	High	High	High
Concession	High	High	High	High	High
Build-Operate-Transfer	High	Variable	High	High	High

Source: Heather Skilling and Kathleen Booth, 2007.

2.3.2 Models of Public-Private Partnerships (PPPs)

Many countries implement Public-Private Partnerships (PPPs) through various models. According to Weitz, Almud, and Richard Franceys (2002), the most prominent include:

1. Service Contracts,
2. Management Contracts,
3. Lease Contracts,
4. Build-Operate-Transfer (BOT) and its variants,
5. Concessions,
6. Joint Ventures, and

Each model differs in asset ownership, risk allocation, investment responsibility, and operational control.

1. Service Contracts

A government agency hires a private entity to undertake particular operational duties or services for one to two years under a service contract. The public sector provides infrastructural services while the private partner handles some operational tasks. The private organization must supply services at a pre-agreed cost and meet public authority performance requirements. Since service contracts have a clear scope and short length, governments generally use competitive bidding. The government pays the private contractor a fixed price, either a flat amount, per-unit cost, or other agreed-upon basis. The commercial partner is incentivized to reduce operating costs and maintain service quality. A cost-plus-fee strategy is utilized when fundamental operating costs, such as labor, are set and the contractor receives a performance or cost savings fee.

2. Management Contracts

A management contract pays the private contractor a set amount for labor and other operational expenditures. Pre-agreed performance objectives typically trigger additional payments in the contract to promote better performance. Some compensation structures include a portion of the earnings for the private partner.

The commercial business handles day-to-day administration and operations, whereas the public sector handles big capital investments, such as infrastructure expansion or upgrades. However, the contract may specify which activities the private

partner must support. In this approach, the private partner communicates directly with clients while the public sector sets tariffs.

Management contracts typically involve the enhancement of financial and managerial systems within the public entity. As a result, decisions related to service levels and priorities are often made with a greater focus on commercial efficiency. This form of partnership extends beyond basic service contracts by transferring operational control—and in some cases, limited financial responsibility—to the private sector, while the public authority retains ultimate accountability for service delivery. Management contracts are commonly applied in sectors such as utilities, healthcare, and transportation, including ports and airports. In most cases, the private partner provides working capital for operations but does not contribute to long-term infrastructure investment.

3. Lease Contracts or Affermage

A leasing contract is a Public-Private Partnership (PPP) in which the private sector partner delivers services and ensures quality and performance. While the public authority retains responsibility for new capital investments and asset replacement, the private operator undertakes the operational and maintenance functions at its own expense and risk. Typically, lease contracts are structured for a duration of approximately 10 years and may be extended up to 20 years, depending on the terms of the agreement. Under this model, service provision is effectively transferred from the public sector to the private entity, which bears the full financial risk associated with operational activities. This includes liability for operating losses, unpaid consumer debts, and any performance-related shortcomings. Importantly, lease contracts do not involve the transfer or sale of public assets to the private sector; the ownership of infrastructure remains with the public authority. The initial capital required for system establishment is usually financed by the public sector, while operational responsibilities are contracted out to the private partner. A portion of the user tariffs collected by the private operator is typically allocated to the public authority to service loans or support future system expansion.

A related but distinct model is the affermage contract, which shares similarities with a lease but differs in key financial arrangements. In an affermage, the private operator collects revenue directly from consumers and pays a pre-agreed affermage fee to the public authority. The operator retains the remaining revenue, providing a stronger

financial incentive and reducing some of the risks associated with low-cost recovery. The affermage fee is often calculated as a fixed amount per unit of service delivered, offering predictability for both parties. These models are commonly applied in sectors such as water supply, waste management, and port operations, where private sector involvement can enhance efficiency without requiring asset transfer

4. Build-Operate-Transfer (BOT)

Build-Operate-Transfer (BOT) and related concessions allow a private firm or consortium to finance and develop a new infrastructure project or major system component to government performance standards. The fundamental Build-Operate-Transfer (BOT) model has many ownership structures and asset transfer schedule variants. The Build-Transfer-run (BTO) approach transfers the facility to the public sector immediately after completion while the private partner contracts to run it. In contrast, the Build-hold-Operate (BOO) approach lets the private partner hold the facility indefinitely without having to return it to the public sector. The Design-Build-Operate (DBO) approach incorporates a single contract for infrastructure design, building, and operation, with public sector ownership throughout the project lifespan. Nationwide laws and project-specific finance constraints regulate asset ownership and transfer time.

Thus, many structural variations exist to fit different policy contexts and investment goals. DBFO transfers design, building, funding, and operations to a private sector partner, further integrating tasks. Private entities' financial duty varies greatly based on contract terms. BOT and its derivatives have mobilized private sector infrastructure development and rehabilitation investment. These approaches reduce commercial risks for the private sector, making them attractive for financing, especially when the government is the sole buyer under long-term agreements. Such approaches succeed if the agreements are credible and enforceable.

5. Concessions

A concession contract is a Public-Private Partnership (PPP) in which the concessionaire delivers infrastructure services in a predetermined region. Importantly, this covers infrastructure funding, building, rehabilitation, and growth, as well as operation, maintenance, and customer management. The concessionaire must make all capital investments for system development and enhancement under this agreement.

Although the private operator delivers and operates assets, the public sector owns them under concession.

The public authority regulates service quality, performance, and tariff compliance instead of providing services. System users pay tariffs directly to the concessionaire. The concession agreement defines tariff structures and may include future tariff modifications. User fees usually fund capital investments. In some cases, the public sector may fund large-scale capital expenditures, especially early in the concession. Concessionaire must ensure appropriate operating capital for everyday operations. Concession contracts are usually 25–30 years lengthy to enable for cost recovery and ROI. Long-term investment and operational efficiency are required in water supply, transportation, energy distribution, and urban services; hence this approach is used. The concession model lets governments use private sector expertise and finance while maintaining regulatory authority and asset ownership.

6. Joint Ventures

Public-private joint ventures co-own and operate infrastructure assets as an alternative to complete privatization. Through equity sales to private investors, the parties might form a new business or share control of an existing one. The jointly held firm may be listed on a stock market to attract more investment and increase transparency.

A critical element of this model is the establishment of sound corporate governance mechanisms, which ensure that the company operates independently from undue political influence. This independence is particularly important given the dual role of the government as both regulatory and shareholder. While this duality may pose risks of political interference, it also aligns the government's interest with the financial sustainability and performance of the venture. By participating as a shareholder, the public sector retains influence over strategic decisions while relying on the private partner to assume day-to-day operational responsibilities.

2.4 BOT-Type Contracts in Public-Private Infrastructure Development

Build–Operate–Transfer (BOT) contracts and its variants are a cornerstone of infrastructure public-private partnerships (PPPs), especially for capital-intensive, long-term projects. These arrangements delegate substantial responsibilities to private

partners, including financing, construction, and operation, while ownership typically reverts to the public sector at the end of the contract term.

A defining feature of BOT-type agreements is the private sector's provision of upfront capital and the temporary ownership of the asset, enabling recovery of investment through user fees or government payments. However, demand risk poses a significant challenge—especially in "take-or-pay" schemes, where governments may be obligated to purchase excess output. In response, some contracts distribute this risk through dual-pricing models (e.g., fixed capacity charges and variable consumption charges), allowing for more balanced risk sharing between public and private actors (Yescombe, 2007; Grimsey & Lewis, 2002).

The BOT framework includes several important variations shaped by local laws, financing environments, and institutional capacity. These include Build–Transfer–Operate (BTO), where asset ownership is immediately transferred to the public sector post-construction; Build–Own–Operate (BOO), which keeps assets permanently under private control; and Design–Build–Operate (DBO), where ownership remains public, but implementation is streamlined under a single private contract. The Design–Build–Finance–Operate (DBFO) model represents a more integrated approach, bundling all major project functions under private sector responsibility, though the degree of financial risk transferred can vary significantly (Delmon, 2011).

