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AUTHOR

Jerry Khoo, B.Eng (Civil)(Hons), MBA

Position: Managing Director, JKhoo Consultancy Ltd

Professional Affiliations: MEngNZ, Asian Development Bank Expert Panel on Transport Infrastructure Planning and Investment (2025–2028)

Email: jerry.khoo@jkhoo.co.nz

ABSTRACT

Pacific Island nations face acute transport vulnerability: cyclones and sea-level rise threaten critical infrastructure serving remote communities where conventional cost–benefit analysis, when applied using standard parameters, can struggle to fully capture social, access, and resilience benefits. The remoteness and rural nature meant that projects for these communities will be of low economic benefits using the conventional cost-benefit analysis due to low traffic / user volumes, however these transport links and connections provide lifelines to healthcare, education, and markets.

Drawing on over 15+ years executing Asian Development Bank (ADB) and World Bank projects across Pacific nations such as Vanuatu, Fiji, Samoa, Papua New Guinea, Solomon Islands, Tonga and Tuvalu, this presentation examines the adapted economic methodologies for land/maritime infrastructure in fragile contexts. Three pivotal cases will be presented:

- Fiji Transport Sector Planning and Management project that involved development of land and maritime transport policies and a 20-year investment plan (including assessment of a ring-fenced road maintenance fund), and the subsequent investment projects to replace the critical bridge and jetty structures;
- Samoa Various Proposed Inland Route(s) (2003, 2010 and 2022) between Faleoleo International Airport and Apia city centre; and
- Tuvalu Maritime and Aviation Transport Sector Review

Using these projects experience, this presentation presents the key observations and examines potential approaches that can be considered in New Zealand.

Adapting Transport Economic Appraisal for Resilience and Equity: Lessons from Pacific Island Contexts for New Zealand

Pacific Island nations face acute transport vulnerability due to exposure to cyclones, sea-level rise, and remoteness that isolates many rural communities. Conventional economic appraisal frameworks, particularly those applying high discount rates, struggle to capture the social and resilience benefits of low-traffic but high-dependence transport links. Drawing on over 15 years of transport planning experience working across the South Pacific region, including work with the Asian Development Bank (ADB) and the World Bank, this paper explores adapted economic methodologies suited to fragile contexts.

Three case studies where Jerry was involved in, namely in Fiji, Samoa, and Tuvalu, provides some

Illustrate some of the policy and project-level innovations that bridge the gap between economic rigour and equitable access. The paper concludes with implications for New Zealand's own transport decision-making frameworks, particularly in addressing resilience, rural accessibility, and long-term climate risk. This think piece represents the views and opinions of the author, based on personal experience working in the Pacific, as well as observations through his involvement in the review of NZTA's investment decision making framework programme. It does not necessarily reflect the official positions or policies of any government or organisation referred to in this think piece paper.

1. Introduction

Transport investment decision-making relies heavily on cost–benefit analysis (CBA) to ensure value for money, transparency, and accountability. In New Zealand, the Economic Evaluation Manual (EEM) and its successor, the Monetised Benefits and Costs Manual (MBCM), are widely regarded as world-class frameworks, grounded in robust economic theory and supported by extensive empirical evidence (as noted in the 2018 Independent Review of NZTA's Investment Decision Making Framework). These frameworks have evolved over time to reflect changing policy priorities, including greater multimodal neutrality, revised discount rates and analysis periods, and the introduction of wider economic benefits.

This paper does not challenge CBA as a decision-making framework, nor does it advocate investment where costs exceed benefits in principle. Instead, it examines how the application of standard appraisal parameters can, in certain contexts, under-represent specific categories of benefit. These challenges are most evident in low-traffic, climate-exposed settings, where transport infrastructure performs a lifeline and system-continuity function rather than a high-volume mobility function.

In this paper, low-traffic contexts refer to corridors or services characterised by low absolute demand due to small population size, geographic dispersion, or remoteness, rather than a lack of underlying need. In such contexts, transport links are often critical for access to healthcare, education, emergency response, and economic participation, even though conventional traffic-based metrics may indicate modest usage. Climate change further compounds these challenges by increasing the frequency and severity of disruption to assets that often lack redundancy.

Drawing on applied experience across Pacific Island nations, this paper explores how economic appraisal can be adapted within our existing best-practice principles to better reflect equity, resilience, and system continuity. Three complementary approaches are examined: (i) legislative and policy mechanisms that explicitly recognise access and equity objectives; (ii) risk-based economic appraisal that refines the Do Minimum to reflect realistic response pathways under climate stress; and (iii) holistic, mode-neutral planning that integrates top-down system objectives with bottom-up community access needs.

