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Is Maintaining a Train Network in New Zealand Worth the Cost? †

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Abstract: The IPCC highlighted the potential for rail transport to play a vital role in transitioning to a low-carbon economy. In many countries, rail networks are operated and maintained by private companies. However, in N.Z., the privatization was undone in 2008. The nationalization was necessary to enable public investments to gain long-term benefits for N.Z. as a whole. Literature shows that accurate life cycle cost analysis of networks is very complex, and benefits are financial, environmental, and social. The latter two categories of benefits are often not considered by private companies. The uncertainties in calculations are often so significant that perhaps a more relevant issue is determining the long-term benefits of a network for a country.

Keywords: rail transport network; rail maintenance; rail rehabilitation; sustainable transport; IPCC; state-owned enterprises; sustainability

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1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) noted in its fifth assessment report that rail transport could be a more environmentally friendly option for passenger and freight transport than other modes of transportation [1]. Specifically for New Zealand (N.Z.), the transport fuel emissions factor for intercity passenger transport is two-thirds that of air transport and less than half compared to a passenger car, although twice that of an intercity bus. The same calculation shows that freight transport by truck is more than ten times less efficient than rail transport [2].

New Zealand is an island country located in the Southwest of the Pacific Ocean, with a population of 5.1 million. The primary export commodities are dairy, wool, meat, timber, and wood [3]. The increase in export over recent decades has also increased the need for transportation. KiwiRail Holding Limited manages the New Zealand train network, operates passenger trains, and transports more than 19 million tons of goods annually.

The efficiency of operating a rail network has long been a topic of concern, leading to privatizing the rail industry in several countries. By allowing independent train operators to operate on a network, competition should lead to greater efficiency. However, in some cases, privatization did not lead to increased efficiency; the cost of maintaining and improving rail networks was too high. In 2008, the N.Z. government undid the privatization to invest public funds to address maintenance deficiencies.

A decade later, N.Z. committed to reaching 1990 emission levels for transport by 2050, and the public rail network again received a significant investment boost. While the environmental benefits of rail transport seem straightforward, it is also important to consider the ongoing financial feasibility of maintaining such a significant asset.

A comprehensive literature analysis has been conducted to determine the costs and benefits of rail networks as a mode of transport in New Zealand. This research aims to clarify the long and short-term costs and give insight into the asset management challenges

and opportunities of rail networks which could be used in business cases in other small island nations.

2. Internal Costs and Benefits

Performing an estimate based on the first principles is a detailed and precise way of calculating a cost estimate derived from adding the costs of individual components. It needs a clear description of the cost items like maintenance, operations, and incidentals.

The costs can be divided into fixed costs which are not dependent on the number of passengers and quantities of transported freight [4]. Examples are expenses related to constructing components like road crossings, tunnels, culverts, transport nodes like air and seaports, renting buildings, permanent labour, administration, etc. There will also be variable costs associated with existing and new infrastructure maintenance. Maintenance requirements depend on the traffic volume, cost, availability of labour and material, and energy. After doing a comprehensive literature review [5], maintenance was defined as "All maintenance activities, actions, strategies, and processes carried out and adopted such as routine, preventive, predictive, scheduled and unscheduled actions aimed at preventing asset failure or downtime, including all logistics and admin activities which will achieve the goal of increasing efficiency, reliability, and safety of the engineering assets" [6]. Specific studies were found that cover life cycle evaluations of elements of rail networks. For instance, rail bridge construction and transition mitigation, drainage systems for rock tunnels, noise and vibration mitigation measures, and (elements of) the track bed [7–11].

The above shows the enormity of the task of calculating a precise estimate based on the components of a national rail network. Moreover, the described fixed and variable costs are examples of internal costs. The main external costs include air pollution, noise, and environmental effects. These costs are not easy to describe objectively [11,12].

Another way of calculating the cost is the top-down method, related to parametric estimation techniques. An example is developing a decision support system, as described by several authors with varying results. A decision support system for evaluating the infrastructure costs to justify expenses and investments in Europe has been set up [13]. However, the author states that this system also has many uncertainties and requires continuous expert data collection and validation [14].

Finally, some reports compare the cost–benefit analysis of maintaining a rail network to the cost of maintaining a road network. For instance, in N.Z., the maintenance cost saving of the rail network against the comparative static situation of no rail is estimated to be around 64M$ per year [13]. This report, however, has not detailed any external costs and benefits.

An example of external costs is the refurbishment of electric locomotives in N.Z. In 2017, KiwiRail decided to move away from its electric locomotives, but lobbying to reduce carbon emissions led the New Zealand Cabinet to intervene, creating the option to electrify more rail segments in N.Z. to reduce carbon emissions. This is an example where the external benefits outweighed the internal costs. The following civil engineering problems and increases in scope related to the mentioned electrification raised the costs considerably, aggravating uncertainties that need to be considered in future cost–benefit analyses. The latter problems are not confined to New Zealand, as Europe's rail infrastructure costs, on average, 45% more than projected [12].

3. External Costs and Benefits

It is unlikely that the transformation of rail transport to a more sustainable form will occur in any meaningful way without government participation. Such participation has been only modest economically and often short-term [14].

In contrast, the strategy of KiwiRail contains economic, environmental, and social goals. KiwiRail is a leader in low-emissions freight transport and supports New Zealand's transition to net zero carbon by 2050. KiwiRail has 4500 employees spread across 50 often small towns and cities in New Zealand. These goals benefit N.Z. as a whole. These variables

have been included in the calculation of the value of rail in New Zealand, estimated to be between USD 1.70 billion and USD 2.14 billion each year [15]. Several external benefits and costs are included in this figure, like reduced congestion by taking cars and trucks off our roads. The rail networks in many countries are monopolies due to their high set-up costs. This is also the case in New Zealand, as large rail infrastructure stretches throughout both islands' geographically challenging landscapes. Table 1 shows the ownership of rail networks in several countries; public ownership often indicates a need for investments, while private ownership could indicate a need for more efficiency.

Table 1. Rail networks, size, and ownership in various countries.

Country	Owners Rail Network	Size in Rail km	Persons/Freight
Fiji	State-owned enterprise	597 km	Freight
New Zealand	State-owned enterprise (bought back in 2008)	3700 km	Both
Australia	Private and state-owned enterprises	33,819 km	Both
Indonesia	(Mostly) state-owned	7032 km	Both
Malaysia	(Mostly) state-owned	2783 km	Both

4. Discussion

Calculating the costs and benefits of a national rail network can quickly become complex. In the literature, decision systems and various other methods are described, but all have inherent uncertainties. These systems still only describe the internal costs and benefits. The economic value of rail to a country or region is not captured in traditional profit and loss calculations. Whether the maintenance of a rail network is worth the cost cannot easily be calculated reliably.

The benefits can be divided into short-term economic benefits and long-term national benefits. National benefits could be sustainability and social issues like the development of a region or industry. This begs the question of whether rail networks should be privatized or be in the hands of private entities. The answer depends on whether the external benefits to a country outweigh the need for efficiency. Private entities can bring more efficiency but will concentrate on short-term profit-seeking. This attitude can interfere with the long-term economic development of (parts of) a country. State-owned enterprises have the advantage that they can have strategic goals which bring long-term profits. State ownership can also be a significant economic enabler. Perhaps deciding whether the rail networks are part of a national strategy to create long-term benefits, such as lower emissions and a more sustainable transport system, is more important because the external costs can outweigh the internal costs.

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