A key distinction between BOT-type contracts and concessions lies in the nature of the assets involved. Concessions often focus on the expansion or operation of existing infrastructure, while BOTs are more frequently applied to greenfield investments requiring significant external financing. Nevertheless, in practice, these categories can overlap as many concession contracts include components of new infrastructure development.

The literature underscores the complexity of BOT arrangements, particularly in terms of financing structure, legal constraints, and transfer of ownership and risk. While these models can catalyze infrastructure growth and reduce public fiscal burdens, their success depends heavily on accurate demand forecasting, well-structured contracts, and effective risk allocation mechanisms (World Bank, 2014; Zhang, 2005)

2.5 A Benefit-Cost Approach to Public-Private Partnerships (PPPs)

Cost-Benefit Analysis (CBA) remains one of the most widely adopted methods for project appraisal across the globe. Its conceptual foundation can be traced back to the pioneering work of Jules Dupuit in 1844, who published a seminal paper in French on the utility of public works. The formal application of CBA began in the United States in the early 20th century, particularly with the Rivers and Harbors Act of 1902, which mandated that evaluations of proposed developments explicitly consider navigation benefits relative to project costs. Projects were eligible for federal funding only when the anticipated benefits outweighed the associated costs.

A significant milestone in institutionalizing CBA was the publication of the "Green Book" in 1950 by the U.S. Federal Interagency River Basin Committee. This document outlined standardized economic analysis principles for the assessment of federally funded water resource projects and laid the groundwork for applying CBA as a tool to evaluate economic efficiency in public investment.

In 1965, economist Robert Dorfman expanded the application of CBA beyond water resources, illustrating its relevance to a broader range of sectors. From the 1960s onward, the use of CBA extended rapidly beyond the United States, particularly in fields such as transportation.

CBA became popular in Europe, mainly in the UK, in the 1960s and 1970s. One example is Coburn, Beesley, and Reynolds' 1960 cost-benefit study of the London–Birmingham Motorway, and Flowerdew's 1972 economic review of the planned third London airport. This growth was fueled by post-war government participation in economic planning and the complexity and extent of infrastructure developments in modern industrial economies.

The economic appraisal of highway projects is a critical component in the decision-making process at various stages of project development. During the planning phase, project developers typically evaluate multiple route alternatives by comparing their economic performance against baseline scenarios, such as the "do-nothing" option—where no intervention occurs—and the "do-minimum" alternative, which involves only minimal upgrades to existing infrastructure. These comparisons help determine whether the proposed investment yields sufficient economic value.

To assess these alternatives, cost-benefit computations are carried out for each option to derive indicators of economic viability. These indicators, commonly referred

to as measures of economic worth, are grounded in engineering economics and explicitly incorporate the time value of money—a principle that reflects how the value of money changes over time. The most frequently used appraisal methods include:

- Net Present Value (NPV)
- Benefit-Cost Ratio (BCR)
- Internal Rate of Return (IRR)

These measures offer numerical insights into the relative efficiency and profitability of investment options and are fundamental to rational infrastructure planning and prioritization (Rogers, 2006).

Economic assessment can be used to justify a system in absolute terms by determining if it is ‘economically efficient’. An inefficient strategy with a negative net present value or benefit/cost ratio below unity would harm society more than it helps. The economic costs of people ‘losing out’ from the highway's development would surpass its advantages. Beneficiaries are road users and ‘losers’ are funders. Assuming at least one alternative has a positive NPV or a B/C ratio larger than unity, the scheme with the highest measure of value will be the most efficient. Cost-benefit analysis is used to evaluate roadway systems' economic effects.

2.5.1 Net Present Value Method

The difference between a project's future cash inflows and outflows is its present net value. This requires discounting all yearly cash flows to the implementation start at a set rate. This is given by the expression

$$NPV = NCF_0 + (NCF_1 \times a_1) + (NCF_2 \times a_2) + \dots + (NCF_n \times a_n)$$

Where,

NPV = net present value of a project,

NCF = net cash flow of a project in years 0, 1, 2, ..., n

a = discount factor in years 1, 2, ...,

n, corresponding to the selected rate of discount.

Similarly following formula can also be used.

$$NPV = \sum_{t=0}^n (CI - CO)_t a_t$$

Where,

n = a sum total for the whole lifetime of the project from year 0 to year n ,

CI_t = cash inflow in the year t , CO_t = cash outflow in the year t ,

a_t = discount factor in the year t corresponding to the selected rate of discount.

All else being equal, a project's net present value (NPV) rises with capital investment (CI) and length but falls with discount rate and operational expenses. A project is financially feasible if its NPV is positive. A positive NPV means the project will produce value and should be done. A negative NPV means the project should be rejected since it would decrease in value. The project breaks even if the NPV is zero. When choosing between mutually incompatible options, choose the one with the largest NPV since it will add the most value.

2.5.2 Benefit- Cost Ratio Method

In formal cost-benefit analysis, a benefit-cost ratio (BCR) summarizes a project or proposal's value for money. The ratio (BCR) compares project profits to costs. Higher BCRs indicate better investments. A project with a BCR above 1 may be worthwhile. The advantages PV surpasses the costs PV. As seen by the expression.

$$BCR = \frac{PV_{benefits}}{PV_{costs}}$$

$$PV_{benefits} = \sum_{n=0}^H \frac{B_n}{(1+r)^n}$$

$$PV_{cost} = \sum_{n=0}^H \frac{C_n}{(1+r)^n}$$

Where

n = Each Period

N = Holding Period

NPV = Net Present Value

IRR = Internal Rate of Return

The above economic indicator shows project feasibility. NVP, IRR, and PP are determined using project cash flow and cost-benefit analysis. Following the computation, the ministry determined whether projects are bankable and provided a cost-benefit analysis:

- Project maintenance and saving
- Time-saving
- Vehicle operation cost saving
- Road accident prevention

The current values of all predicted future cash flows connected with a project make up net present value (NPV). Present value is future cash flows discounted to their current value.

A project is deemed investment-worthy if its NPV is positive, indicating that it is expected to generate a net gain in value.

2.5.3 The internal rate of return (IRR)

IRR is the discount rate at which a project's NPV equals zero. For all costs and benefits, economic prices (representing social opportunity costs) or financial market prices (reflecting market transactions) can be used. A financial loss is likely if the financial IRR is lower than the project's cost of capital. If the economic IRR is below the opportunity cost of capital, the project is uneconomical. (Nam Geon Cho,2008)

$$IRR = \sum_{t=0}^n \frac{B_t}{(1+r)^t}$$

$$IRR = \sum_{t=0}^n \frac{C_t}{(1+r)^t}$$

Where , B_t : Present value of Benefits

C_t : Present value of costs

r: Discount rate

n:Duration Year

2.5.4 Highway User Benefits Approaches

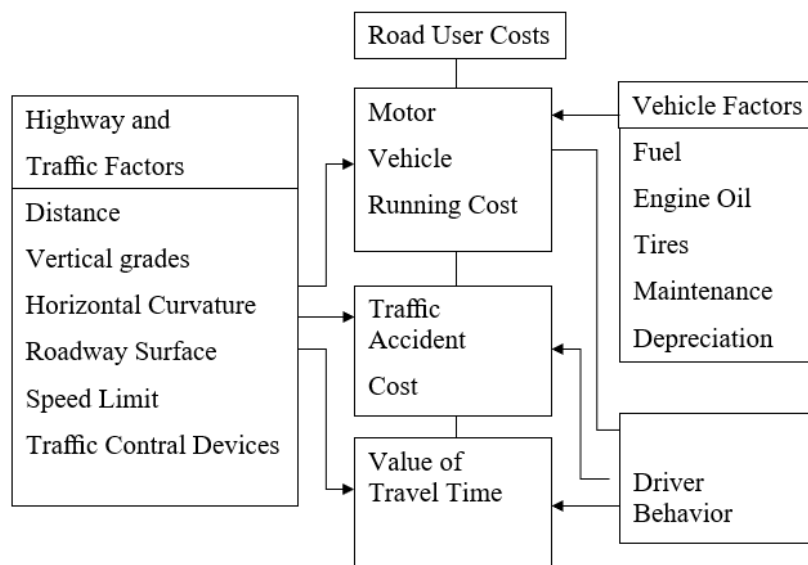
The application of cost-benefit analysis (CBA) in the assessment of highway projects is often complex due to the diverse range of benefits associated with road infrastructure improvements. While some benefits can be readily quantified in monetary terms, others present greater challenges in valuation. Notably, many of the benefits derived from transport enhancements manifest as reductions in various costs, primarily categorized as user benefits. These benefits accrue directly to individuals or

entities that utilize the improved roadway infrastructure (Rogers,2006). Key components of user benefits typically include:

- Reductions in vehicle operating costs, such as fuel, maintenance, and depreciation;
- Time savings, resulting from improved traffic flow and reduced congestion;
- Decreases in accident frequency, which lead to fewer injuries, fatalities, and associated economic losses.