The relevance of these approaches extends beyond small island states. Many of the conditions examined, such as exposure to climate hazards, limited network redundancy, and low-density demand, are increasingly present in parts of New Zealand's rural and coastal networks. By situating Pacific experience alongside the evolution of New Zealand's appraisal framework, this paper aims to inform ongoing refinement of practice, particularly in the context of resilience, adaptation, and long-term network sustainability.

The remainder of the paper is structured as follows. Section 2 outlines the background and evolution of economic appraisal practice, with particular reference to New Zealand. Section 3 discusses discount rates and key appraisal parameters in low-traffic contexts. Section 4 presents the three complementary approaches through applied case material. Section 5 concludes by summarising key findings and outlining practical implications for New Zealand practitioners.

2. Purpose and Scope of Economic Analysis in Transport Investment

Economic analysis in transport projects provides a systematic framework to evaluate the efficiency, effectiveness, and broader impacts of investments. Both the Asian Development Bank (ADB) and the World Bank have established guidelines that underscore the importance of ensuring scarce resources are allocated efficiently while achieving maximum social and economic benefits.

According to the ADB (2017), the primary purpose of economic analysis is to:

- Assess efficiency and resource allocation: Evaluate whether a project generates sufficient net economic benefits relative to its costs.
- Support investment decisions: Provide decision-makers with evidence on project viability and prioritisation among competing projects.
- Incorporate broader development objectives: Go beyond financial returns to account for social, environmental, and regional impacts, including poverty reduction, inclusion, and access to essential services.

Similarly, the World Bank (2000) highlights that economic analysis should:

- Ensure projects contribute to sustainable development goals and equitable outcomes.
- Identify trade-offs between efficiency and equity in resource allocation.
- Incorporate risk and uncertainty, including natural hazards, climate variability, and long-term infrastructure resilience.

The World Bank also suggests, broadly the ten questions that an economic analysis should answer, namely:

- What is the objective of the project?
- What will happen if it is implemented, and what if it is not?
- Is the project the best alternative?
- Are there any separable components, and how good are they separately?
- Who are the winners and losers?
- Is the project financially sustainable?
- What is the project's fiscal impact?
- What is the project's environmental impact?
- Is the project worthwhile?

In essence, economic analysis is in the Pacific region, as required by these funding agencies, not limited to narrow financial calculations. In fragile, remote, or low-traffic contexts, such as Pacific island nations, these analyses must also recognise social and resilience benefits that conventional measures like travel-time savings or vehicle operating costs may overlook.

3. Discount Rate Theory and Its Implications

A discount rate is used in economic appraisal to convert future costs and benefits into present value terms. This enables decision-makers to compare projects with benefits and costs occurring at different points in time. The underlying principle is that a dollar today is more valuable than a dollar in the future due to the opportunity cost of capital and risk (Boardman et al., 2018).

Under the former Economic Evaluation Manual (EEM) and the current Waka Kotahi NZ Transport Agency Monetised Benefits and Costs Manual (MBCM), discount rates and analysis periods have evolved over time. Earlier versions of the EEM (and also the even earlier predecessor PEM) applied relatively high discount rates (in excess of 10%) and shorter appraisal horizons, reflecting a context where transport investment was largely focused on delivering low-cost, incremental improvements to the regional state highway network. Over time, discount rates were revised downward and analysis periods extended, reducing structural bias against capital-intensive projects and allowing long-lived benefits to be more fully represented.

Historically development agencies, such as ADB and World Bank, also adopted relatively high discount rates (e.g. 12% in the Pacific) for economic appraisals. Higher discount rates provided several practical advantages:

- Resource prioritisation: High discount rates favour projects with immediate or short-term returns, ensuring scarce funding targets “quick wins” that produce rapid economic or social benefits.
- Risk management: By discounting future uncertainties more heavily, high rates implicitly account for risks such as cost overruns, project delays, or socio-political instability.
- Efficient allocation in capital-constrained environments: In developing economies, focusing on high-return projects ensures that limited investment funds achieve measurable economic impact within the short-to-medium term.

While historically useful, higher discount rates create challenges for rural and climate-sensitive transport projects, particularly in Pacific island nations:

- Undervaluing long-term resilience: Projects designed to enhance climate resilience such as roads, reinforced bridges, or maritime infrastructure capable of withstanding cyclones, often have high upfront costs and benefits realised over decades. High discount rates reduce their present value, making them appear economically inefficient (i.e. lower BCR).
- Bias against low-traffic infrastructure: Many rural and remote communities have small populations and low traffic volumes. Discounted future benefits are small relative to construction and maintenance costs, discouraging investment despite the critical social and economic importance of these links.
- Difficulty in justifying adaptation projects: Climate change adaptation often requires investing in durable, higher-cost solutions to mitigate extreme events. With conventional discounting, the long-term benefits of avoided losses (e.g., from bridge failure during cyclones) are undervalued, leading to underinvestment.
- Policy and equity implications: High discount rates risk marginalising communities that cannot generate conventional economic returns but rely on transport infrastructure for fundamental rights such as healthcare access, education, and market participation.

