



Broadening Transport Appraisal

Summary and Conclusions

188

Roundtable

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Glossary

Accessibility	The ease with which destinations can be reached to enable access to fundamental needs such as work, education, healthcare and shopping. Accessibility measures consider the time and cost required to reach destinations, using different modes, as well as factors such as comfort and safety.
Benefit–cost ratio	The ratio of the total dollar value of the expected benefits of a proposed project and the total dollar value of the expected costs.
Cost–benefit analysis	A systematic method for summing all the expected benefits and costs arising from a particular action (e.g. a proposed transport project) and comparing them using discounting to make benefits and costs accruing at different times comparable.
Discounting	A method used to convert future values occurring over different periods of time to a present value so that alternative future values can be compared on the same basis.
Discount rate	The specific percentage rate(s) used in conducting discounting.
Diversity, equity and inclusion	A term used to describe policies and programmes that promote the representation and participation of different groups of individuals (e.g. people of different ages, races and ethnicities, abilities, genders, religions, cultures and sexual orientations).
Deliberative monetary valuation	An interactive valuation method, which brings different actors together to form value judgements in an open dialogue. It allows consideration of ethical beliefs, moral commitments and social norms rather than being based solely on the aggregation of individual utility values.
<i>Ex-ante</i> evaluation	Evaluation undertaken before an investment decision is made.
<i>Ex-post</i> evaluation	Evaluation undertaken after an investment decision is made.
Internal rate of return	A measure of the profitability of an investment. The IRR is the discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis.
Mobility	The ability and ease of moving people and goods.
Monetise	To convert a benefit or cost into an equivalent monetary value.

Multi-criteria analysis	A means of systematically comparing the attractiveness of different investments or other actions by explicitly identifying and ascribing weights to performance criteria, scoring options against each criterion and summing up the resulting scores to provide an aggregate measure.
Needs case	Assessment undertaken to determine whether investment is required in a particular context.
Net present value	Difference between the discounted value of all expected benefits of a project and the discounted value of all expected costs.
Participatory value evaluation	A method for assessing the relative desirability of a set of potential investments. In a participatory value evaluation, participants are given information about the impacts of a range of potential projects and a constrained public budget in an experimental environment. They are asked to choose their preferred projects, while respecting the public budget constraint. The trade-offs made can be used to establish individuals' preferences to rank these projects in terms of their desirability.
Shadow carbon price	An investment analysis tool that adds a hypothetical surcharge to the price of projects that involve the creation of carbon emissions. The shadow price is intended to enable the harms associated with emissions (or benefits of reductions) to be taken into account in investment decisions, making for more comprehensive analyses.
Stochastic cost estimation	A technique for estimating the level of uncertainty of an economic result. The simulation technique makes use of probability distributions.
Subjective well-being	A self-reported measure of well-being, typically obtained by questionnaire. It includes both emotional reactions and cognitive judgements.
Utilitarianism	An ethical perspective based on the view that the best available outcomes is one that leads to the greatest happiness of the greatest number of people.
Welfare economics	A branch of economics that uses micro-economic techniques to evaluate well-being (welfare) at the aggregate level. Application of the principles of welfare economics gives rise to the field of public economics, the study of how government might intervene to improve social welfare. Welfare economics provides the theoretical foundations for certain instruments of public economics, including cost-benefit analysis.
Willingness to pay	The maximum price a person is willing to pay for a good or service.

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Executive summary

What we did

This report examines what ongoing shifts in the objectives of transport policy mean for transport project appraisal and planning processes. Many countries are rethinking their transport policy and planning objectives. Their focus is increasingly shifting from providing mobility to ensuring accessibility; giving greater priority to equitable access for all; recognising the urgency of decarbonising transport; and making urban environments healthier, safer and more liveable. The report summarises the findings of a discussion among 44 experts from 21 countries at an ITF Roundtable held from 29 September to 31 October 2021.

What we found

Appraisal techniques should consider the impacts of potential investments on all transport policy objectives. Indirect valuation techniques have progressively broadened the scope of cost–benefit analysis (CBA) to capture more impacts that are harder to express in monetary values. However, changing policy objectives – in particular, increased interest in equity, access and climate change issues – require further enhancements to CBA and the use of complementary appraisal methods.

CBA sometimes addresses equity concerns by incorporating distributional weights. However, factoring equity issues directly into CBA requires disaggregated assessment (e.g. by income, gender or location) and weighting the results. Choosing weights to reflect policy objectives is challenging. Moreover, opportunities for dialogue on the relative importance of distributional and efficiency impacts are lost if results are presented only in aggregated form.

There are questions regarding the analytical robustness of CBA in incorporating climate change imperatives in decision making. However, recent CBA guidance has done much to address this issue. The conceptual basis for determining shadow carbon prices increasingly reflects the cost of achieving national emission-reduction commitments.

Supplementary analyses alongside CBA results can greatly enhance the information available to decision makers, even where state-of-the-art CBA practice is applied. These include various kinds of accessibility analyses which can shed light on social, regional and gender-equity issues.

Many experts advocate using multi-criteria analysis (MCA) to integrate the results of the diverse analyses. However, presenting the results of multiple analyses as a single set of MCA scores is often problematic, since views can differ on the weights allocated to different objectives. Presenting results as aggregated MCA scores reduces the information readily available to decision makers and stakeholders. Short summaries that highlight the results of the CBA, the supplementary analyses and their implications offer more insights for decision making.

To address shifts in transport policy objectives, a broad response that encompasses the entire transport planning process should accompany improvements to appraisal. Project identification, in particular, must

respond to changing transport policy objectives. Critical steps are better framing of project proposals in light of broader policy objectives identifying alternatives consistent with these broader framings, and improving the way projects are reviewed against broader policy objectives in the initial needs-case assessment. Adopting a strategic planning framework can improve outcomes by offering a co-ordinated and consistent approach to infrastructure investment.

Ex-post evaluation can do much to refine appraisal by identifying systemic biases and enhancing methodologies. However, evaluation results are not always transferable between projects or countries. A major problem in evaluation practice is the fleeting nature of data. Thus, data for *ex-post* studies must be gathered from the start of a project to avoid data loss. Systematic and comparable evaluations can be greatly facilitated by establishing permanent observatories, as in France.

Decision processes should account for the complexity of the problems that major infrastructure investments address and the uncertainty involved. Extensive stakeholder engagement can reduce the risk of planning failures by improving information, identifying and addressing concerns, enhancing the legitimacy of decisions and avoiding the withdrawal of consent by important parties. Multi-stage decision making improves outcomes as decisions are made progressively as more and better information becomes available. Sound decision making should integrate three elements: technical assessment, process management and public engagement.

What we recommend

Develop long-term strategic infrastructure plans that explicitly identify transport policy objectives

Strategic plans should explain the importance of each objective and set out the policies and investments required to achieve them. This helps ensure project appraisals reflect governments' strategic policy orientations.

Broaden project appraisal to ensure its processes and practices take account of all transport policy objectives, as embedded in strategic infrastructure plans

CBA should make use of indirect valuation techniques and other methodological innovations. Aggregate CBA should be supplemented with a disaggregated appraisal of project costs and benefits for population groups of concern (e.g. because of income, gender, or location). Other analytical tools can yield additional insights. They should be adopted as needed.

