Sustainable Transport Appraisal: A Literature Review and Implications for Policy Makers

Yeonjung Songa, c, Warren Whitneya, Wen Zhanga, b, Barry Collearya, b, Brian Caulfield b, Juan Martinez-Covarrubiasa, d

a National Transport Authority, Dublin, Ireland

b Trinity College Dublin, Dublin, Ireland

c Kobe University, Kobe, Japan

d American University, Washington, United States

juan.martinez@nationaltransport.ie

**Abstract.** Questions have arisen regarding whether current transport appraisal methodologies and parameters are prejudicial to sustainable transport solutions. With the emergence of the climate change and sustainability agenda, there is wide recognition of the need for modal shift from private-car-based modes to sustainable modes such as public transport and active travel. Despite this policy re-orientation, the use of the traditional appraisal methods and parameters with their inherent assumptions does not always support the policy. Cost-benefit analysis (CBA) is likely to recommend options that do not necessarily align with current sustainable policy goals. To cater for hard-to-monetise benefits, multi-criteria analysis (MCA) is employed in transport appraisal. However, there is a concern that multi-criteria analysis (MCA) is difficult to operate given the need for agreed weightings among stakeholders. This study summarises the challenges of the current appraisal frameworks through a literature review and analysis of the appraisal framework in Ireland. By doing so, this study aims to outline what should be improved for transport appraisal to work under the sustainability policy agenda.

**Keywords:** Transport appraisal; sustainable transport; cost-benefit analysis; transport investments.

**Disclaimer:** The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the official position of the National Transport Authority.

1. Introduction

Current well-established frameworks and methods for transport appraisal were first developed more than 50 years ago (Vickerman, 2017) when the socio-technological trends were based on the private-car. Consequently, this was translated to the aim of building fit-for-purpose infrastructure for this mode of transportation. Cost Benefit Analysis (CBA) that focuses on the monetisation of benefits has been a widely used tool in transport appraisal. In the conventional appraisal system using CBA, travel time savings have been a key variable that has a disproportionate impact on the monetised benefits. With the emergence of the climate change and sustainability agenda, the conventional transport appraisal approaches result in a potential systemic failure of having an appraisal framework that can yield results that are not aligned with national policy.

This paper delves into the challenges faced by decision-makers who need fit-for-purpose methods to assess solutions consistent with sustainable policies. We summarise challenges in the current transport appraisal framework from the perspectives of policy alignment and promotion of sustainable transport (Section 2). We also review discussions to complement the shortcomings of traditional frameworks (Section 3) through the literature review. We then analyse the new appraisal framework for transport projects in Ireland (Section 4) and discuss the implications of this analysis (Section 5).

1. Challenges in Conventional Transport Appraisal for Sustainable Transport

Although a CBA has been the most widely used tool for a long time, there has been a debate about the appropriateness of CBA as a means of evaluating projects and of choosing between alternatives (Vickerman, 2017). Welde and Volden (2021) argue that the current CBA model has issues including 1) no distribution of effects between groups and regions; 2) negligible impact of environmental consequences on Net Present Value (NPV); 3) discounting negative future effects; 4) uncertainty of input variables and huge variation of appraisal results in individual projects over time; 5) promoting investment in affluent areas; 6) recommendation of projects in conflict with societal goals. While Multi-Criteria Analysis (MCA) is considered an alternative to CBA, MCA can result in a preference ranking which risks either reinforcing the a-priori preferences or being ignored as most stakeholders already had an a-priori preference for a politically sensitive project (te Boveldt et al., 2022).

On the other hand, the value of travel time savings (VTTS) is considered a central notion in transport CBA (Meunier, 2019). The VTTS has been important as a parameter that helps to estimate behavioural choices and as a parameter that helps to determine value for money in allocation of public funds (Goodwin, 2019). However, the critical view that the benefits calculated may give too much weight to time as compared with other criteria of importance to individuals and objectives of transport policy such as sustainability and equity has grown in recent years.

Fosgerau and Jensen (2003) point out that travel time savings account for around 80 per cent of the quantified benefits of new transport infrastructure in CBA. Welch and Williams (1997) find that a substantial part of this benefit may be made up of large numbers of people saving small amounts of time. While the definition of “small amount of time” varies depending on the literature, “small” can be defined as less than 5 minutes (Welch and Williams, 1997; Mackie et al, 2003). But Welch and Williams (1997) also point out that the threshold of small time could depend on trip length or duration. There are suggestions that a lower or discounted unit value for VTTS could be used for small time savings while the great majority of countries adopt a Constant Unit Value (CUV) approach (Wallis et al., 2015).

1. Alternative Transport Appraisal Approaches

ITF (2022) summarises some modifications to CBA to focus on the accessibility and equity impacts from the literature review: 1) Willingness-To-Pay-based valuations; 2) applying a uniform equity value of time to all users; 3) measure of subjective well-being which considers a greater increase in wellbeing from a given accessibility improvement to low-income group; and 4) use of a range of discount rates that reflect the rate of time preference of the different groups affected by the proposed project. To complement the valuation approach in the dominant style of CBA, some additional methodologies are suggested. These include social choice valuation that values environmental impacts more than travel time savings (Mouter et al., 2019) and Cumulative Effects Assessment as a complementary tool for environmental assessment for projects (Tricker, 2007).