This evolution demonstrates that appraisal practice already recognises that discount rates are not static parameters, but policy-sensitive tools that must align with broader investment objectives and evidence.

In low-traffic contexts, discounting can have a significant influence on appraisal outcomes. Where traffic volumes are modest, benefits often accrue through service continuity, reliability, and avoided disruption rather than large, immediate time savings. These benefits tend to materialise over longer periods and are therefore more sensitive to higher discount rates. This does not imply that such benefits should be artificially inflated, but it does mean that appraisal outcomes can be highly sensitive to how long-term risks and avoided costs are represented.

Climate change further amplifies this effect. In climate-exposed networks, a significant share of project value may lie in avoided future losses, such as reduced frequency of closures, avoided emergency reinstatement costs, and sustained access to essential services. When these benefits occur irregularly but have high consequence, conventional discounting can reduce their present value to a level that appears marginal, even when the underlying risk is well evidenced.

Within the New Zealand context, this raises an important application question rather than a methodological one: are future climate-related costs and disruptions being adequately represented in the appraisal baseline? If such costs are understated in the Do Minimum, the effect of discounting is compounded, and the relative value of resilience-focused investments may be under-represented.

4. Case Study Observations: Adapting Economic Appraisal for Resilience and Equity

Conventional cost–benefit analysis (CBA) frameworks, while effective for large-scale, high-traffic projects, struggle to capture the full value of rural and remote infrastructure in the Pacific. Low user volumes, high logistics costs, and long-term climate exposure mean that many essential links appear economically unviable under conventional appraisal rules.

To address this, agencies and practitioners have begun to adapt economic methodologies by broadening what counts as “value.” These adapted approaches seek to integrate social inclusion, climate resilience, and system continuity into investment planning. Three Pacific case studies demonstrate how such adaptations have been applied in practice.

4.1. Legislative and Policy Framework

A case study from leading the development of the ADB funded Fiji Transport Sector Planning and Management project (2014-2016) was how Fiji recognises the rights of transport access at a constitutional level.

Globally, only a small number of countries explicitly recognise access to transport as a legal or constitutional right. In most jurisdictions (as shown in Figure 1 below), transport is viewed as an economic activity or a public service, rather than a social entitlement.