Incorporate accessibility indicators, or other relevant tools, to assess equity impacts in transport project appraisals

The increasing focus on accessibility as the central objective of transport policy requires that appraisals incorporate purpose-specific measures to capture and assess accessibility and other relevant dimensions of equity. Methods should be chosen for their ability to clarify the specific issues at stake.

Provide detailed guidance on accounting for climate change impacts in transport project appraisals, incorporating clear linkages between shadow carbon prices and emissions reductions commitments

CBA is a robust method for addressing climate change impacts if all relevant impacts are assessed and realistic estimates of the cost of meeting emissions reduction targets are used. Social willingness-to-pay measures – that is, measures of the values society collectively places on key outcomes – should be incorporated in the analysis.

Present the results of transport project appraisals in a transparent and concise format that highlights needs-case assessments

The results of broader project appraisals that assess performance against a wider range of policy objectives cannot readily be expressed in terms of a single metric. Decision makers and stakeholders differ on which impacts are important and what weights should be attached to them.

This implies that, to support well-informed discussion and decision making, appraisal results should be presented in a multi-dimensional format that separately presents the performance of potential projects across different measures, and in terms of different underlying policy objectives.

Ensure decision-making processes for large investments in transport systems account for uncertainties and the need for broad stakeholder support

Processes that are properly adapted to capture decision-critical factors minimise the risk of planning failures. For large investments, the decision process should be multi-staged, with feedback loops that incorporate previous outcomes into subsequent decisions. Stakeholder engagement should commence at the early stages of the process and be maintained throughout.

Integrate technical assessment, process management and public engagement into decision processes for major transport infrastructure investments

Ensuring that these three elements are well-integrated will help ensure that decisions meet efficiency, equity and other underlying objectives and enjoy wide support, enabling them to be implemented effectively.

Undertake systematic *ex-post* evaluation for all transport infrastructure projects entailing expenditure above an identified level

Ex-post evaluation can contribute significantly to improved appraisal methods. Increasing evaluation activity, and standardising methods and processes, is essential to ensure these gains are realised.

Consider the merits of the permanent observatory model as a means of maximising the quality of evaluations

Meeting the substantial data requirements is a major challenge when conducting evaluations. The fact that much data is fleeting in nature, and difficult or impossible to obtain *ex-post*, underlines this problem. Permanent observatories, established at project inception, appear to be a promising means of addressing data and other quality control issues and enhancing evaluations of larger infrastructure projects.

The objectives of transport planning

Transport policy and planning objectives are being fundamentally rethought in many OECD countries. A central element of this shift is the increasing move to replace the traditional mobility focus of transport planning with an accessibility-based perspective. The accessibility perspective recognises that transport is a derived demand and that the purpose of passenger transport policy is to enable people to reach destinations to participate in various activities. As the ITF has previously argued, “mobility does not in itself ensure accessibility, and can even detract from it. Greater mobility for some can reduce mobility and accessibility for others. This can, in turn, lead to significant deterioration of certain aspects of the quality of life and an inefficient use of economic and natural resources” (ITF, 2020a).

A core focus of the accessibility perspective is on providing equitable access, ensuring everyone enjoys an acceptable minimum level of accessibility. This focus implies that the distribution of the benefits of transport investment should be a central consideration for policy makers. In many significant domains of government intervention (e.g. health care, education and housing), delivering a particular good to citizens is the overriding concern. Equity is a central goal of government policies, and policy interventions – including regulations, taxes and subsidies – are designed to deliver equity in each domain. There is a strong argument that transport planning should adopt the same perspective, as adequate accessibility is a fundamental requirement for achieving an acceptable standard of living (Shiftan et al., 2021).

Different dimensions of equity are relevant within an accessibility paradigm. Equity can be considered at geographical and household levels and in terms of characteristics such as gender and disability. Addressing the different dimensions of equity has a range of implications for transport planning goals. In particular, transport planners need to ensure that:

- access to local services in regional areas is adequate and consistent, and that regional connections to the national transport network are also adequate
- transport links within metropolitan areas provide adequate accessibility for those without access to private vehicles
- transport networks provide sufficient accessibility to address a wide range of journey types and purposes
- transport modes and infrastructure facilities are considered safe by all user groups
- transport modes and infrastructure facilities are accessible to all, including people with restricted mobility and those with other disabilities that can limit accessibility.

The second major shift in transport planning is towards recognising that individual project appraisals often do not result in the delivery of transport infrastructure investment programmes which, taken as a whole, contribute effectively to achieving governments’ strategic transport objectives. For example, a major finding of the recent review of the United Kingdom’s project appraisal guidance (HM Treasury’s Green Book) was that appraisals frequently do not address proposals’ impacts on strategic government objectives, including equity (“levelling up”) and climate change (HM Treasury, 2020b).

This conflict between the outcomes of project-level appraisal and the need to optimise the performance of larger investment programmes is becoming more apparent – and critical. Governments are increasingly adopting strategic planning processes to guide the delivery of major infrastructure programmes, moving away from practices that typically saw infrastructure investment decisions made in response to specific bottlenecks.

This disconnect between individual project appraisals and the strategic objectives of transport planning is clear in the context of the imperative need to address climate change. This imperative has two essential dimensions in relation to long-term transport policy. First, it involves giving priority to the urgent need to decarbonise the transport system to meet international commitments to limit greenhouse gas emissions, and thus temperature rises. This implies a need for fundamental changes to current transport systems and a substantial modal shift away from private vehicles, notwithstanding the progressive electrification of the vehicle fleet. Second, it involves ensuring that transport infrastructure is sufficiently resilient to expected increases in the frequency and severity of extreme weather events. Resilience issues must be addressed when designing and constructing new infrastructure and in decision making on maintenance and upgrade programmes for existing infrastructure (OECD, 2018).

Traditional appraisal processes and techniques have undergone significant evolution in recent decades. In particular, as the ITF has recently highlighted (2021a), the external impacts of major transport projects have increasingly been brought within the scope of appraisal through analysis of wider economic benefits. These external benefits derive from the positive impacts on productivity of increased urban agglomeration, which some investments in improved transport infrastructure can enable. In addition, cost–benefit analysis (CBA) has evolved methods for quantifying, monetising and incorporating a wider range of benefits and costs within the central analysis.

Despite these changes, significant further review and modification of appraisal practice is required to ensure that it appropriately considers the broader policy objectives identified above. A central issue is that traditional “mobility-based” CBA appraisals do not give due weight to the effects of transport infrastructure choices on health, local and global environmental impacts, or quality of life factors such as the aesthetic quality of locations in the public domain (ITF, 2020a). The underlying requirement is to address concerns that “[t]he disconnect between urban transport policy making and other policy areas, such as public health or spatial planning . . . [is] causing serious negative social impacts such as chronic disease, premature mortality (Khreis et al., 2016), or community severance” (Shortall and Mouter, 2021).

Roundtable participants considered means of expanding and reforming the practice of transport appraisal to ensure that the results generated support decisions that lead to the effective achievement of governments’ strategic objectives. However, a major finding is that achieving this outcome requires wider changes, extending beyond appraisal. These include changes in wider transport planning, decision making, and stakeholder engagement practices and processes.

Addressing equity, sustainability and other strategic objectives

Transport appraisal has long centred on the use of cost–benefit analysis (CBA). This reflects CBA’s foundation in welfare economics and consequent ability to provide clear information on the relative welfare impacts of different options and its ability to express outcomes in terms of clear, comparable metrics. Given the political nature of many major infrastructure investment decisions, these are crucial advantages. It can thus function as a countervailing power against the pursuit of projects for essentially political purposes (Mouter, 2017).