Figure 2.1 shows three main user costs utilized in transportation project evaluations: vehicle operation, journey time, and accident costs. These expenses are frequently called advantages since improving a transportation infrastructure lowers the perceived price for customers, as illustrated on the demand curve (Garber & Hoel, 2009).

Figure 2.1 Road User Cost Factors



Source: Highway Engineering Economy, U.S. Department of Transportation, Federal Highway Administration, April 1983

2.5.5 Travel-Time Savings

The enhancement of highway infrastructure typically leads to reductions in travel time and improvements in the reliability of transport services. For users of transportation systems, time is intrinsically linked to economic value. The extent of this relationship largely depends on how individuals utilize the additional time made available through such improvements.

Within cost-benefit analyses, the valuation of time savings often involves differentiating between work-related and non-work-related travel. The latter encompasses commuting as well as leisure trips. Under the idea that travel time may be used for productive activities, industrialized economies value work time at the average industrial salary plus fringe benefits. However, economic evaluation specialists disagree on how to value non-work time. In instances with time trade-offs, such values must be inferred from behavioral decisions because there is no direct market process to establish its value. Empirical research conducted in industrialized nations suggests that non-working time is typically valued at approximately 20% to 35% of the value of working time (Adler, 1987). In contrast, valuations in less developed countries are often set at comparatively lower percentages.

2.5.6 Vehicle Operating Cost Savings

Vehicle operating costs (VOC) refer to expenses related to fuel, maintenance, tire wear, depreciation, and other vehicle-related expenditures. These costs are influenced by changes in vehicle-miles traveled (VMT), which may decrease due to shorter routes or improved traffic flow, or increase due to extended facility access (Forkenbrock & Weisbrod, 2001). Reductions in stop frequency and smoother speed cycles can also yield VOC savings. Once the changes in VMT and traffic conditions are estimated, cost savings are determined using per-mile cost figures that vary by vehicle class (Cambridge Systematics, 2009). The building work zone increases vehicle operating expenses due to extended vehicle use. Fuel, tire wear, engine oil, repair, and mileage-related depreciations are included (Ellis et al., 1997; Mallela & Sadasivam, 2011).

2.5.7 Safety Benefits

Safety improvements represent a critical dimension of highway user benefits. Transportation projects often aim to reduce the frequency and severity of crashes

through geometric redesigns, signal upgrades, or access management strategies. The expected safety benefits are evaluated using standard crash modification factors (CMFs) and severity weighting techniques (Elvik, 2001). Agencies such as the Minnesota Department of Transportation (MnDOT) provide standardized economic values for various crash severities (MnDOT Office of Traffic Engineering, 2020). These values are applied to the estimated changes in crash incidence to derive monetary safety benefits.

2.5.8 Capital Costs

Economic analysis calculates a transportation investment's cost as the total resources needed to complete it. This encompasses all expenditures necessary to construct and maintain the infrastructure over its operational life. Importantly, the focus of the analysis is not on identifying which stakeholder bears the costs, but rather on capturing the full scope of economic resources expended to realize the project. Total investment for roadway improvement is capital costs. These include engineering, design, building, and landscaping costs. For clarity and to facilitate analysis, capital costs should be categorized according to their position within the infrastructure's life cycle. Engineering, right-of-way acquisition, major structures, grading and drainage, sub-base and base layers, surface, and miscellaneous elements are common groups. This way of organizing capital expenses helps estimate infrastructure components' remaining usable value over time (American Association of State Highway and Transportation Officials, 2003).

2.6 Review on Previous Studies

Cost-benefit analyses of road infrastructure projects typically include three main categories of quantifiable benefits: (a) residual value of the investment, (b) travel time savings, and (c) vehicle operating cost (VOC) savings. The residual value accounts for the economic worth of the infrastructure at the end of the evaluation period. This is generally estimated at 25% of the total capital cost, reflecting the long-lasting nature of the base course materials, which represent a significant share of the construction investment and are less prone to rapid degradation compared to surface layers (Asian Development Bank, 2010).

Travel time savings result primarily from improved road quality and higher vehicle speeds. These are monetized using estimates of average income. According to

the International Monetary Fund (2009), Cambodia's GDP per capita in 2009 was \$853, with 45% of the population economically active and working an average of 2,000 hours per year, resulting in an estimated hourly income of \$0.95. However, to reflect the lower rural income levels, a conservative value of \$0.50 per hour was used for motorcycle and public transport passengers. For passengers in cars and 4-wheel drive vehicles, often among the top 20% of income earners, an hourly income of \$2.00 was assumed. Non-work travel time, estimated at 50% of total travel time for higher-income passengers and 30% for others, was valued at \$0.30 per hour for car/4WD passengers and \$0.15 per hour for other users. Freight time savings were excluded from the analysis due to the complexity of quantifying time-value for goods in transit (ADB, 2010).

Vehicle Operating Cost (VOC) savings form a substantial share of the benefits, arising from reduced road roughness and increased vehicle speeds. These improvements reduce costs related to fuel consumption, vehicle maintenance, tire wear, and depreciation. Using the HDM-4 (Highway Development and Management Model), VOC savings were estimated for 14 vehicle types commonly used in rural Cambodia, including conventional and unconventional motorized vehicles as well as non-motorized modes (ADB, 2010). This vehicle-specific modeling enables more precise estimation of user cost reductions due to infrastructure improvements.

Upgrading road infrastructure delivers a range of economic benefits, primarily through enhanced vehicle operating conditions and improved transport efficiency. As observed in the *Uttar Pradesh Major District Roads Improvement Project* (RRP IND 43574-025), the benefits of upgrading existing project roads include higher vehicle speeds and improved riding quality, which collectively result in reduced travel time and lower vehicle operating costs (VOCs) over the analysis period (Asian Development Bank 2013). In the absence of road improvement interventions, road surfaces are subject to faster deterioration due to regular traffic loads and weathering. This degradation leads to progressive reductions in average vehicle speeds, increasing the burden on both private and commercial road users. By contrast, the upgrading project preserves road surface conditions, allowing for consistent travel speeds and reducing wear and tear on vehicles. The resulting VOC and time savings, compared with a "without-project" baseline scenario, are considered critical benefits in the project's economic analysis (ADB, 2013).

To quantify these benefits, the Highway Development and Management Model (HDM-4) was employed. HDM-4 enables a robust estimation of road user costs by

integrating detailed input parameters, including vehicle and fuel prices, as well as the costs of crews, maintenance, labor, and tires. This model allows analysts to simulate how different road conditions affect operating costs across various vehicle types, producing a comprehensive view of road user savings attributable to infrastructure upgrades (World Bank, 2011).