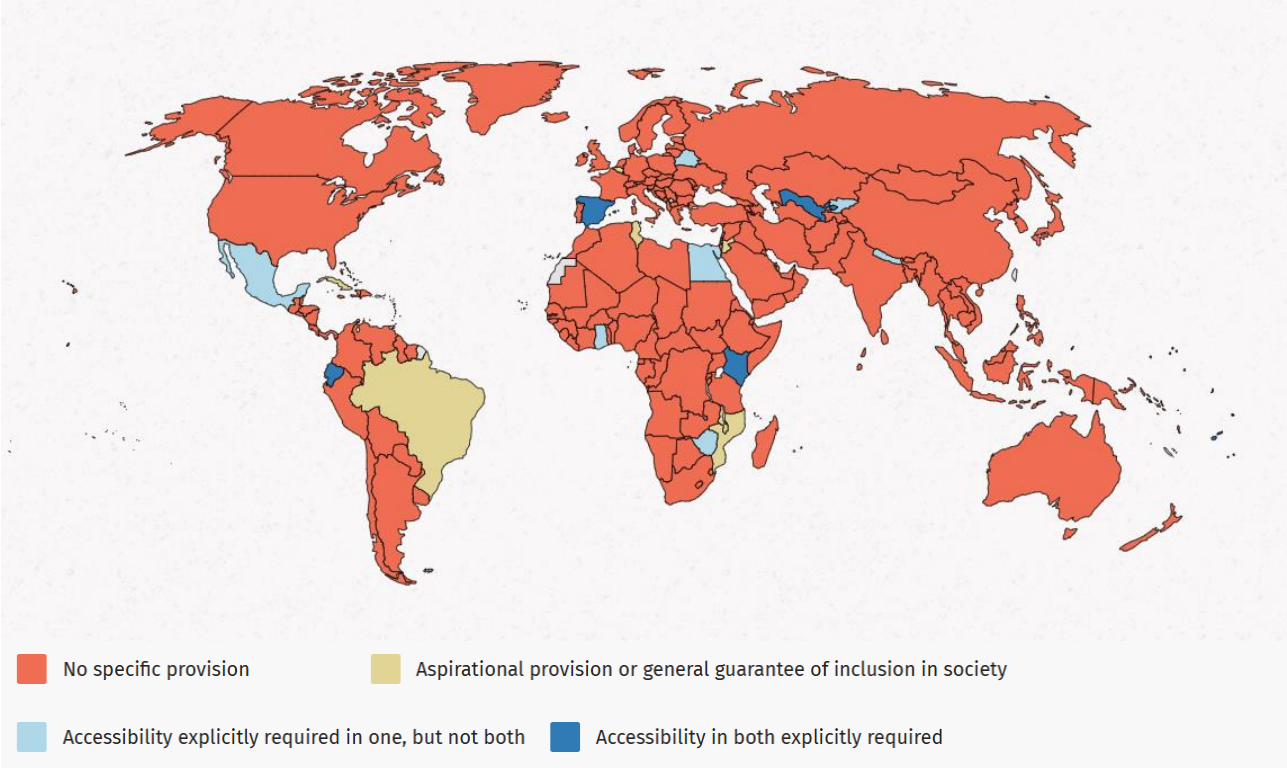

Figure 1: Countries where constitution explicitly require public places and/or public transportation to be physically accessible (World Policy Center, 2024)

As a result, the provision of basic transport access in rural and remote areas often depends on fiscal capacity and policy discretion, rather than legal obligation. This distinction is especially relevant for small island developing states, where high infrastructure costs, limited fiscal space, and dispersed populations make service provision inherently challenging.

In this context, Fiji stands as one of the few countries whose 2013 Constitution recognises the right to reasonable access to transportation and accessibility for persons with disabilities.

This constitutional recognition commits the country to take "reasonable measures within its

> "Right to reasonable access to transportation
>
> 34.(1) The State must take reasonable measures within its available resources to achieve the progressive realisation of the right of every person to have reasonable access to transportation.
>
> (2) In applying any right under this section, if the State claims that it does not have the resources to implement the right, it is the responsibility of the State to show that the resources are not available…..
>
> Rights of persons with disabilities
>
> 42.(1) A person with any disability has the right—
>
> (a) to reasonable access to all places, public transport and information;"

Figure 2: Excerpt from the 2013 Constitution of the Republic of Fiji (Republic of Fiji, 2013)

available resources" to progressively realise that right. While the commitment is highly dependent on economic feasibility, it establishes an important principle of inclusion and access, creating a legal foundation that guides subsequent transport policy and investment planning.

To work within this constitution, the development of the transport policies in the ADB funded project included a component around the Community Service Obligation (CSO). This policy tool designed to address the economic–social access gap. The CSO concept reflects the extent to which the government is prepared, under its social welfare and income distribution policies, to fund services or infrastructure that are socially necessary but economically unviable.

The policy rationale for Government to fund a CSO, or require a state-owned commercial enterprise (SOE) to deliver one, can be either (Khoo, 2015):

- the service is expected to develop demand over time to a level where it becomes economic which justifies a "start-up" funding injection by Government; or
- the service will continue to be un-economic but it is funded for other reasons (for example a policy decision to provide a basic level of access to population concentrations of a certain size or to local level administrative centres).

As the second of these relies on a continuing subsidy which removes investment from alternative spending, the extent to which Government is prepared to fund long term sub-economic services becomes a matter of income redistribution and welfare policy as much as transport policy.

The reason for targeting social welfare objectives through transport spending is that the alternative of directly distributing benefits through the tax system may be impractical for the rural population, many of whom are not formally employed, and provision of direct financial benefits to the potential users of transport services (such as rebates or subsidies on passenger fares and freight) does not ensure that either the infrastructure or services will be available. Also, conventional benefit-cost analysis seldom makes any allowance for differences in marginal utility of income.

From the ADB project, the CSO policy and funding for Fiji were broadly developed and summarised as:

1. Determine the total quantum of CSO funding to be made available each year. This should be decided broadly by Government, but as a starting point, an estimate of the percentage of transport funding that can be classified as CSO support in recent years can provide a benchmark;
2. Broadly apportion the funds by transport mode and by funding pool, but taking account of the desirability of equal treatment across modes;
3. For existing transport infrastructure and for Government supported transport services, estimate the cost of the CSO component that is the excess funding provision or "top up" that cannot be justified through economic benefits;
4. For potential upgrading, new construction and new transport service projects, similarly estimate the excess funding provision as a percentage of total cost;
5. Priority rank the CSO projects by increasing percentage "top up" requirement. This will result in those projects that are closest to achieving a BCR of 1.0 having first call on funds. However, maintenance of existing infrastructure should still have priority over upgrading and then new construction; and
6. Allow top-up funding or in-kind contributions from local communities to raise the project's ranking to give it more likelihood of funding under the CSO policy.

Under Fiji's approach, CSO funding can apply to (Khoo, 2015):

- Maintenance of low-volume rural roads and jetties,
- Upgrading of critical links serving isolated communities, and
- New construction of access routes where conventional cost–benefit ratios (BCR < 1.0) would otherwise preclude funding.