As an alternative form of appraisal from the traditional CBA, quality-based tools have been considered. For example, Transport Quality of Life appraisal on all modes of transport (Carse, 2011), a participatory MCA that involves multiple actors (Hickman and Dean, 2019), a Participatory Value Evaluation that assesses the desirability of government projects (Mouter et al., 2019) and stakeholder-based appraisal method using stakeholder-based impact (te Boveldt et al., 2022) have been proposed in previous research. Thus, there are still questions as to whether these alternative approaches can be widely used by practitioners in terms of robustness and practicality.

1. Appraisal Framework for Transport Projects in Ireland

In Ireland, the Transport Appraisal Framework (TAF) was published in June 2023 to replace the Common Appraisal Framework (CAF) for Transport Projects and Programmes. The CAF was in operation since 2016 before the TAF was published. While the CAF focused on providing guidance on the conventional appraisal methodologies such as CBA, CEA and MCA, the TAF proposes a new appraisal process, the Transport and Accessibility Appraisal (TAA), which replaces MCA as the main qualitative appraisal tool for assessing short-listed options in the transport appraisal process for proposals with costs greater than €30 million. For schemes with estimated costs of up to €30 million, a detailed MCA is sufficient.

The TAA process retains many aspects of the MCA including criteria and impact assessments, but notable differences include the absence of economic criteria and the separation of the previous environment criterion into climate change impact and local environment impact criteria. The TAA intends to capture the impact of the short-listed options across six key criteria: 1) Accessibility, 2) Social, 3) Land Use, 4) Safety, 5) Climate Change, and 6) Local Environment. Scoring of each criterion should be based on impacts to be measured by suggested key performance indicators using potential data sources. Each indicator, sub-criterion and criterion is evaluated using a seven-point Likert scale (high positive, positive, slight positive, neutral, slight negative, negative high negative) and is presented using colours as shown in Figure 1. Another difference to the MCA is that the scores for each criterion are not intended to lead to a numerical total across all criteria for a given option and should be considered independently of one another.


**Fig. 1.** TAA Summary Reporting Table (Source: TAF Module 7 – Detailed Guidance on Appraisal Techniques)

The TAF also establishes new parameters for journey time reliability, journey quality, electric vehicle fuel consumption, and cycling journey quality, as well as updating parameters to be used in transport CBAs. One of the changes from the CAF is that the TAF discounts travel time savings of 5 minutes or less. These small amounts of time impacts for transport users of 5 minutes or less should be excluded from the central scenario in CBA while these benefits/costs may be applied as part of sensitivity testing. This is a noticeable difference from most other countries’ approaches to applying CUV. However, Canada has a similar approach to the TAF which states that savings of less than 5 minutes per one-way trip should not be included in the overall economic performance results such as Benefit Cost Ratio (BCR) while it uses a CUV approach in valuing these savings. Several countries such as the United States and France that previously used discounted values for small time savings have changed to the CUV approach (Wallis et al., 2015).

1. Discussion

The TAA process can help bring a more qualitative and standardised approach to the assessment of impacts that cannot be sufficiently assessed using existing approaches to MCA and CBA. The use of a standard set of criteria will allow decision-makers to compare projects in their respective investment portfolios using a standard suite of metrics. Also, the standard template for the TAA results table can help in the comparison of impacts across different projects. This may enable TAA to be used as a tool to help guide portfolio investment decisions for state transport agencies, local authorities, and central government. Another likely benefit of the TAA process will be increased assessment of impacts that have not been commonly examined across all transport investment proposals but could support sustainable transport modes. In particular, the TAA impact assessments relating to social impacts and climate adaptation should provide a more detailed understanding of related impacts across a broader range of transport proposals.

However, the TAA process also has some apparent limitations. Firstly, it is likely that not all TAA indicators may be relevant or add value to the appraisal of certain proposals. There is potentially a need to allow for greater flexibility in the selection of indicators that can be used in the TAA process, but this will need to be balanced against the potential benefits of having a standard set of criteria and indicators. Secondly, the TAF does not define a specific refinement approach for reaching a TAA criterion score from multiple indicator results or single indicator score from multiple impact assessment results, such as the quantitative mean and median approaches. Thirdly, there is no guidance on how to weigh certain impacts or indicator results. For example, using the quantitative mean approach to assess an option under the TAA climate change criterion, it is possible for an option to receive both a negative and positive indicator rating that would result in a neutral criterion rating. However, this conceals the possible negative impacts assessed for the option under one or more of the climate change indicators.