Vehicle Operating Cost (VOC) plays a crucial role in estimating economic benefits in the feasibility studies of highway projects. The improvement of road conditions—either through new construction or the upgrading of existing roads—is expected to result in lower VOCs for road users. This reduction is primarily driven by smoother road surfaces, decreased congestion, and improved travel speeds, all of which lead to more efficient vehicle performance and reduced wear and tear (Jayasinghe et al., 2017).

The operating cost of a vehicle is influenced by a multitude of factors, including pavement roughness, travel speed, vehicle type, road geometry, and traffic conditions. Traditionally, VOC estimates have been updated using price indexes, which adjust cost components such as fuel and maintenance prices. However, this method fails to capture the real variability introduced by changes in physical and operational parameters, making it inadequate for accurate feasibility evaluations, particularly in local contexts such as Sri Lanka.

Recognizing this gap, Jayasinghe et al. (2017) conducted a study to develop more representative VOC values for cars and medium trucks, considering varying roadway conditions across Sri Lanka. The study emphasizes the significant effect of road roughness on VOC. As roughness increases, it disproportionately impacts operating costs—especially at higher travel speeds—due to increased fuel consumption, vehicle strain, and maintenance requirements.

CHAPTER III
OVERVIEW OF THE DEVELOPMENT OF ROAD INFRASTRUCTURE IN
MYANMAR

3.1 Road Infrastructure Development in Myanmar

According to the Data Collection Survey on Nationwide Road and Bridge Priority Projects, Final Report (2020), a total of 21,943 kilometers (13,635 miles) of roads had been constructed in Myanmar before 1988. After that, the government focused on repairing and upgrading roads and bridges through several short-term plans. These plans were mainly implemented during the period of the State Law and Order Restoration Council to improve transportation across the country.

By the end of the fiscal year (2000-2001), the total length and types of roads in Myanmar were reported as follows in table 3.1.

Table 3.1 Road Pavement Type

No	Road Pavement	Length
1.	Asphalt roads:	12,920 km (8,028 miles)
2.	Rock Roads	4,814 km (2,991 miles)
3.	Firm ground roads	5,029 km (3,125 miles)
4.	Earthen roads	6,001 km (3,729 miles)
Total road length		28,764 km (17,873 miles)

Source: Department of Public Works, Ministry of Construction (MOC)

In 2001, the Ministry of Construction (MOC) developed a 30-year Long-Term Plan (2001–2030) aimed at upgrading roads and bridges to meet international standards. The goal of this plan is to improve transportation access within Myanmar and to neighboring countries by upgrading the national road network to the following standards (Data Collection Survey, 2020) see in table 3.2.

Table 3.2 National Road Network Development

No	Highway Road	Length	Pavement Type
1.	International arterial roads	14.6 meters	Four-lane with asphalt concrete pavement
2.	Major union highways	73 meters	Two-lane asphalt concrete pavement
3.	Other union highways	3.65 meters	Asphalt concrete pavement

Source: Department of Public Works, Ministry of Construction (MOC)

3.2 Private Sector Involvement in Road Development Sector in Myanmar

In Myanmar, the private sector builds and maintains roads and bridges. The Survey Program for the National Transport Development Plan in the Republic of the Union of Myanmar, Final Report (Department of Public Works, Ministry of Construction, 2014) found that private companies have supported road and bridge projects financially and operationally. They collect toll revenues and occasionally maintain roughly 400 tollgates on important highways and bridges in the country.

Road and bridge operations are funded by toll revenues from the “auction” and Build-Operate-Transfer (BOT) regimes. The Department of Public Works (PW) contracts private toll collectors under the auction system. PW maintains roads and bridges with government funds. BOT permits private enterprises to finance road and bridge construction or renovation with their own funds. Toll fee collecting helps enterprises recoup their investment and make money (table 3.3).

Table 3.3 Type and Responsible Body for Operations and Maintenance

Type of O&M	Responsible Body		
	Toll collection	Maintenance	Operation
Public Works (PW)	PW	PW	PW
Auction	Private	PW	PW
BOT	Private	Private	Private

Source: Department of Public Works, Ministry of Construction (MOC)

On 22 July 1996, the Ministry of Construction, Asia World Company, and Diamond Palace Company began the first BOT contract in Myanmar's road sector to improve a 102-mile, 3-furlong section of the Lashio–Muse Road with Myanmar Investment Commission approval. Private participation has grown greatly since then.

Estimated BOT contracts cover 90% of roads transporting more than 1,000 cars per day, excluding expressways. Myanmar's BOT roads make up 14% of trunk roads and 31% of national highways. Toll rates on Myanmar's roads are regulated by the Department of Highways (DOH), previously known as the Public Works Department. These rates are reviewed every two to four years or are negotiated directly within BOT contracts. Currently, BOT toll rates range from approximately USD 0.03 per kilometer for small vehicles (e.g., saloon cars) to USD 0.22 per kilometer for large trucks, while toll rates on auction roads are typically one-third to one-fifth of BOT toll rates (VDB Loi, 2018).

3.3 Development Policy of Road Infrastructure in Myanmar

The Ministry of Construction (MOC) aims to expand the national road network from 35,899 kilometers in 2011 to 52,305 kilometers by the fiscal year (2030-2031), reflecting an ambitious target of approximately 2% annual growth. While the plan rightly emphasizes the importance of leveraging private sector participation through Build-Operate-Transfer (BOT) arrangements and attracting foreign direct investment, concerns remain regarding the heavy reliance on the BOT system, which may prioritize profit generation over long-term safety, quality, and equitable access (JICA, 2020). Additionally, the involvement of international financial institutions such as the Asian Development Bank (ADB) and the World Bank is critical for funding but may impose external policy conditions that could influence domestic decision-making priorities. Although the plan explicitly aligns with national goals to promote transportation efficiency, regional integration, national security, and poverty alleviation through job creation and improved market access, the practical challenges of implementation—such as limited institutional capacity, potential governance issues, and the technical demands of maintaining upgraded roads require further scrutiny.

3.4 Practicing of BOT Contracts in Myanmar

The Build-Operate-Transfer (BOT) contracts in Myanmar's road development sector are structured with specific timelines and long-term obligations for private contractors. Each BOT agreement requires the private company to complete initial road repairs and widening within a maximum of three years, followed by regular maintenance for the remaining contract period of 40 years, which can be extended up to 55 years in five-year increments. All capital investment, including initial construction

and ongoing maintenance costs, is fully financed by the BOT contractor. In return, contractors are granted toll collection rights, typically beginning after the completion of the initial improvement works. (ADB, 2018).

The technical specifications within these contracts primarily address pavement type, road width, shoulders, and embankment construction but generally omit specific requirements related to road safety features, geometric design standards, or realignment provisions, potentially limiting the long-term safety and performance of the upgraded roads. Moreover, the scope of works defined in the contracts tends to be generic and broadly standardized across projects, regardless of traffic volume or regional conditions. The Ministry of Construction (MOC) plays a central role in advancing these BOT projects as part of Myanmar's Public-Private Partnership (PPP) strategy, which is essential for expanding and improving the national transport network under fiscal constraints. Due to limited public financial resources, the BOT system has become a key mechanism to attract private sector investment in road infrastructure (ADB, 2014).

Currently, the Department of Highways, under the MOC, manages a total road network of approximately 26,523 miles and 3 furlongs. Out of this, 24 local private companies are engaged in the construction and maintenance of 64 road sections, covering approximately 3,028 miles, 1 furlong, and 524 feet, which represents around 11% of the total roads managed by the department through BOT contracts (ADB, 2018).

The Mandalay Region, accounting for nearly 30% of total B.O.T contracts, reflects its central role in national economic geography. As Myanmar's second-largest city and a major transportation and trading hub, Mandalay has long served as a logistical and economic corridor linking Upper and Lower Myanmar. The high number of B.O.T projects suggests a favorable environment for public-private partnerships, likely supported by existing infrastructure, institutional capacity, and projected economic returns. This strong concentration reinforces Mandalay's position as a key driver of regional development.