The introduction of the CSO framework provides a mechanism for governments to transparently fund transport infrastructure or services that are economically sub-viable but socially essential. While it aligns infrastructure planning with social equity and access objectives, it also introduces fiscal and governance challenges that must be managed through clear policy and institutional frameworks. Some of these are discussed below.

Advantages:

1. Promotes equitable access to essential services

- Improves access to remote and low-income communities to critical social and economic services such as healthcare, education, and markets.
- Supports the constitutional and policy objectives of "reasonable access" (as in Fiji's Constitution, Republic of Fiji, 2013), where the transport network is viewed as a basic right rather than purely an economic asset.

2. Enhances transparency and accountability

- By explicitly identifying the portion of funding directed to social or uneconomic purposes, governments can separate welfare-driven investment from commercially viable projects.
- This clarity allows for more consistent public reporting and better alignment between fiscal decisions and national development priorities.

3. Enables targeted, evidence-based subsidies

- CSO mechanisms can quantify and justify funding shortfalls for specific projects, providing an objective basis for subsidies.
- Encourages prioritisation based on social impact and "top-up" requirements rather than ad hoc political decisions.

4. Supports social cohesion and regional balance
   - Reduces inequality between urban and rural populations by maintaining connectivity for outer islands, rural settlements, and vulnerable groups.
   - Promotes inclusion and reduces the sense of marginalisation in outer regions, which is a major issue in Pacific Island nations with geographically dispersed populations.
5. Encourages integrated policy and investment planning
   - Provides a framework for cross-sectoral collaboration (transport, health, education, social development).
   - Allows governments to allocate CSO funds strategically across transport modes.
6. Facilitates donor coordination and justification
   - Development partners such as the Asian Development Bank and World Bank often require clear rationale for investments that do not meet strict economic efficiency tests.
   - A defined CSO policy enables these projects to be justified as social investments consistent with national priorities and international frameworks (e.g., the Sustainable Development Goals).

Disadvantages

1. Risk of fiscal unsustainability
   - Ongoing subsidies for uneconomic routes or infrastructure can become a long-term fiscal burden.
   - Without a hypothecated or ring-fenced transport fund, CSO allocations may compete with other critical budget priorities such as health or education.
2. Potential for political interference
   - CSO funding may be directed towards politically motivated projects rather than objectively prioritised investments.
   - Lack of transparent criteria can erode confidence in the system and reduce alignment with genuine social needs.
3. Limited performance incentives
   - State-owned enterprises (SOEs) or agencies delivering CSO services may face weak performance monitoring, leading to inefficiencies.
   - If subsidies are guaranteed, there may be little motivation to reduce costs or improve service quality.
4. Inconsistent measurement of social benefits
   - Without robust frameworks to measure these impacts, CSO allocations can appear arbitrary or inefficient.
5. Possible distortion of market competition

- In transport services (e.g., inter-island shipping), government-funded CSO operators may crowd out private providers.
- Subsidised fares or routes can discourage innovation or efficiency improvements in the private sector.

Policy Implications and Lessons

Despite these challenges, Fiji's framework demonstrates an institutionally grounded pathway for integrating social and resilience objectives into economic decision-making. The CSO model transforms the constitutional principle of access into a practical funding mechanism that aligns public expenditure with social policy outcomes.

For other Pacific nations, and for remote regions in larger economies such as New Zealand, this approach highlights how rights-based or policy-anchored funding can coexist with economic efficiency frameworks. The key lies in transparency, performance-based management, and the explicit identification of CSO components within annual budgets.

In the broader context of climate adaptation, the CSO mechanism also provides a means to channel investment toward resilient, socially critical infrastructure that might otherwise be excluded under traditional economic appraisal methods. It operationalises the idea that resilience and equity are not externalities, but public goods.

4.2. Risk-Based Economic Appraisal for Climate Resilience

Traditional cost–benefit analysis (CBA) frameworks are designed to measure economic efficiency under stable and predictable conditions. However, Pacific Island countries operate in a context of high climate risk, limited redundancy in infrastructure, and small but dispersed populations. This combination of factors makes a purely deterministic or "average-case" CBA challenging to be applied for decision-making.

In many instances, the "Do Minimum" scenario in appraisals can struggle to account for the likely costs of inaction, particularly when existing infrastructure is exposed to flooding, coastal erosion, or cyclone damage. These hidden costs, including emergency response, reconstruction expenditure, and the prolonged isolation of communities, can be highly significant.