The traditional approach to CBA in transport appraisal adopts the aggregated value of travel-time savings as the central benefit measure for infrastructure investments. Business travel is accorded higher values, with little attention paid to the distribution of travel-time savings. CBA practice has developed progressively, and the use of indirect valuation techniques, which provide monetary values for a wide range of impacts, is now more common. Public policy objectives have broadened to include a greater focus on environmental and social issues. However, CBA is still frequently criticised as unduly narrowly focused.

The broader range of policy objectives that transport appraisal must consider has increasingly raised questions about whether the CBA-focused approach remains appropriate and adequate. Transport planning increasingly emphasises accessibility, and the size and distribution of accessibility gains have become central considerations. As the decarbonisation of the transport system becomes a pressing priority, it is essential that the relative performance of different options against this criterion is accurately analysed and the results conveyed clearly to policy makers. The impact of investments on the resilience of the transport system in the face of climate and other threats is increasingly critical. The transport investment programme as a whole must also contribute to strategic objectives such as modal shifts that support decarbonisation and urban liveability goals. In all of these areas, CBA-based appraisal continues to be criticised. Its critics see it as providing insufficient information on the relative performance of different potential investments across the expanded range of relevant objectives.

Some transport planners argue that broadening the goals of transport planning necessarily increases misalignment between people’s personal choices and their preferences regarding the allocation of government transport funding. For example, Manaugh et al. (2015) observe that for most of the 20th century, transport objectives were almost entirely mobility-based. The associated goals of congestion reduction, travel-time savings and safety improvements for motorists were relatively easy to value by observing people’s (hypothetical) private consumer choices. In this context, CBA captured all the essential goals of transport planning identified by policy makers at that time. However, urban transport projects now pursue both traditional goals (e.g. costs, travel-time savings, safety and reduction of noise pollution) and a wide range of non-traditional goals. Examples include long-run sustainability, urban liveability, decarbonisation, resilience and social equity. Many authors argue that CBA is far less well-equipped to address these non-traditional goals, which are either not included in CBA or under-valued because they are not fully quantified or monetised (Shortall and Mouter, 2021).

In response, many jurisdictions require one or more supplementary analyses as part of standard appraisal processes. The use of multiple analyses raises the issue of presenting the results coherently and systematically to effectively inform decision makers. A common approach is to use multi-criteria analysis (MCA), which usually involves applying explicit weights to performance scores across different policy objectives to reflect views of their relative importance. However, as discussed below, MCA is often criticised for arbitrariness in setting weights. It is also sometimes criticised because presenting a single score as the outcome of the analysis can reduce transparency. This is arguably a criticism of common MCA practice rather than an intrinsic weakness of the methodology, as it is also possible to draft MCA reports that present the entire matrix of impact scores and weights, thus providing a highly transparent information set.

Some critics argue that, even where MCA is adopted, CBA often continues to take a predominant role in decision making. For example, Shiftan et al. (2021): argue that “the practice of MCA usually includes CBA as the main criterion with often little attention for other criteria in the policy and political discussions on transport investments”. Di Ciommo and Shiftan (2017) argue that “[e]ven when [equity] is at the core of the appraisal, the utilitarian approach at the base of this evaluation disables a proper consideration of equity”.

Ensuring that project appraisal, and ultimately project selection, adequately address the expanded range of policy priorities requires appraisal techniques to be adapted, expanded or supplemented. Broadening appraisal is essential to ensure that all dimensions of the benefits sought through transport investments are included in the analysis and appropriately weighed, including by using scenario analysis to address significant uncertainties.

Roundtable participants identified and discussed several improvements to standard appraisal techniques, some already relatively well-established and others less developed. Improvements canvassed included greater rigour in addressing the “needs case”, which informs the threshold decision as to whether investment is required in a given context. However, a core finding is that broader changes to transport planning processes are needed to account for recent shifts in transport policy objectives.

Modifying cost–benefit analysis

While indirect valuation techniques have enabled an increasing range of environmental and other values to be monetised and included in the CBA, a major concern remains over CBA’s ability to compare the distributional impacts of potential investments. The increased focus on the accessibility perspective has made this issue especially acute.

Bonafous (2021) notes a marked contradiction between equity and profitability in most transport investments. This contradiction is due to increasing returns to scale, which implies that the most profitable investments are those undertaken along heavily used axes and in regions that generate high traffic levels. Yet these areas already tend to enjoy high initial levels of accessibility. Indeed, Bonafous and Masson (2003) have proposed a formal proof of the contradiction. Policy makers must clearly understand the equity impacts of investment options. This is essential to enable them to understand the nature and extent of the equity/efficiency trade-offs and make informed choices between project options.

Several other modifications to CBA have been proposed, and some implemented to greater or lesser extents. Some enable CBA to address equity issues by changing the weights given to impacts on different groups to reflect policy makers’ equity objectives. Many involve departing from values based on willingness to pay (WTP) for benefits such as travel-time savings. This is because WTP-based values necessarily favour

projects that predominantly benefit higher-income groups, whose greater ability to pay typically yields higher WTP estimates (Martens, 2006). As Shiftan et al. (2021) note, this implies a deviation from the welfare-theoretic underpinning of CBA. However, Jara-Diaz (2007) argues it is consistent with people's general public preferences to give a higher weight to the interests of low-income groups when considering potential social expenditures.

One alternative to WTP-based valuations is to apply a uniform "equity" value of time, to all users of the proposed service. Another is to use reverse weightings, which ascribe higher monetary values to benefits accruing to relatively disadvantaged groups and lower values to benefits reaped by relatively advantaged groups. Doing so increases the likelihood that projects providing more significant benefits to deprived groups will be selected. The primary rationale for this approach derives from the economic concept of diminishing returns. That is, if accessibility is considered as a good or service, a given increase in accessibility will be less highly valued by someone who already enjoys high levels of accessibility than someone who does not.

Critics argue that adopting such weights is insufficient to address equity issues effectively and ensure adequate standards of accessibility for all. For example, Martens and Di Ciommo (2017) argue that low-income groups, people with limited mobility and other groups characterised by small numbers of realised trips and low travel-time values effectively remain invisible if CBA approaches based on measuring the value of travel-time savings remain central to project appraisal.

Nahmias-Biran and Shiftan (2016) propose a method for addressing this issue, based on a measure of subjective well-being (SWB). As low-income groups gain a greater increase in well-being from a given accessibility improvement, the SWB measure, which the authors call "the subjective value of accessibility", compensates for income differences by including subjective well-being factors. Shiftan et al. (2021) note: "By applying this in an 'equity benefit analysis' as a variation on a pure welfare-based cost-benefit analysis, projects that direct accessibility gains to population groups with relatively low levels of accessibility or relatively low incomes are likely to perform better than projects that would do the opposite."

Di Ciommo (2021) highlights another potential approach to integrating equity considerations into CBA. This involves replacing the use of a single benchmark discount rate, as recommended in most governments' CBA guidance documents, with a range of rates that reflect the rate of time preference of the different groups affected by the proposed project. Providing decision makers with CBA results calculated using both approaches to discounting demonstrates the impact of including this measure of equity considerations. However, this approach also introduces several difficulties. One is that it appears to imply a presumption that the appropriate conceptual basis for setting the discount rate is that of the social rate of time preference. By contrast, many countries' CBA guidance material argues for (or requires) the use of an opportunity cost of capital-based approach. Moreover, while the conceptual basis for setting discount rates and the specific rates recommended varies, most appraisal guidance documents argue for consistent approaches to discounting across sectors and project contexts. This emphasis reflects the fact that the choice of the discount rate should be determined by a broader range of factors than those relating to the assessment of performance against specific objectives in a given sector (OECD, 2009).