Similarly, Yangon and Bago, with 6 contracts each (approximately 9.84%), are well-positioned along major trade routes and economic clusters. Yangon, being the commercial capital, naturally attracts infrastructure investment due to its urban density, industrial zones, and economic demand. Bago's proximity to Yangon likely increases its strategic value for spillover infrastructure projects and regional connectivity, both of which are essential components of regional economic development. (see table 3.4).

Table 3.4 Distribution of B.O.T Contracts in Myanmar

Region	Number of B.O.T Contracts	Length (Mile/furlong)	Percent share by Total B.O.T contracts
Ayawaddy	3	154	5%
Bago	6	161	10%
Kachin	1	47/4	2%
Kayin	3	55/1.5	5%
Magway	8	948	13%
Mandalay	18	717	30%
Mon	4	199/6	7%
Naypitaw	1	39/5.5	2%
Sagaing	5	243/7	8%
Shan	5	177/5	8%
Thanintharyi	1	111	2%
Yangon	6	95	10%
Total	61	2902	100%

Source: Department of Public Works, Ministry of Construction (MOC)

CHAPTER IV

ECONOMIC ANALYSIS ON MAUBIN-SAMALAUK ROAD PROJECT

4.1 Overview of Maubin-Samalak Road Project

Functionally, the road infrastructure of Maubin -Kazan Road formally known as Maubin-Samalak Road is subdivided into three distinct segments:

1. Maubin–Sarmalak Road: 16 miles and 2 furlongs (26.152 km),
2. Maubin Bridge Approach Road: 2 miles and 4 furlongs (4.023 km),
3. Maubin Bypass Road: 2 miles and 5 furlongs (4.225 km),

Collectively, these segments comprise the full 34.400 kilometers of the Maubin-Kazan Road. The project's necessity and urgency were underscored by the widespread infrastructural damage caused by Cyclone Nargis in May 2008, which significantly impacted transportation networks across the Ayeyarwady Region. In the aftermath, local authorities and relevant agencies initiated emergency responses, including the granular base rehabilitation of road sections to ensure continued vehicular access and mobility.

Subsequently, in 2010, the Ministry of Construction undertook a comprehensive field assessment, culminating in the issuance of Pavement Design Cross Sections. These technical directives facilitated the initiation of more structured and durable road surface reconstruction efforts.

The culmination of these developmental milestones was marked by the official inauguration of the Maubin-Kazun Road by the Chief Minister of the Ayeyarwady Region on June 8, 2013, symbolizing a key advancement in regional infrastructure modernization and resilience-building.

4.1.1 Implementation of B.O.T Contract

On December 29, 2015, a Build-Operate-Transfer (B.O.T.) agreement was formally executed for the development of the Maubin-Kazun Road, involving a total capital investment of 4.287 billion Kyats. The Maubin-Kazun Road serves as a strategic linkage to the Yangon–Patheingyi Road, with the connection point located at milepost 32/5, corresponding to approximately 52.505 kilometers. The primary route spans from

Table 4.1 Capital Fund

Fiscal Year	Capital Fund for Maintenance of the Maubin-Kazun Road (in Million Kyats)
2011-2012	500.220
2012-2013	131.56
2013-2014	239.810
2014-2015	3213.120
2015-2016	21413.2
2016-2017	16609.6
2017-2018	8455.23
2018-2019	24668
2019-2020	16609.61
2020-2021	8455.23
2021-2022	3255.1
2022-2023	2022.49
2023-2024	1396.577
2024-2025	2922.039
	60158.956

Source: Ministry of Construction (MOC)

4.2 Existing Traffic Condition

An existing traffic conditions survey is a critical input for conducting a Benefit-Cost Analysis (BCA) for transportation projects. The Maubin–Samalauk Road was constructed as a two-way asphalt road, providing a paved surface suitable for vehicles. The total length is 21 miles and 3 furlongs (equivalent to 21.375 miles), with a width of 18 feet, which is generally sufficient for two-way traffic.

4.2.1 Numbers of Vehicle Per Day (Monday)

The toll collection data for the origin -destination survey of Yangon–Maubin (YGN–MUB) and Maubin–Yangon (MUB–YGN) routes on June 2, 2025 (Monday) reveals both the volume and economic contribution of various vehicle types using the toll road. A total of 1,322 vehicles traveled along both directions of the route on this

date, generating a total toll revenue of 531,600 Kyats. The distribution of vehicles and revenue between the two directions was relatively balanced, with 676 vehicles traveling from Yangon to Maubin, contributing 261,400 Kyats, and 646 vehicles traveling in the opposite direction, contributing 270,200 Kyats. Among all vehicle types, trishaws had the highest volume, with 346 outbound and 315 inbound trips, accounting for a combined 661 trips and total revenue of 66,100 Kyats. Although trishaws represent a significant share of traffic, their individual toll fees are low.

Table 4.2 Number Vehicles on Monday

YGN - MUB		2.6.2025 (Monday)	MUB-YGN	2.6.2025 (Monday)
Vehicle Type	Number	Toll Fee (Kyats)	Number	Toll Fee (Kyats)
Trishaw	346	34600	315	31500
Light Truck	54	16200	47	14100
Farm Truck	91	36400	87	34800
bus	106	74200	110	77000
TE	15	24000	16	25600
highway bus	4	2800	2	1400
Dina (15 feet)	52	57200	58	63800
3 axles	8	16000	11	22000
Total	676	261400	646	270200
Total number of vehicles				1322
Total Amount (kyats)				531600

Source: Survey Data

Table 4.3 Number of Heavy Vehicles on Monday

YGN - MUB		2.6.2025 (Monday)	MUB-YGN	2.6.2025 (Monday)
Types of Vehicle	Number	Toll Fee (Kyats)	Number	Toll Fee (Kyats)
Highway	5	3500	1	700
TE	15	24000	17	27200
3 axles (8 whelels)	73	146000	104	208000
3 axles (8 whelels)	13	32500	70	175000
4 axles (10 wheels)	6	16200	0	0
4 axles (12 wheels)	1	3200	6	19200
5 axles (14 wheels)	0	0	11	41800
5 axles (14 wheels)	0	0	3	12900
18 wheels	0	0	0	0
22 wheels	3	22500	6	45000
Total	116	247900	218	529800
Total number of vehicles				334
Total Amount (kyats)				777700

Source: Survey Data

4.2.2 Number of Vehicle Per Day (Sunday)

The toll collection data for heavy vehicles traversing the Yangon–Maubin (YGN–MUB) and Maubin–Yangon (MUB–YGN) routes on June 1 and 2, 2025, reveals significant variations in traffic volume and revenue generation between weekend and weekday operations. On Sunday, June 1, a total of 281 vehicles were recorded, resulting in toll revenues amounting to 640,900 Kyats. In contrast, on Monday, June 2, vehicle volume increased to 334, with a corresponding rise in revenue to 777,700 Kyats. This upward trend reflects the typical increase in freight movement and commercial activity observed during the beginning of the workweek.

Among all vehicle categories, three-axle (8-wheel) trucks consistently constituted the largest share of toll-paying traffic, both in terms of frequency and monetary contribution. These vehicles alone generated over 338,000 Kyats on Sunday and more

than 529,000 Kyats on Monday, underscoring their pivotal role in regional logistics and cargo transportation. Additionally, the presence of larger vehicles, such as five-axle (14-wheel) and twenty-two-wheel trucks, was more prominent on Monday, suggesting a pattern in which high-capacity freight is mobilized during weekdays to meet supply chain demands.

The comparative data underscores a clear correlation between the day of the week and the scale of commercial transport operations. While Sunday saw moderate levels of traffic dominated by mid-sized trucks, Monday exhibited a substantial increase in both traffic density and toll revenue, indicative of enhanced economic activity and logistical coordination.