A risk-based economic appraisal reframes project assessment from a narrow efficiency test to a resilience-oriented investment evaluation. The approach generally incorporates the following elements:

- Explicit consideration of climate hazards: Identify the probability and severity of climate-related events (e.g. cyclones, storm surges, sea-level rise) that could affect the "Do Minimum" or proposed project options.
- Quantification of avoided losses: Estimate the economic, social, and service-continuity costs avoided by improving infrastructure resilience (e.g. avoided bridge failure or road closure).
- Scenario analysis: Develop multiple climate scenarios (low, medium, high impact) to test the robustness of investment performance under uncertainty.
- Residual risk evaluation: Recognise that even resilient assets retain residual risks; quantify these to ensure full life-cycle appraisal.
- Inclusion of social and access benefits: Beyond economic output, assess benefits related to access to education, healthcare, emergency evacuation, and food supply chains.

From the involvement in the World Bank funded planning and feasibility assessment projects that

spanned (separately) over the past two decades, alternative routes for inland route connections between Faleolo International Airport and Apia city centre. Currently the key coastal route (approximately 25km), West Coast Road, provides the connectivity between the airport and the city centre, going through multiple villages and smaller town centres along its length. West Coast Road runs along low-lying coastal areas highly exposed to flooding, coastal erosion, and storm surge. During major cyclones, sections of the route have been repeatedly inundated, isolating communities and disrupting access to essential services and airport operations. These recurring disruptions highlighted the vulnerability of Samoa's critical transport corridor and underscored the need for a more climate-resilient inland alternative.

With increasing focus on impacts of climate change over the past two decades, the key observation on the evolution to the evaluation approach in Samoa (as well as with the current Fiji Critical Bridges and Jetties Replacement Project, funded by joint ADB/WB as a result of the 2014-2016 ADB project) can be broadly summarised as below:

1.Enhanced Do-Minimum definition:

The base case incorporated the projected costs of increased flooding, coastal inundation, and potential road closures under climate-change scenarios.

2.Counter-factual assessment:

The more recent appraisal explicitly considered the consequences and costs of asset failure, as part of the Do-Minimum scenario.

3.Decision-path analysis:

The more recent evaluation analysed the implications of delayed intervention, for example, if a critical infrastructure fails in the future (in an annual probabilistic approach) rather than being replaced proactively, what would the total reinstatement and disruption costs be? Would the infrastructure having needed to be replaced with one that would had been proactively (albeit at a higher cost due to a cost premium of urgency)?

Do Minimum Definition under the MBCM

Under New Zealand's Waka Kotahi Monetised Benefits and Costs Manual (MBCM), the Do Minimum represents the baseline against which all investment options are assessed. The MBCM recognises that, for most transport activities, it is not practical to do nothing. Instead, a minimum level of expenditure or activity is required to maintain a minimum level of service. Accordingly, the Do Minimum is defined as the least-cost option that provides a minimum level of service, accounting for committed and funded activities and any legal or safety requirements that must be met. The Monetised Benefits and Costs Manual (MBCM, 2024) defines the Do-minimum as:

"For many transport activities, it is often not practical to do nothing. A certain minimum level of expenditure or activity may be required to **maintain a minimum level of service**. This minimum level of expenditure or activity and the resultant performance is known as the do-minimum, and should be used as the basis for analysis, rather than the do-nothing… For the purposes of this manual, the do-minimum is defined as the least cost option that provides a minimum level of service."

This definition provides an important discipline within economic appraisal. By requiring the Do Minimum to be credible and not overstated, the MBCM avoids artificially degrading the base case in order to inflate the apparent benefits of proposed options. It also ensures that appraisal outcomes remain grounded in realistic operational practice, rather than hypothetical deterioration scenarios that would not reasonably occur.

The MBCM further cautions that particular care is required where the cost of the Do Minimum

approaches or exceeds the cost of the options being assessed. In such cases, the Do Minimum should be re-examined to confirm that it represents the true least-cost means of maintaining minimum service, rather than incorporating elements that implicitly pre-empt the preferred option.

This framework has served New Zealand well and reflects international best practice in transport economic evaluation. However, its application increasingly requires careful interpretation in contexts where climate change is altering the operating environment, particularly for rural, coastal, and low-redundancy networks. In such cases, the challenge is not the definition itself, but how realistically the Do Minimum reflects what would actually occur as assets are exposed to more frequent and severe disruption.

Refining the Do Minimum for Climate Resilience

In climate-exposed contexts, refining the Do Minimum involves making explicit the likely response pathways following asset damage or failure, rather than assuming a continuation of historic operating conditions. This does not require abandoning MBCM principles. Rather, it requires a clearer articulation of what constitutes a reasonable minimum level of service under evolving risk conditions.

For example, consider a flood-prone bridge on a rural state highway. A conventional Do Minimum might assume routine maintenance and reactive reinstatement following flood damage, with temporary closures accepted as part of normal operations. A refined, risk-based Do Minimum would explicitly incorporate the probability-weighted costs of flood events, including emergency works, traffic management, detours, and user disruption. Where damage is recurrent, the appraisal should consider whether repeated emergency reinstatement remains a credible baseline response, or whether some form of strengthening or partial replacement would realistically occur even in the absence of the proposed project.