Some criticisms of CBA question the reliability of revealed preference-based valuations as an accurate gauge of citizens' preferences in a public policy context. Recent work in welfare economics has also addressed these criticisms, adopting the view that people may have different preferences as citizens, considering broader social welfare, than those they express in their roles as consumers. Empirical research supports this view, showing that individuals value the impacts of transport projects (e.g. travel-time savings and accident risk) differently when assessed against the public budget versus their private budgets (Mouter et al., 2017, 2018, cited in Shortall and Mouter, 2021).

Participatory value evaluation (PVE) and deliberative monetary valuation (DMV) are two examples of this work. Proponents of PVE and DMV propose these methods as complements, rather than alternatives, to CBA.

In PVE, individuals receive information about the impacts of several possible public projects and a constrained public budget in an experimental context. The exercise gathers data on their preferences for allocating scarce public resources (Mouter et al., 2021) rather than inferring these preferences based on their private expenditure choices, as is done in traditional CBA. Evaluators can then rank these projects by desirability (Shortall and Mouter, 2021). PVE potentially enables individuals to express a broader range of preferences about government policies than existing methods (Mouter, Koster and Dekker, 2019).

DMV “raises concepts of social willingness to pay and accept which are distinct from an aggregate of individual values” (Spash 2007). In this approach, differences in valuation result from individuals adopting different valuation processes in group and individual contexts (see also Shortall and Mouter, 2021). DMV seeks to recognise the importance of social interaction in preference formation by asking individuals to express their preferences after exposure to one or more deliberative mechanisms. Examples include group discussions, consulting expert witnesses, or a forum. This deliberative aspect allows citizens to learn from each other, form reasoned opinions and evaluate positions. It also addresses critiques of the individual approach traditional CBA takes to preference formation (Kenter et al., 2016).

Both methods seek to amend standard welfare economics. However, there is little experience with their implementation to date. Hence, their practical ability to address critiques of CBA remains unknown (Shortall and Mouter, 2021). Moreover, both draw conclusions based on people’s statements of their preferences in hypothetical situations. While this potentially makes it possible to gather data on a broader range of issues, the reliability of the results depends on the quality of the hypothetical scenarios. For this reason, the results of stated-preference studies are generally considered less robust than those based on analysing actual consumer behaviours. This distinction argues for caution in using these emerging methodological tools.

Some critiques of CBA challenge the utilitarian perspective underlying the welfare economics paradigm. For example, Van Wee et al. (2014) argue that utilitarianism may not address crucial moral dimensions of transport policies, such as freedom of choice or alleviating inequality. Thus, several proposed alternative or complementary analytical tools (e.g. some deliberative approaches) are not grounded in welfare economics.

Another criticism of attempts to address equity issues within CBA lies in the relative lack of transparency that these approaches entail, given the aggregative nature of CBA. Even where equity-based weights are applied, decision makers do not necessarily receive information about the values adopted. This makes it difficult or impossible for them to compare the performance of different options on this specific dimension. The weights used to derive these equity values are also frequently poorly justified. Projects with poor distributional outcomes may still score more highly overall (i.e. in net present value or benefit–cost ratio terms) but decision makers may remain unaware of this unless they receive information on distributional impacts alongside aggregated CBA outcomes (Shiftan et al., 2021).

These shortcomings arguably make using a modified CBA to address equity issues a poor solution, at least in contexts in which distributional impacts are central to the policy objectives. Moreover, if multiple policy objectives are relevant to the analysis, choosing the weights to apply within the CBA can become challenging. In practice, identifying the impacts of proposals on specific groups in unweighted terms, and discussing their different distributional impacts alongside the aggregate CBA results, remains the more common means of addressing equity issues in CBA. This method is then supplemented by a qualitative discussion highlighting the nature and extent of the equity/efficiency trade-offs between proposals.

For example, the guidelines issued by the Netherlands Bureau for Economic Policy Analysis (2013) state that if the distributional effects of proposed investments are substantial, the CBA should clarify these distributions across societal groups, so that policy makers can determine what weight to give these effects. As Gomiijn and Renes (2013) point out: “The outcome of this exercise can then provide a basis for deciding, for example, that a measure that delivers a negative rate of return should still go ahead because of its distributional effects. Conversely, CBA can be used to rank measures intended to bring about a more favourable distribution of income or welfare according to their economic welfare impact.”

This approach improves the transparency of the various weighting approaches by presenting information on the impacts on individual groups in a disaggregated format. In practice, this means elected policy makers rather than officials assign these weights. Conversely, there is arguably also a loss of transparency because the weights policy makers apply in deciding between proposals are necessarily implicit. Where multiple distributional impacts (or claims) are involved, it may be challenging to understand what distributional claims have been weighed, and to what extent.

However, the fundamental challenge is to include distributional issues in the analysis and the policy process. In practice, if accessibility is not an explicit part of transport policy objectives, this (rather than methodological limitations or divergences of view) may be why CBA fails to address distributional issues adequately.

Cost–benefit analysis and climate impacts

CBA’s ability to address the implications of transport investments for climate change imperatives has also been the subject of much discussion. Theoretically, in a perfectly functioning market economy, the prices of goods and services internalise the total cost of producing them, including environmental costs. This assumption also implies that the price attached to greenhouse gas emissions is sufficiently high to prevent the devastating consequences of climate change. However, emissions are often not priced; and where taxes and other interventions establish effective carbon prices, these have invariably been too low to provide the needed incentives.

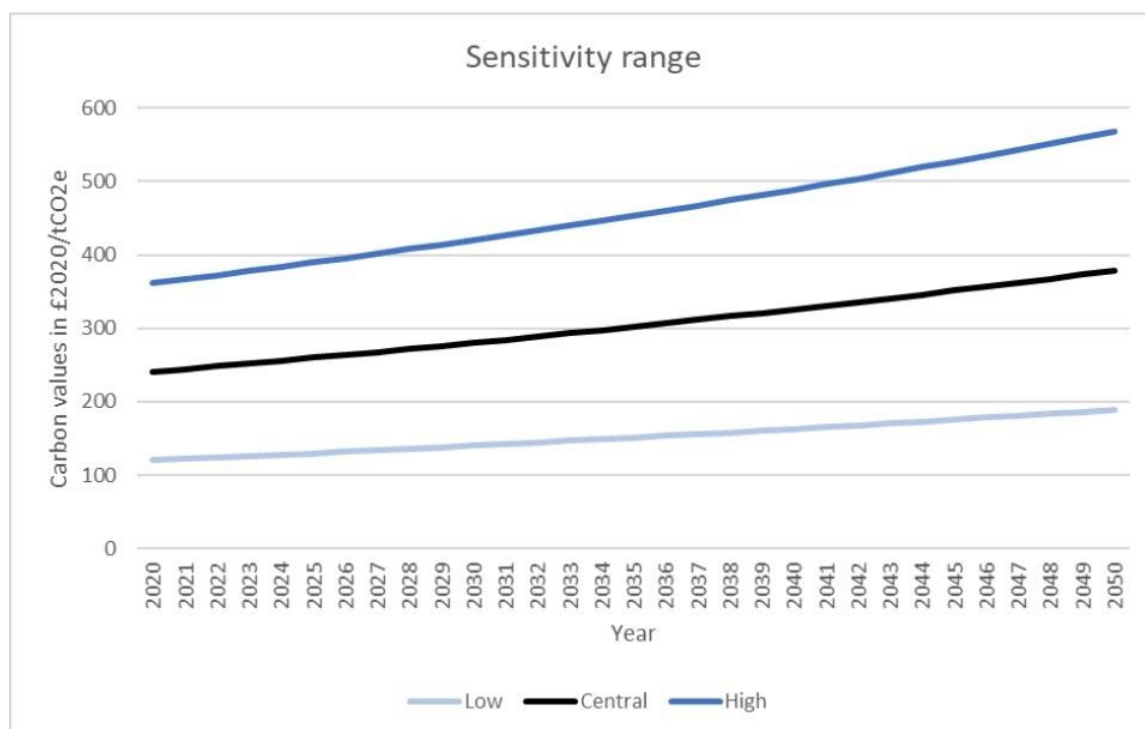
Transport appraisal methods have been adjusted to account for these shortcomings via efforts to calculate shadow prices of carbon, and apply them in CBA calculations. This relies on the feasibility of identifying robust shadow carbon prices that are widely accepted as reflecting the full costs of damage from, or of adapting to, climate change. This is a dynamic concept: CBA for long-term projects must incorporate credible future values for shadow carbon prices.