Table 4.4 Number Vehicles on Sunday

YGN - MUB		1.6.2025 (Sunday)	MUB-YGN	1.6.2025 (Sunday)
	Number	Toll Fee (Kyats)	Number	Toll Fee (Kyats)
Highway Bus	6	4200	3	2100
TE	22	35200	31	49600
3 axles (8 whelels)	107	214000	62	124000
3 axles (8 whelels)	9	22500	1	2500
4 axles (10 wheels)	4	10800	2	5400
4 axles (12 wheels)	8	25600	10	32000
5 axles (14 wheels)	0	0	1	3800
18 wheels	0	0	3	19200
22 wheels	3	22500	9	67500
Total	159	334800	122	306100
Total number of vehicles				281
Total Amount (kyats)				640900

Source: Survey Data

On Sunday, June 1, 2025, a total of 223 vehicles used the Yangon–Maubin (YGN–MUB) and Maubin–Yangon (MUB–YGN) routes, generating a combined toll revenue of 103,890 Kyats. Compared to weekdays, the traffic volume was noticeably lower, consistent with typical weekend travel patterns. The Yangon–Maubin direction

recorded 128 vehicles contributing 60,060 Kyats, while 95 vehicles returned from Maubin to Yangon, generating 43,830 Kyats. Trishaws and buses made up a large portion of the traffic, though their toll contributions remained modest. The highest toll income came from 3-axle vehicles, contributing 54,000 Kyats in total, despite relatively low numbers, showing their higher fee rate. Overall, the reduced traffic volume and revenue reflect the lower demand typically observed on Sundays, especially from commercial and heavy vehicles.

Table 4.5 Number Vehicles on Sunday

YGN - MUB		1.6.2025 (Sunday)	MUB-YGN	1.6.2025 (Sunday)
Vehicle Type	Number	Toll Fee (Kyats)	Number	Toll Fee (Kyats)
Trishaw	57	5700	33	3300
Light Truck	4	1200	7	2100
Farm Truck	20	8000	12	4800
mini bus	0	0	0	0
bus	14	9800	10	7000
TE	1	1600	2	3200
Dina (15 feet)	16	1760	13	1430
3 axles	16	32000	11	22000
Total	128	60060	95	43830
Total number of vehicles				223
Total Amount (kyats)				103890

Source: Survey Data

4.2.2 Vehicle Operation Cost

Assumptions Factors for Vehicle Operation Cost are considered as Tire cost and Fuel cost in this study. Table 4.6 shows assumption value of the vehicle tire cost in this study. Fuel cost is assumed as 2000 kyats per liter which is based on fuel price of year 2020. Average vehicle operation cost is calculated as 11876 kyats, see detailed calculation in appendix. The approach of operation cost is calculated as following;

$$\text{Vehicle Operation Cost} = \text{Fuel cost} + \text{Tire Cost (Repair)}$$

Table 4.6 Tire Cost

Types of vehicles	Tire Cost Per Wheel (Used Tire) (Kyats)
4 wheels	60000
6 wheels	60000
6 wheels	60000
10 wheels	80000
12 wheels	100000

Source: Survey Data

4.3 Economic Analysis

4.3.1 Net Present Value (NVP) Method

According to project data obtained from the Maubin District Office under the Ministry of Construction, several key input parameters have been identified for the economic feasibility analysis of the proposed road construction project. The initial investment cost for the project is estimated at 4.287 billion Kyats, which will be expended over a designated construction period of two years. The Average Annual Daily Traffic (AADT) is projected to be 1,660 vehicles, serving as a foundational metric for traffic-related benefit estimation. A traffic growth rate of 5% per annum has been assumed, reflecting anticipated increases in vehicular movement due to regional economic development and enhanced connectivity. The analysis will be conducted over a 30-year project life span, which is standard for major infrastructure investments and allows for long-term benefit-cost evaluation.

To account for the time value of money, an annual discount (interest) rate of 8% will be applied in the economic evaluation. The project's yearly maintenance cost, estimated at 0.0238 billion Kyats, would be included in the life cycle cost model to represent the ongoing costs of road quality and safety.

Net Present Value (NPV) was computed using 2035-2036 as the zero point and counting back from the start. NPV is not discounted but inflated at 8% interest. The project yields more than 8% interest since the (NPV) (1242.938 billion kyats) is positive between road construction and 2049-2050, 27 years. Thus, the Maubin-Samalauk road project is worthwhile.

4.3.2 Internal Rate of Return (IRR)

Table 4.7 shows that at discount rates of 7% and 8%, the project's Net Present Value (NPV) is positive, MMK 1.73 billion and MMK 1.47 billion. Under these conditions, the project should provide net economic advantages, making it financially feasible.

The IRR is 8.23%, while the NPV is \$0. At this break-even discount rate, the project's benefits equal its expenses. IRR is a significant investment decision-making criterion, separating financially acceptable and unsuitable projects.

When the discount rate exceeds the IRR—for instance, at 8.3% and 9%—the NPV becomes negative, at MMK -0.10 billion and MMK -1.16 billion, respectively. It implies that if the cost of capital surpasses the IRR, the project would no longer be economically justified, as it would fail to recover its investment costs through future cash flows.

Table 4.7 Interest Rate & Net Profit

Sr.No	Interest Rate	Net Value (billions)
1	7%	1.73
2	8%	1.47
3	8.23%	0.00
4	8.3%	-0.1
5	9%	-1.16

Source: Own Computing

Table 4.8 shows that favorable net cash inflows in the project's final years (2035–2036) boost the financial return and achieve an 8% IRR. The project's long-term economic worth and viability depend on these late-stage advantages.

Table 4.8 Net Present Value (IRR 8%)

Sr	Year	Construction Cost	Maintenance Cost	P.W.F	P.W	Total Construction Cost	V.O.C	P.W.F	P.W	Total Benefit	N.P.V
1	2011-2012	0.857		0.926	0.794	0.680					
2	2012-2013	2.144		0.857	1.838	2.518					
3	2013-2014	1.286		0.794	1.021	3.539	0.020	0.794	0.016	0.012	-3.527
4	2014-2015		0.024	0.735	0.017	3.557	0.030	0.735	0.022	0.016	-3.541
5	2015-2016		0.024	0.681	0.016	3.573	0.044	0.681	0.030	0.021	-3.552
6	2016-2017		0.024	0.630	0.015	3.588	0.066	0.630	0.042	0.026	-3.561
7	2017-2018		0.024	0.583	0.014	3.602	0.100	0.583	0.058	0.034	-3.568
8	2018-2019		0.024	0.540	0.013	3.615	0.150	0.540	0.081	0.044	-3.571
9	2019-2020		0.024	0.500	0.012	3.626	0.224	0.500	0.112	0.056	-3.570
10	2020-2021		0.024	0.463	0.011	3.637	0.337	0.463	0.156	0.072	-3.565
11	2021-2022		0.024	0.429	0.010	3.648	0.505	0.429	0.217	0.093	-3.555
12	2022-2023		0.024	0.397	0.009	3.657	0.757	0.397	0.301	0.119	-3.538
13	2023-2024		0.024	0.368	0.009	3.666	1.136	0.368	0.418	0.154	-3.512
14	2024-2025		0.024	0.340	0.008	3.674	1.704	0.340	0.580	0.198	-3.476
15	2024-2025		0.024	0.315	0.0075	3.682	2.556	0.315	0.806	0.2540	-3.428
16	2025-2026		0.024	0.292	0.0069	3.688	3.834	0.292	1.119	0.3266	-3.362
17	2026-2027		0.024	0.270	0.0064	3.695	5.751	0.270	1.554	0.4201	-3.275
18	2027-2028		0.024	0.250	0.0060	3.701	8.626	0.250	2.159	0.5402	-3.161
19	2028-2029		0.024	0.232	0.0055	3.706	12.939	0.232	2.998	0.6947	-3.012
20	2029-2030		0.024	0.215	0.0051	3.711	19.409	0.215	4.164	0.8934	-2.818
21	2030-2031		0.024	0.199	0.0047	3.716	29.113	0.199	5.784	1.1489	-2.567
22	2031-2032		0.024	0.184	0.0044	3.721	43.670	0.184	8.033	1.4775	-2.243
23	2032-2033		0.024	0.170	0.0041	3.725	65.505	0.170	11.156	1.9001	-1.825
24	2033-2034		0.024	0.158	0.0038	3.728	98.257	0.158	15.495	2.4436	-1.285
25	2034-2035		0.024	0.146	0.0035	3.732	147.386	0.146	21.521	3.1425	-0.589
26	2035-2036		0.024	0.135	0.0032	3.735	221.079	0.135	29.890	4.0412	0.306
27	2036-2037		0.024	0.125	0.0030	3.738	331.619	0.125	41.514	5.1970	1.459
28	2037-2038		0.024	0.116	0.0028	3.741	497.428	0.116	57.659	6.6834	2.9426
29	2038-2039		0.024	0.107	0.0026	3.743	746.142	0.107	80.082	8.5950	4.8516
30	2039-2040		0.024	0.099	0.0024	3.746	1119.214	0.099	111.224	11.0532	7.3075
31	2040-2041		0.024	0.092	0.0022	3.748	1678.821	0.092	154.478	14.2145	10.4666
32	2041-2042		0.024	0.085	0.0020	3.750	2518.231	0.085	214.553	18.2800	14.5300
33	2042-2043		0.024	0.079	0.0019	3.752	3777.346	0.079	297.991	23.5082	19.7564
34	2043-2044		0.024	0.073	0.0018	3.754	5666.019	0.073	413.876	30.2317	26.4781
35	2044-2045		0.024	0.068	0.0016	3.755	8499.029	0.068	574.828	38.8782	35.1230
36	2045-2046		0.024	0.063	0.0015	3.757	12748.544	0.063	798.372	49.9977	46.2410
37	2046-2047		0.024	0.058	0.0014	3.758	19122.816	0.058	1108.850	64.2975	60.5394
38	2047-2048		0.024	0.054	0.0013	3.759	28684.223	0.054	1540.070	82.6871	78.9277
39	2048-2049		0.024	0.050	0.0012	3.761	43026.335	0.050	2138.986	106.3363	102.5757
40	2049-2050		0.024	0.046	0.0011	3.762	64539.503	0.046	2970.814	136.7493	132.9876