A similar issue arises for low-lying coastal roads with no viable alternative routes. Under future climate conditions, increasing closure frequency may result in prolonged isolation of communities and loss of access to essential services. In such cases, continued patch repair and reinstatement may no longer represent a reasonable minimum service response. Refining the Do Minimum requires recognising when reactive maintenance ceases to be a credible or sustainable baseline and when alternative responses, such as partial realignment, managed retreat, or provision of alternative access, would realistically be pursued.

For low-volume rural roads serving critical community facilities, such as schools, marae, or medical centres, a minimum level of service may reasonably be interpreted as year-round reliability rather than average passability. A refined Do Minimum can therefore include the expected costs of emergency access provision or temporary alternative arrangements when climate events disrupt access, ensuring that the baseline reflects the real social and economic consequences of service failure.

Importantly, refining the Do Minimum does not automatically justify investment. Where network redundancy exists, such as parallel routes or alternative modes, a higher tolerance for disruption may remain appropriate. In these situations, a refined Do Minimum may still support lower levels of intervention, demonstrating that this approach improves appraisal accuracy rather than biasing outcomes in favour of investment.

By incorporating these considerations, economic appraisal more accurately represents the true cost of maintaining a minimum level of service under climate stress. This enables avoided disruption, avoided emergency expenditure, and continuity of access to be assessed transparently, while preserving the rigour and discipline of cost–benefit analysis.

4.3. Holistic, Mode-Neutral and System-Level Economic Appraisal

The third approach illustrated by the Pacific case studies is the use of holistic, system-level appraisal that integrates both top-down strategic analysis and bottom-up community needs assessment. This approach is particularly relevant in small, dispersed, and low-traffic contexts where transport systems function as integrated networks rather than collections of discrete projects or modes.

The Tuvalu Maritime and Aviation Transport Sector Review provides a clear example of how this dual perspective can be applied in practice. Tuvalu's geography, comprising small, widely dispersed island communities with limited population bases, means that conventional, project-by-project economic appraisal risks overlooking the cumulative value of transport connectivity across the system. In response, the Tuvalu analysis deliberately adopted a mode-neutral and system-wide perspective, assessing how maritime and aviation services jointly support national connectivity objectives.

At a top-down level, the analysis examined the domestic transport system as a whole, including inter-island distances, population distribution, service frequencies, operating and capital costs, and the functional roles of maritime and aviation modes. Rather than assuming a single dominant mode, the study tested a range of integrated scenarios combining shipping services, fast ferries, and limited aviation investment. This enabled identification of network configurations that could deliver acceptable levels of connectivity, resilience, and affordability at the system level, rather than optimising individual assets in isolation.

However, the Tuvalu case also demonstrated that macro-level optimisation alone is insufficient. A bottom-up perspective was essential to understand how different island communities rely on transport services to meet essential social needs. This included access to secondary education, which is concentrated on specific islands, access to healthcare services, particularly where referrals to Funafuti are required, and the movement of essential goods that support local livelihoods and food security. For smaller and more remote island groups, the consequences of infrequent or unreliable services were often disproportionate to their population size and traffic volumes.

By integrating these top-down and bottom-up perspectives, the Tuvalu analysis was able to move beyond simple demand-based metrics and instead assess transport options based on their ability to maintain functional access to essential services across the system. In practice, this meant recognising that some communities could be more effectively served by maritime services, while others justified targeted aviation investment despite low passenger volumes, particularly where travel time, safety, or emergency response considerations were critical.

Importantly, this approach did not abandon economic discipline. Rather, it reframed the appraisal question from "Which individual project yields the highest benefit–cost ratio?" to "Which combination of modes and services delivers the greatest system value within fiscal constraints?" This allowed trade-offs between cost, service frequency, resilience, and coverage to be considered transparently, while remaining consistent with best-practice appraisal principles.

The Tuvalu case highlights the value of treating transport infrastructure and services as interdependent components of a broader system, particularly in contexts where network redundancy is limited and climate exposure is high. While New Zealand's investment framework is necessarily focused on land transport, the underlying lesson remains relevant. For remote rural regions and isolated coastal communities, assessing land transport assets in isolation may under-represent their role within a wider system of access that includes maritime or aviation alternatives.

For New Zealand practitioners, this reinforces the importance of system-level thinking under the Investment Decision-Making Framework, particularly where resilience, access, and continuity of

service are key outcomes. Integrating top-down strategic objectives with bottom-up understanding of community needs can improve the alignment between appraisal outcomes and real-world service performance, especially in low-traffic and climate-exposed parts of the network.