Recent developments have raised significant issues in this regard. CBAs have, in the past, typically incorporated shadow carbon prices based on those observed in carbon markets, notably the European Union’s Emissions Trading Scheme. However, these prices depend on how much carbon is defined as available to buy – a figure determined by political negotiation – and the market conditions in industries that buy them. Neither are fixed in relation to global carbon targets. Prices on the European carbon market have remained low, despite rapid increases in recent years. From around EUR 5 per tonne before the 2018 reforms, they rose an order of magnitude by mid-2021 (to approximately EUR 56/tonne on 1 July), and were predicted to reach over EUR 90/tonne by 2030. Nonetheless, the combined effects of these prices in the traded sectors, and the use of similar prices in cost–benefit studies in the non-traded sectors (including most of transport) will not have sufficient effect on decision making to enable climate change targets, and the carbon emission targets they imply, to be met.

Carbon-emission targets increasingly reflect the perspective of the maximum stock of atmospheric carbon that is consistent with meeting policy goals on temperature increases rather than the flow of annual emissions. This approach reflects, in particular, the scientific work of the Intergovernmental Panel on Climate Change (IPCC), as reported to the 26th United Nations Climate Change Conference of the Parties (COP26) in Glasgow in 2021. It implies significantly higher shadow prices, given the speed with which concentrations of CO₂ in the atmosphere will exceed maximum target levels were the current rate of emissions to be maintained.

Reflecting this, recently revised CBA guidance in some countries has adopted much higher shadow prices for CO₂ for appraisal purposes. For example, in 2015 France adopted carbon values rising from EUR 56/tonne in 2020 to EUR 100/tonne in 2030 (Carbon Pricing Leadership Coalition, 2017). Most recently, revised editions of the UK Treasury’s Green Book and associated guidance documents (BEIS 2021), published following a 2020 review, adopted a “central” scenario CO₂ valuation for 2021 of GBP 241/tonne. This rises to GBP 280/tonne by 2030 and GBP 378/tonne by 2050. A “high” scenario value of over GBP 500/tonne (see Figure 1) is also included.

Figure 1. Government guidance on carbon values for use in project evaluation, United Kingdom



Source: UK Department for Business, Energy and Industrial Strategy (2021).

The UK Department for Transport has adopted this pricing guidance for transport appraisal and extended the series to the year 2100. By that time, the high-scenario carbon price approaches GBP 1 000/tonne (at 2010 prices). The current guideline value for 2021 emissions is thus more than an order of magnitude higher than the 2018 value, and the guideline value for 2030 emissions is 3.5 times the equivalent value in the 2018 edition (BEIS, 2018). The guidance also requires the use of low- and high-price scenarios. The high-price scenario now includes prices of GBP 361/tonne in 2021, rising to GBP 568/tonne by 2050 (BEIS, 2021).

The updated shadow carbon prices in France and the UK seek a target-consistent marginal abatement cost to achieve agreed global targets aiming to limit the average global temperature increase to 1.5 degrees Celsius (°C). These targets imply net-zero carbon emissions by 2050, with an interim target of a 78% reduction in emissions by 2035 compared with 1990 levels. The scientific literature shows some variation in shadow prices calculated as meeting these conditions. However, there is broad agreement. The 2030 value in the UK's Green Book is marginally lower than the IPCC median cited result (GBP 147/tonne versus GBP 163/tonne). The 2050 value, meanwhile, is much higher than the corresponding IPCC median (GBP 576/tonne versus GBP 326/tonne), while still within the interquartile range of IPCC carbon values.

The most recent work by Stern and Stiglitz (2021) also supports the use of significantly higher carbon prices. Like the BEIS guidance, it points to an increasing focus on the target of keeping temperature increase to 1.5°C and the widespread adoption of “net zero by 2050” commitments as major drivers of this conclusion. The authors note that the report of the 2017 Commission they chaired (Carbon Pricing Leadership Coalition 2017) recommended carbon prices for 2030 of USD 50–100/tonne but argue in their 2021 paper that subsequent tightening of international targets would justify adopting a figure at the top of this range. They also cite Kaufmann et al. (2020), who derived a carbon price of USD 125/tonne for 2030 based on a social cost of carbon methodology, noting that “The two approaches (exemplified by Stern-Stiglitz and Kaufman et al.) are different but in either case the numbers likely to emerge would be more in the region of USD 100 per ton by 2030 rather than the USD 50 per ton (in 2007 prices, USD 60 in 2018 prices) estimated by the Interagency Group in the Obama administration” (Stern and Stiglitz, 2021).

In sum, while carbon values adopted for policy appraisal purposes continue to vary, there is a clear trend towards applying significantly higher values. This trend reflects greater appreciation of the urgency of climate action and the consequent adoption of more specific and challenging abatement targets. It also recognises that rational policy requires a risk-averse approach in the face of severe or existential risks (Stern and Stiglitz, 2021).

These trends are consistent with a shift in transport planning perspectives from a “predict and provide” to a “decide and provide” paradigm – that is, one based on identifying preferred future outcomes and taking policy decisions to support their achievement, as previously recommended by the ITF (2021b). The Nationally Determined Contributions adopted in response to climate-change targets agreed at successive UN summits constitute the required policy outcomes, with shadow carbon prices set at levels consistent with their achievement.

Changes in carbon pricing of this extent and rapidity will likely lead to large changes in the rankings of sets of proposed transport infrastructure projects. With higher shadow carbon prices, investments in low-carbon modes become more attractive, in relative terms, than increases in road capacity to cope with more travel by high-carbon modes. This, in turn, indicates that traditional CBA-based appraisal methods can be made consistent with the achievement of the significant modal shift and changes in traffic volumes that the strategic policies of ITF member country governments require.

However, this will only occur if appropriate values for major variables such as greenhouse gases are used consistently. Appraisals must include and quantify all relevant impacts (e.g. the health impacts of increased use of active transport). Of course, cost–benefit calculations alone will not reduce carbon impacts. Decisions taken need to be consistent with those calculations. This is not always the case, as other considerations may cause decision makers to proceed with investments that undermine the achievement of the targets.