Source: Survey Data

V.O.C = Vehicle Operating Cost

P.W.F = Present Worth Factor

P.W = Present Worth

N.P.V = Net Present Value

As shown in Table 4.9, the final years of the project (2025–2026) generate positive net cash inflows, which play a crucial role in increasing the overall financial return and achieving an Internal Rate of Return (IRR) of 8.23%.

Table 4.9 Net Present Value (IRR 8.23%)

Sr	Year	Construct ion Cost	Maintenc e Cost	P.W.F	P.W	Total Construct ion Cost	V.O.C	P.W.F	P.W	Total Benefit	N.P.V
1	2011-2012	0.857		0.924	0.792	0.68		0.924			
2	2012-2013	2.144		0.854	1.830	2.51		0.935			
3	2013-2014	1.286		0.789	1.014	3.52	0.020	0.940	0.02	0.02	-3.51
4	2014-2015		0.024	0.729	0.017	3.54	0.030	0.944	0.03	0.03	-3.51
5	2015-2016		0.024	0.673	0.016	3.56	0.044	0.948	0.04	0.04	-3.52
6	2016-2017		0.024	0.622	0.015	3.57	0.066	0.952	0.06	0.06	-3.51
7	2017-2018		0.024	0.575	0.014	3.59	0.100	0.956	0.10	0.09	-3.49
8	2018-2019		0.024	0.531	0.013	3.60	0.150	0.959	0.14	0.14	-3.46
9	2019-2020		0.024	0.491	0.012	3.61	0.224	0.962	0.22	0.21	-3.40
10	2020-2021		0.024	0.453	0.011	3.62	0.337	0.965	0.32	0.31	-3.31
11	2021-2022		0.024	0.419	0.010	3.63	0.505	0.967	0.49	0.47	-3.16
12	2022-2023		0.024	0.387	0.009	3.64	0.757	0.970	0.73	0.71	-2.93
13	2023-2024		0.024	0.358	0.009	3.65	1.136	0.972	1.10	1.07	-2.57
14	2024-2025		0.024	0.330	0.008	3.66	1.704	0.974	1.66	1.62	-2.04
15	2024-2025		0.024	0.305	0.0073	3.66	2.556	0.976	2.49	2.44	-1.23
16	2025-2026		0.024	0.282	0.0067	3.67	3.834	0.978	3.75	3.67	0.00
17	2026-2027		0.024	0.261	0.0062	3.68	5.751	0.980	5.63	5.52	1.84
18	2027-2028		0.024	0.241	0.0057	3.68	8.626	0.981	8.46	8.30	4.62
19	2028-2029		0.024	0.222	0.0053	3.69	12.939	0.983	12.71	12.49	8.80
20	2029-2030		0.024	0.206	0.0049	3.69	19.409	0.984	19.10	18.79	15.10
21	2030-2031		0.024	0.190	0.0045	3.70	29.113	0.985	28.68	28.25	24.56
22	2031-2032		0.024	0.175	0.0042	3.70	43.670	0.986	43.07	42.47	38.77
23	2032-2033		0.024	0.162	0.0039	3.70	65.505	0.987	64.67	63.85	60.14
24	2033-2034		0.024	0.150	0.0036	3.71	98.257	0.988	97.10	95.96	92.25
25	2034-2035		0.024	0.138	0.0033	3.71	147.386	0.989	145.78	144.19	140.48
26	2035-2036		0.024	0.128	0.0030	3.71	221.079	0.990	218.85	216.65	212.94
27	2036-2037		0.024	0.118	0.0028	3.72	331.619	0.991	328.53	325.48	321.76
28	2037-2038		0.024	0.109	0.0026	3.72	497.428	0.991	493.15	488.91	485.19
29	2038-2039		0.024	0.101	0.0024	3.72	746.142	0.992	740.21	734.33	730.61
30	2039-2040		0.024	0.093	0.0022	3.72	1119.214	0.993	1110.99	1102.83	1099.11
31	2040-2041		0.024	0.086	0.0020	3.73	1678.821	0.993	1667.42	1656.10	1652.38
32	2041-2042		0.024	0.080	0.0019	3.73	2518.231	0.994	2502.43	2486.73	2483.00
33	2042-2043		0.024	0.074	0.0017	3.73	3777.346	0.994	3755.44	3733.67	3729.94
34	2043-2044		0.024	0.068	0.0016	3.73	5666.019	0.995	5635.66	5605.46	5601.73
35	2044-2045		0.024	0.063	0.0015	3.73	8499.029	0.995	8456.94	8415.06	8411.33
36	2045-2046		0.024	0.058	0.0014	3.73	12748.544	0.995	12690.20	12632.13	12628.40
37	2046-2047		0.024	0.054	0.0013	3.74	19122.816	0.996	19041.95	18961.42	18957.68
38	2047-2048		0.024	0.050	0.0012	3.74	28684.223	0.996	28572.13	28460.47	28456.73
39	2048-2049		0.024	0.046	0.0011	3.74	43026.335	0.996	42870.95	42716.13	42712.40
40	2049-2050		0.024	0.042	0.0010	3.74	64539.503	0.997	64324.13	64109.47	64105.73