5. Conclusions and Implications for New Zealand

5.1. Key Conclusions

This paper has examined how transport economic appraisal can be adapted to better reflect equity, resilience, and system continuity in low-traffic and climate-exposed contexts, drawing on applied experience from Pacific Island nations. Importantly, the paper does not challenge cost–benefit analysis (CBA) as a decision-making framework. On the contrary, it recognises that New Zealand's economic evaluation framework is widely regarded as world-class, grounded in sound economic theory and supported by extensive empirical research (from the 2018 Independent Review of NZTA's Investment Decision Making Framework).

The central conclusion is that the limitations observed are not inherent flaws in CBA itself, but arise from how appraisal parameters are applied in specific contexts. In particular, standard assumptions around demand, discounting, and base-case definition can under-represent certain benefit categories where transport infrastructure serves a lifeline or system continuity function, rather than a high-volume mobility function.

Three complementary approaches were identified through the Pacific case studies:

- Legislative and policy-based mechanisms (such as Community Service Obligations) that explicitly recognise access and equity as public policy objectives;
- Risk-based economic appraisal, which more realistically defines the Do Minimum by accounting for climate-related disruption, asset failure, and avoided loss; and
- Holistic, mode-neutral planning, integrating top-down system objectives with bottom-up community access needs.

Together, these approaches demonstrate that economic appraisal can remain rigorous while being more responsive to context, risk, and social outcomes.

5.2. Implications for New Zealand's Economic Evaluation Practice

New Zealand's transport appraisal framework has already demonstrated an ability to evolve in response to changing policy priorities. The historical development of the EEM, now reflected in the MBCM, has progressively incorporated:

- more mode-neutral values of time,
- longer analysis periods and revised discount rates,
- consideration of induced traffic through application of variable trip matrix,
- recognition of wider economic benefits, and
- emerging consideration of resilience and reliability.

The Pacific experience suggests that a next phase of refinement could further strengthen appraisal practice in New Zealand, particularly for rural, coastal, and climate-exposed networks.

Key implications include:

1) Refining the Do Minimum definition:

While the MBCM appropriately defines the Do Minimum as the least-cost option providing a

minimum level of service, there is scope to more explicitly incorporate probabilistic disruption and climate-related deterioration where these are reasonably foreseeable. This would improve the quantification of avoided loss and resilience benefits without overstating baseline deterioration.

2) Improving treatment of resilience and reliability:

Although resilience is recognised in the MBCM, its monetised representation remains relatively limited. Greater use of scenario analysis or sensitivity testing could better reflect the economic consequences of network failure, particularly where alternative routes or modes are constrained.

3) Recognising low-traffic does not mean low value:

In low-density or remote parts of New Zealand, traffic volumes alone may not fully reflect the importance of a transport link. Appraisal frameworks should continue to recognise access, safety, and continuity benefits that accrue to small populations but carry high social value.

4) Supporting system-level decision-making under IDMF:

The Investment Decision-Making Framework (IDMF) places greater emphasis on assurance, outcomes, and system performance across the transport network. Integrating system-level insights from economic appraisal can strengthen investment prioritisation, improve risk management, and support more transparent trade-offs between cost, resilience, and service outcomes.

It is also important to recognise that, in New Zealand, the IDMF and associated appraisal guidance administered by Waka Kotahi NZ Transport Agency are primarily focused on land transport investment. While this focus is appropriate given statutory responsibilities, it means that appraisal and prioritisation are often undertaken within modal and sectoral boundaries, rather than across the full transport system.

Experience from Pacific Island nations highlights the value of a mode-neutral, system-level perspective, particularly where resilience, access, and continuity of service are critical outcomes. While direct institutional comparison is not appropriate, these lessons suggest that even within a land-transport mandate, greater consideration of interdependencies with other modes, such as coastal shipping, ferries, or aviation, can enhance investment decision-making, particularly for remote and low-redundancy networks(noting that cross-modal coordination may occur through other agencies or strategies, even where formal appraisal responsibilities remain mode-specific.).

5.3. Broader Lessons for Practitioners

For transport planners, economists, and engineers, the key lesson is not to abandon established evaluation methods, but to apply them with greater contextual awareness. The Pacific case studies illustrate how economic appraisal can be adapted to better reflect real-world conditions of climate risk, geographic isolation, and social dependency.

For New Zealand practitioners, these lessons are increasingly relevant as climate change places growing pressure on coastal and rural infrastructure, and as investment decisions shift toward resilience, adaptation, and long-term network sustainability. The experience from Pacific Island nations therefore offers not a critique of New Zealand practice, but a complementary perspective that can inform its continued evolution.

5.4. Final Remarks

Ultimately, robust economic appraisal remains essential to ensuring value for money and accountability in transport investment. However, as the operating environment becomes more complex and uncertain, greater emphasis on resilience, equity, and system continuity will be required. By building on the strong foundations of the MBCM and learning from applied experience in comparable contexts, New Zealand is well positioned to continue leading internationally in

transport investment decision-making.

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