A second methodological issue relevant to climate change and other long-term environmental policy issues is the appropriate use of discounting in CBA. The OECD has previously discussed the argument that the application of discount rates favours short-term policy-making perspectives. It noted that an increasing

number of appraisal guidelines recommended using lower discount rates for projects with very long time horizons. However, different guidance documents provided diverging justifications for this move. These included the need to account for the preferences of future generations; expected declines in per-capita income growth rates; and the need to acknowledge increasing uncertainty about appropriate discount rates in the distant future (OECD, 2009).

Some guidelines conclude that discounting is not the preferred way to address the conceptual issues associated with assessing impacts over long time horizons. In the UK, the BEIS supplemented its recent review of the Green Book guidance with a purpose-specific review of the application of discount rates to long-term environmental impacts. The review engaged with a range of academic experts to determine whether there was a theoretical justification for applying a lower discount rate for projects with environmental impacts.

The resulting report (HM Treasury, 2021) found that, on balance, a differentiated discount rate should not be applied to environmental impacts. It reasoned that discounting constitutes an imprecise way of accounting for effects such as lack of substitutability and increasing relative scarcity. It concluded that the existing Green Book methodologies could instead be modified via relative price adjustments and increasing values over the appraisal period to better address these issues. It noted that these conclusions were consistent with those of the Treasury's review of the economics of biodiversity (Dasgupta, 2021).¹

The complexities involved when addressing the issues of shadow carbon prices and discount rates suggest that addressing climate change-related impacts continues to pose significant problems for CBA. However, the conceptual framework of CBA can accommodate the costs and benefits of carbon and contribute to successful climate-change policies.

That said, while CBA is well placed to analyse the aggregate benefits and costs of climate-related policies, much policy making now focuses on the distributional dimension of climate change. Climate change is increasingly being understood as having a significant social justice dimension, as it becomes more apparent that many of the most severe impacts will fall on the most vulnerable populations. This recognition has several aspects. Many of the geographical areas that will be most heavily affected by changes, including sea level rises and extreme weather, are in the Global South. In many developed country contexts, low-income groups are more vulnerable to climate change impacts because of living in lower-quality housing. At the same time, the aged are more susceptible to the health impact of extreme heat exposures. Lower-income groups (e.g. tenants as opposed to owner-occupiers) are also made more vulnerable by being less able to fund and undertake mitigation actions (Preston et al, 2014).

The importance of this dimension of climate policy suggests that applying additional analyses to generate detailed information on the incidence of climate impacts on groups of concern will also be important. This can help to inform decision makers adequately on the social justice implications of different policy choices.

Integrating cost–benefit analysis and complementary analytical tools

Many government project appraisal processes now require additional analytical tools to be applied in parallel with CBA. These seek to better assess impacts that CBA is seen as unable to address adequately. They include a variety of accessibility measures, environmental impact analyses and assessment of the gender impacts of different investment options (see Box 1).

Box 1. Incorporating accessibility analysis in transport appraisal in Israel

In response to Israel's 2012 national plan for developing public transport, a group of government ministries, experts and consultants collaborated to produce a strategic plan for public transport in the country's largest metropolitan area, Tel Aviv.

The methodology combined strategic, long-term tools, more detailed transport planning, and network simulations using the Tel Aviv activity-based transport model. The plan included a shift away from the current road-dominated model and towards a high level of metro use. The three categories of strategic goals were (a) level of service (including accessibility, system and service coverage, and speed), (b) level of transit usage and (c) level of investment required. The design chosen for the transit network reflected these strategic goals, demand characteristics, current and expected future land use, and mass-transit systems' shape in similar cities.

Policy makers in the Mass Transit Committee (MTC) then set the goals, criteria and weights needed to enable the conduct of an MCA to assess the identified alternatives. The four main criteria considered in the analysis, and the weights assigned to each, were transport (40%), economic criteria (30%), quality of life and the environment (20%) and feasibility (10%). Equity was analysed separately as a unique dimension in evaluating the plan, with a focus on accessibility.

The impact of the strategic plan options was analysed using a travel-demand model that divided the metropolitan area into 1 310 zones. Demographic data was produced for each zone (e.g. the number of households, population size, gender and age distribution, car ownership and employment). Long-term spatial and housing plans were then used to forecast these zonal attributes for the target years 2030, 2040 and 2050.

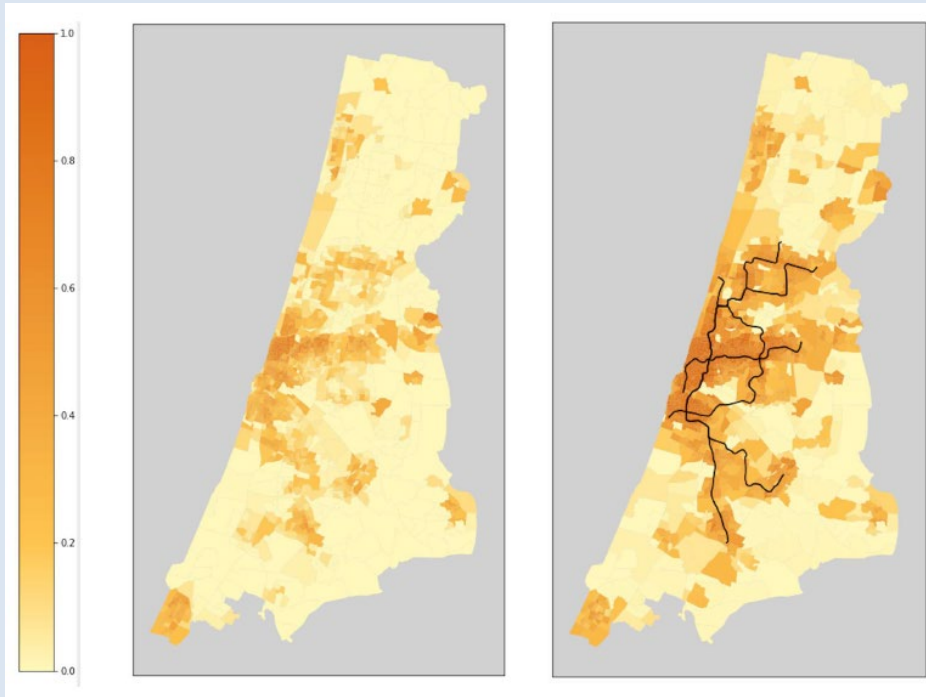
This forecasting enabled an estimate of the change in accessibility for each zone for each target year. In addition, changes in accessibility levels were calculated for each socio-economic group. These calculations showed that implementing the plan would yield major accessibility gains for all zones served by the proposed lines. These gains were substantially higher for the lowest socio-economic groups.

Policy makers selected a radial transit network based on three subway lines and three light rail lines. Three rapid-transit bus lines complement this network, forming an outer ring and providing local service on the edges of the urban area. Figure 2 summarises the accessibility gains. It shows that, following the plan's implementation, all socio-economic groups will have a level of accessibility that meets or exceeds the target level of 50% of destinations within 45 minutes. Figure 3 shows the difference in the proportion of destinations reachable, on average, by each socio-economic decile due to the plan. The levels of accessibility are very similar for all groups, in contrast to the current position.