V.O.C = Vehicle Operating Cost

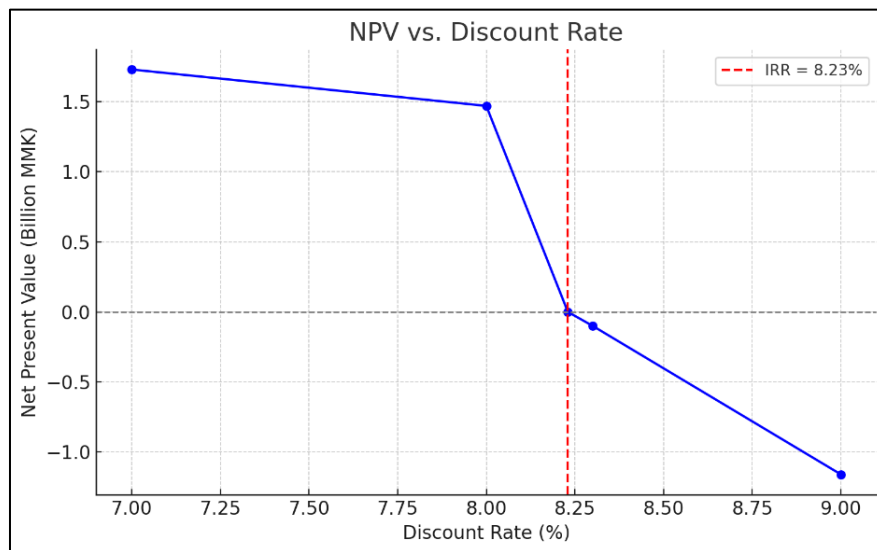
P.W.F = Present Worth Factor

P.W= Present Worth

N.P.V = Net Present Value

Figure 4.2 illustrates the relationship between the Net Present Value (NPV) and the discount rate, highlighting the project’s financial performance under varying cost of capital scenarios. The red dashed vertical line marks the Internal Rate of Return (IRR), calculated at 8.23%, where the NPV equals zero. This rate represents the financial break-even point—an essential threshold for investment appraisal—indicating the rate at which the project’s discounted cash inflows exactly offset its initial and ongoing costs. As the discount rate increases from 7% to 9%, the NPV progressively declines, moving from MMK 1.73 billion to MMK -1.16 billion. This inverse connection shows how greater discount rates devalue future cash flows. Positive NPVs show that the project is financially viable for discount rates below 8.23%. Once the cost of capital exceeds the IRR, the project delivers negative NPVs, showing it no longer generates enough returns to justify the investment. Thus, the IRR is essential for project financial viability.

Figure 4.2 Internal Rate of Return (IRR)



Source: Survey Data

4.4.3 Benefit-Cost Ratio Method

Over a 28-year evaluation period, the Benefit-Cost Ratio (BCR) for the Maubin–Sarmalauk Road construction project was calculated at IRR 8% using the standard formula:

$$\begin{aligned} \text{Benefit and Cost Ratio} &= \frac{\text{Total Benefits}}{\text{Total Construction Cost}} \\ &= 5.197 / 3.73 = 1.39 > 1 \end{aligned}$$

Since the BCR exceeds 1, it indicates that the project's anticipated economic benefits outweigh its total construction costs. A BCR of 1.39 suggests that for every Kyat invested, there is a return of 1.39 Kyats in economic benefits. Therefore, the construction of the Maubin–Sarmalauk Road can be considered economically viable and financially justifiable under the given assumptions.

4.4 Impact of The Maubin-Samalauk Road

A transport link of Maubin to yangon city spans a total length of 21 miles and 3 furlongs (34.400 kilometers), beginning at Kazun Village, which is situated at the 32/5 milepost (approximately 52.505 kilometers) of the Yangon–Patheingyi Highway. The road terminates at the junction of the Maubin–Kyaiklat–Pyapon Road near milepost 0/6 (approximately 1.207 kilometers). Along its route, the road traverses a series of rural settlements and townships, delivering direct transportation benefits to the villages, including La Mine, Chaung Gyi, Kan Chaung, Mee Thwe Chaung, Lel Kine, Le Thaw, Ah Lan, Yanan Chaung, Kyaung Su, Wa Taw, Htanidawt, Talotlatt, and Nyang Wine villages. Additionally, the route intersects with key roadways connecting Maubin Town to Twante and Yele Kalay, thereby enhancing regional accessibility. By linking the townships of Nyaung Tone and Maubin, the road facilitates more efficient movement of people, agricultural goods, and commercial products within the Ayeyarwady Region. Furthermore, it provides improved connectivity to multiple waterways and rail crossings, which are critical to rural livelihoods. The enhanced road access not only reduces travel time and vehicle operating costs but also promotes socioeconomic integration between rural villages and urban centers, ultimately contributing to local development and regional trade growth.

CHAPTER V

CONCLUSION

5.1 Findings

The Maubin–Samalauk Road project, implemented under a Build-Operate-Transfer (B.O.T.) model with an initial investment of 4.287 billion Kyats and continued capital expenditure reaching over 60 billion Kyats by 2025, demonstrates substantial economic and developmental value. Initially justified by the infrastructural damage from Cyclone Nargis in 2008, the project has evolved into a critical regional transport link that connects major townships, rural settlements, and trade corridors within the Ayeyarwady Region.

Based on the economic feasibility analysis conducted using data provided by the Maubin District Office under the Ministry of Construction, the Maubin–Sarmalauk Road project demonstrates strong financial viability. The total initial investment of 4.287 billion Kyats over a two-year construction period is justified by the projected traffic volume (AADT of 1,660 vehicles), an assumed annual traffic growth rate of 5%, and a standard analysis period of 30 years. These inputs provide a robust basis for evaluating long-term economic benefits and costs.

The project's annual maintenance cost of 0.0238 billion Kyats was incorporated into the life cycle cost model, and a discount rate of 8% was applied to reflect the time value of money. The Net Present Value (NPV) analysis, calculated with 2035–2036 as the zero point and adjusted for inflation, yielded a positive NPV of 1.242 billion Kyats over a 27-year operational period. This indicates that the project generates returns above the 8% discount rate, confirming its economic desirability.

Furthermore, the Internal Rate of Return (IRR) was calculated at 8.23%, slightly exceeding the assumed cost of capital. As shown in Table 4.7, the NPV remains positive at discount rates of 7% and 8%, with values of 1.73 billion Kyats and 1.47 billion Kyats, respectively. However, the NPV turns negative when the discount rate exceeds the IRR (e.g., -0.10 billion Kyats at 8.3% and -1.16 billion Kyats at 9%), underscoring the sensitivity of the project's viability to financing conditions.

In conclusion, both the NPV and IRR results affirm that the Maubin–Sarmalauk Road project is economically sound and worth implementing. The projected benefits—

driven by improved regional connectivity, increased traffic volume, and long-term cost efficiency—support its selection as a priority infrastructure investment in the Ayeyarwady Region

Moreover, the Maubin– Sarmalauk Road has provided direct socio-economic benefits to the villages, reducing travel time and vehicle operating costs. Its function in enhancing rural–urban connectivity has likely contributed to improved market access, employment opportunities, and social services, supporting long-term regional development and poverty reduction.

5.2 Suggestions

The Maubin–samalack Road is an important road for the Ayeyarwady Region because it connects towns and supports local development. Based on the study’s results in terms of economy, road condition, and traffic, several suggestions can be made for future improvement. Since the project was carried out using the Build-Operate-Transfer (B.O.T.) method with an investment of 4.287 billion Kyats, it is important for the government to closely monitor the road’s operation. This will help ensure that the project continues to bring benefits over its 30-year period. The Ministry of Construction should also check the road's condition regularly, manage costs properly, and ensure that toll collection is fair and clear.

This study aimed to check if the project was economically useful, how much traffic it carries, and how it helps the region. Therefore, future road planning should include better predictions of traffic, especially the changes between weekdays and weekends. For example, since there is more truck movement and toll income on Mondays, the road should be made strong enough for heavy vehicles, and proper parking areas should be added. Also, because the project has a good return (with an IRR of 8.23% and BCR of 1.39), this method could be used in other poor rural areas that need better roads.

To help more people in the region, it is suggested that small roads be built to connect the Maubin–Samalauk Road with nearby villages and boat routes. This would help farmers, small businesses, and others to reach markets more easily. The government should also improve the connection between roads, rivers, and railways, because these are important for daily life and transport in the area.

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