The removal of the impact of 5 minutes or less for the VTTS may reduce the impact of benefits from travel time savings on the economic appraisal. Some road projects, such as a link road to the main carriageway and replacement of the old substandard road, are likely to result in travel time savings of less than 5 minutes. However, once this applies to traffic volumes through the normal appraisal period, for 30 years, this impact becomes quite large, and the benefit could be overestimated while only an unperceivable change is made to users which would not change any behaviour. Therefore, the removal of the impact of 5 minutes or less could alleviate the overestimation of the benefit of these projects from an economic perspective and could give more opportunities for sustainable transport projects.

However, this is also likely to be an issue for sustainable transport schemes as these schemes also struggle to generate large journey time savings. In Ireland, travel time savings from public transport schemes and active travel schemes are typically less than 5 minutes. In addition, travel times by these transport modes are generally less than 30 minutes. In the Irish context, the threshold of 5 minutes for small time savings would be high while Wallis et al (2015) find that values for time savings of 3-5 minutes are typically in the order of half the threshold values through literature review. Therefore, reviewing the travel times and savings of the projects in the past and studying whether Irish users value small travel time differently are recommended to set up a more acceptable threshold and value for the small travel time and to ensure its impact on the sustainable transport modes.

1. Conclusion

Approaches in the TAF attempt to fill the gap between transport appraisal and policy as the TAA highlights qualitative criteria which enable the assessment of broad aspects of projects. The TAA can be a supplement to the CBA results which enhances the information available to decision-makers by shedding light on the social impacts. The removal of the travel time savings of less than 5 minutes could be considered as a way to reduce the dominance of travel time in a CBA.

However, it still seems that in general the transport appraisal is disconnected from the policy objectives focusing on sustainability and societal benefits of transport projects. CBA still seems to play a dominant role in quantitative approaches and travel time saving represents a large proportion of monetised benefits in the CBA. The benefit from time savings only exists in the short-run while in long-run benefits of investment are seen from changes in land use and spatial distribution (Metz, 2017). Also, transport policy and planning objectives are being fundamentally reconsidered in many countries and a central element of this shift is to focus on accessibility-based perspective (ITF, 2022). In order to respond to the shift of policy objectives, a policy screening prior to the appraisal could be introduced. Reconsidering the valuation of travel time savings in terms of productivity and preference for the faster trip could be also considered to evaluate its impacts considering users’ changing concepts of travel time and on-board experience.

References

1. Carse, A. (2011), Assessment of transport quality of life as an alternative transport appraisal technique, Journal of Transport Geography, 19, 1037–1045.
2. Fosgerau, M. and T. L. Jensen (2003): ‘Economic appraisal methodology — controversial issues and Danish choices’, European Transport Conference, 4–6 October, Strasbourg, France.
3. Goodwin, P. (2019), The Influence of Technologies and Lifestyle on the Value of Time, International Transport Forum Discussion Paper, No. 2019/03, OECD Publishing, Paris.
4. Hickman, R. and Dean, M. (2018), Incomplete cost – incomplete benefit analysis in transport appraisal, Transport Reviews, 38(6), 689-709.
5. International Transport Forum (2022), Broadening Transport Appraisal: Summary and Conclusions, ITF Roundtable Reports, No. 188, OECD Publishing, Paris.
6. Mackie, P.J., Wadman, M. Fowkes, A.S., Whelan, G., Nellthorp, J., and Bates, J. (2003), Values of Travel Time Savings UK, Institute of Transport Studies, University of Leeds, Working Paper 567.
7. Meunier, D. (2019), Mobility Practices, Value of Time and Transport Appraisal, International Transport Forum Discussion Paper, No. 2020/01, OECD Publishing, Paris.
8. Metz (2017), Valuing transport investments based on travel time saving: Inconsistency with United Kingdom policy objectives, Case Studies on Transport Policy, 5, 716-721.
9. Mouter, N., Cabral, M.O, Dekker, T.and van Cranenburgh, S. (2019), The value of travel time, noise pollution, recreation and biodiversity: A social choice valuation perspective, Research in Transportation Economics, 76, 100733.
10. te Boveldt, G., Keseru, I. and Macharis, C. (2022), When monetarisation and ranking are not appropriate. A novel stakeholder-based appraisal method, Transportation Research Part A: Policy and Practice, 156, 192-205.
11. Tricker, R.C. (2007), Assessing cumulative environmental effects from major public transport projects, Transport Policy, 14, 293-305.
12. Vickerman, R. (2017), Beyond cost-benefit analysis: the search for a comprehensive evaluation of transport investment, Research in Transportation Economics, 63, 5-12.
13. Wallis, I., Rupp, K. and Alban, R. (2015), Travel Time Saving Assessment, NZ Transport Agency Research Report 570.
14. Welde, M. and Volden, G.H. (2021), Norwegian perspectives on ex post evaluation, Presentation at Broadening the Scope of Transport Appraisal to Capture the Full Impact of Investments Roundtable by ITF, available at <https://www.itf-oecd.org/repository/broadening-scope-transport-appraisal-capture-full-impact-investments-roundtable>, last accessed 2023/9/25.
15. Welch, M. and H. William (1997): ‘The sensitivity of transport investment benefits to the evaluation of small travel-time savings’, Journal of Transport Economics and Policy, 231–54.