Additional equity analysis included a comparison of Lorentz curves and Gini coefficients for the pre- and post-metro cases. Thus, the analysis demonstrates the nature and extent of equity and accessibility benefits. Transport appraisers often present this type of analysis to decision makers alongside CBA results. Thus, CBA remains influential, especially if governments have adopted threshold values that must be met (e.g. positive net present value, minimum benefit–cost ratio) before project approval.

However, providing a separate accessibility analysis enables a comparison of the size and incidence of the accessibility gains with the results of a traditional CBA. This provides transparency to decision makers about the nature and extent of any equity/efficiency trade-offs. By contrast, incorporating equity weights within the CBA is likely less transparent. See Shiftan et al. (2021) for additional details.

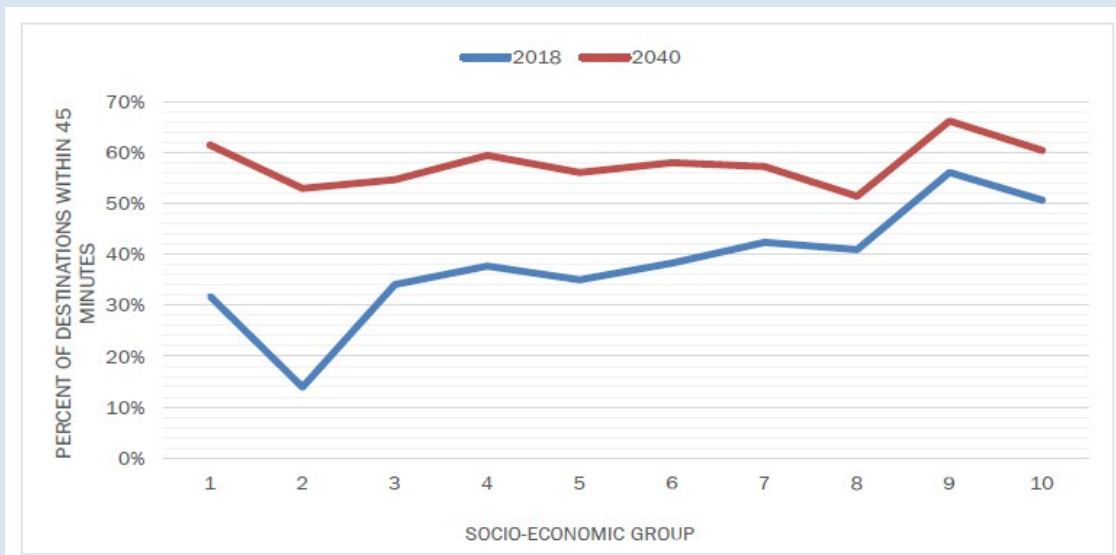
Figure 2. Accessibility maps: before and after the proposed transit system in Tel Aviv



Note: The Grey lines in the right-hand map are metro routes. Areas with darker shading have greater accessibility.

Source: Shiftan et al. (2021).

Figure 3. Accessibility change by socio-economic decile, Tel Aviv



Source: Shiftan et al. (2021).

The OECD has documented similar developments in the appraisal of proposed regulation. In this context, many countries have supplemented CBA requirements with mandates to address specific policy issues of concern explicitly. Examples include the impacts of regulation on competition, trade, small business, administrative burdens, the environment, sustainable development, regional development, gender equity, poverty, and native populations.

The main rationale for adopting most of these additional requirements is the concern that traditional CBA does not adequately address crucial distributional questions (OECD, 2009). However, this development raises the issue of integrating the results of these analyses to provide a coherent information set to decision makers. The OECD has previously identified the risk of losing analytical coherence as a core concern when adopting multiple complementary analyses (OECD, 2009).

Multi-criteria analysis

Shiftan et al. describe multi-criteria analysis (MCA), with CBA results incorporated as one dimension of the analysis, as “the main alternative approach” to sole reliance on an expanded CBA. They also identify the main difference between the two approaches: “In contrast to cost–benefit analysis, multi-criteria analysis does not express all the effects in one dimension (money) but uses several dimensions concomitantly” (2021). They argue that, unlike CBA, MCA is open-ended and can absorb additional criteria.

MCA can be used to assess the impacts of proposed investments in terms of regional, social and gender dimensions of equity. In relation to social equity, it can incorporate various indices of income inequality, such as the Gini or Palma indexes, to provide different perspectives on the distributional consequences of potential projects. Including a broader range of equity indicators in the analysis may lead to this criterion being weighed more heavily overall by contributing to a better understanding of the specific equity issues at stake and their extent.

Shiftan et al. (2021) also cite the composite Sustainable Mobility Inequality Indicator (SUMINI), created by Thomopoulos and Grant-Muller (2013). SUMINI uses an MCA approach to quantify a range of equity impacts of infrastructure investments and incorporates criteria weights derived from stakeholders as part of an analytic hierarchy process. Also of note is the “transportation equity scorecard” approach of Williams et al. (2020), which provides a framework to address equity during project screening and ranking. They base their approach on a review of the literature and practice in integrating equity factors into project evaluation and priority setting. It includes a range of equity-related criteria and makes it possible to ascribe weights to each after consulting with relevant stakeholders.

The practical impact of MCA depends on how planners communicate their results to decision makers and stakeholders. Shiftan et al. (2021) identify three broad approaches:

1. adopting criterion weights to reflect the relative political priority accorded to each impact and summing the weighted scores to obtain an overall performance measure, enabling a single ranking of the options
2. presenting policymakers with a matrix of impacts, without summing the scores across the different criteria, to provide a richer database to inform decision making
3. providing a set of unweighted scores for the various options across each of the performance criteria, enabling different stakeholders to determine their own weights (reflecting their own priorities) and thus their own rankings of project options, facilitating a political decision-making process.

The use of these approaches partly responds to the difficulties of assigning criteria weights as the basis for deriving an aggregated result. As suggested above, stakeholders' views on appropriate weights may differ significantly. Thus, there can be tension between producing an integrated analysis and achieving a high level of acceptance of the analysis by stakeholders.

Shiftan et al. (2021) argue that, regardless of the approach taken, an MCA which includes CBA as one dimension of the analysis provides substantially more information to decision makers than an expanded CBA. This greater transparency also provides the basis for broader engagement on priorities and choices. However, MCA has long been criticised for bringing subjectivity into the analysis and lacking transparency. These criticisms centre on how MCA determines weights and scores and whether these elements are transparent in the published MCA and thus able to be analysed and criticised.

The allocation of criteria weights is open to manipulation by proponents of particular options (OECD, 2009). Subject-matter experts and focus groups consulted about weighting and scoring impacts often self-select (if sent a general invitation) or belong to specific interest groups. This results in a risk that interest groups and special pleading have an undue influence over MCA results (Dobes and Bennett, 2009).

Reflecting these concerns, some government analytical guidance limits MCA use to specific circumstances. For example, the UK Green Book explicitly rejects the use of simple MCA "because of its lack of transparent objectivity" (HM Treasury, 2020a). Instead, it accepts only the use of a more sophisticated variant, which it calls multi-criteria decision analysis (MCDA), stating that "MCDA should not be confused with simple weighting and scoring, sometimes referred to as Multi Criteria Analysis (MCA). This latter is not a recognised Green Book approach because of its lack of transparent objectivity." Moreover, the use of MCDA is only authorised when considering unmonetised trade-offs at the longlisting stage of project identification and not as a substitute for CBA in appraising shortlisted proposals.

The Green Book (HM Treasury, 2020a) also highlights the need to give significant attention to quality control: "To work effectively MCDA requires top level decision makers, senior experts and stakeholders to be assembled in a workshop, facilitated by an independent expert facilitator experienced in MCDA, and the use of swing weighting." This cautious approach to using MCA differs markedly from earlier editions of the Green Book. The 2003 edition described "weighting and scoring (sometimes called multi-criteria analysis)" as the most common technique for comparing unvalued costs and benefits. It provided substantial guidance on how to adopt the method and references a detailed manual (HM Treasury, 2003). The current sceptical approach perhaps reflects a reaction to problems encountered with the prior use of MCA in practice.

Other critiques of MCA are more fundamental. For example, Dobes and Bennett (2009) argue that MCA breaches the principle of dimensionality by attempting to compare unlike properties on a common scale. They note that this problem is compounded when MCA effectively multiplies cardinal numbers (the quantities of whatever is being measured) by an ordinal scale (the "score" allocated on each criterion) and an interval scale (the weightings used), then treats the result as a cardinal number that can be added to other cardinal numbers.

In sum, MCA suffers from its own methodological limitations. Like CBA, it requires significant inputs of expert resources to ensure a high-quality result. Thus, while MCA can potentially provide a framework for integrating various analytical tools, its effective use requires detailed guidance, transparency provisions and independent oversight. Shortall and Mouter (2021) argue that while complementary tools add value by addressing one or more critiques of CBA, no single method will address all of them, while none can include all aspects of policy appraisal (environmental, economic, social, ethical). They conclude that further research is needed into how the different methods can be effectively combined and their respective strengths harnessed. Preparing a summary appraisal document for decision makers highlighting the results

of the CBA and supplementary analyses will likely communicate vital considerations more effectively. Such a document is also more transparent than a single MCA result or score.

Addressing the gender dimension of equity

In addition to the regional and social dimensions of equity, there is increasing recognition of the need to address access for people with reduced mobility, which has been discussed in several recent ITF reports (e.g. ITF 2020a, ITF 2017), and the gender dimensions of transport demand (e.g. ITF and FIA Foundation, 2022). The ITF has recently published a Gender Analysis Toolkit for Transport (see Box 2), which considers gender issues in transport planning in the analysis of infrastructure investment options and women's roles in the transport workforce. The toolkit provides readily usable tools to enable transport planners to consider gender issues and identify the gender-specific data necessary for the analysis, design, and data collection processes and create indicators of the level of gender equity.

Di Ciommo (2021) highlights major data needs for addressing the gender dimension of equity. This includes data on the breakdown of trip numbers by purpose; differences in the distribution of trips by purpose between genders; and differences in attitudes to the use of different modal and service type choices between genders. Di Ciommo also highlights crucial differences in transport usage between genders based on data from two very different urban contexts in Spain and the United States. These show that the highest proportion of trips relate to caring activities (over 40% of the total in both cases), while women undertake a disproportionate share (two-thirds) of caring-related journeys.

Conversely, the orientation of transport planning leans strongly towards commuter demands, where men undertake higher numbers of trips. A re-orientation of transport planning to better cater to unmet needs for caring-related trips would imply a greater focus on local-level improvements (e.g. making areas more pedestrian and cycling friendly), rather than optimising large-capacity axes. It would also have considerable potential to address the current bias towards the needs of men in transport planning.

Different patterns of trip purposes constitute one explanation for the observation of significant gender-based differences in the propensity to use different transport modes, which reflect personal choices and access. Recent data show that women are more likely than men to use public and active transport and less likely to use private vehicles. Women also have a less positive attitude to shared mobility options, greater wariness of new and unproven technologies and a less positive attitude toward autonomous vehicles (Di Ciommo, 2021).

These differences necessarily lead to gender-based differences in the pattern of benefits associated with different transport investment choices. Decision makers increasingly seek to account for these differences in project selection and subsequent evaluations. An example relates to the M-30 road tunnel project in Madrid. Analysis showed that women, who made less use than men of private transport, would benefit less from the project. Furthermore, their greater use of active transport meant they were more exposed to the negative pollution impacts generated by the proposal.

However, Di Ciommo argues that effectively addressing gender inequities in transport infrastructure programmes requires a broader approach. In particular, transport planners should incorporate diversity, equity and inclusion (DEI) in the initial stages of the planning process and consider broader issues such as the organisation of transport services and the design of public space from the DEI perspective.

Box 2. The ITF Gender Analysis Toolkit for Transport

The ITF Gender Analysis Toolkit for Transport provides a straightforward method for incorporating a gender-inclusive perspective into transport projects, plans and policies. It offers governments, international organisations, contractors, and all those who design, manage, implement or evaluate transport projects three uncomplicated tools for carrying out their own gender analyses.

ITF's approach to gender analysis aims to answer three questions:

1. How are travel behaviours and patterns of women and men affected by their social roles and the level of accessibility of transport services?
2. How will transport policies, programmes and projects affect women and men differently?
3. How will greater gender equality in the transport workforce enhance transport infrastructure, systems and modes to benefit women and other users?

The Gender Analysis Toolkit for Transport helps ITF member countries and other stakeholders identify the gender-specific data necessary for the analysis; create essential indicators to determine the level of gender equality; and design the data collection processes, including surveys.

The Toolkit comprises three tools:

1. The **Gender Checklist** makes it easy to assess a project's gender-inclusivity and creates transparency by providing a simple Gender Equality Score as a benchmark.
2. The **Gender Indicators** help project leads and policy makers to select the metrics most suited to measure gender equality in their project and to identify relevant data.
3. The **Gender Questionnaire** offers a ready-made template to design surveys and data collection processes.

Together, these three tools offer practitioners a simple yet comprehensive set of tools to advance gender neutrality in transport.

Access the Toolkit online: www.itf-oecd.org/gender-toolkit.

Improving appraisal through *ex-post* evaluation

Evaluating a completed project (*ex-post* evaluation) is a widely acknowledged means of improving appraisal practice. It can help identify systemic biases and unanticipated impacts, thus providing a basis for enhancing *ex-ante* appraisal methodologies. However, a range of challenges must be understood and addressed for the potential benefits of *ex-post* evaluation in improving appraisal to be fully realised in practice.

Reviewing evaluation outcomes

Nicolaisen (2021) reviews the literature on *ex-post* evaluation to identify major conclusions and lessons for the design and practice of *ex-ante* appraisal. Despite studies pointing to the potential benefits of conducting systematic project evaluations and assessing the results against *ex-ante* appraisals, in practice, only a relatively limited number of evaluations occur. Citing Laird et al. (2012), Nicholson notes that mandated public-sector evaluations rarely receive rigorous academic attention. Existing studies typically include only a small number of observations, raising questions of availability bias, and have suffered from other methodological difficulties, which limit their usefulness. A further issue is that a completed project often differs from the proposal subjected to *ex-ante* evaluation.

However, Nicolaisen also argues that, despite these shortcomings, existing studies provide valuable insights. These insights have implications for *ex-ante* appraisal and transport planning practice. The literature on evaluation also includes studies by national auditing bodies, parliamentary committees and multilateral lending institutions, including the World Bank. Surveying this literature, he identifies five conclusions on improving *ex-ante* appraisal practice.

1. **Construction costs are underestimated (as is the case for most larger projects).** This systemic bias appears to have several causes, including unforeseen construction obstacles, especially in relation to underground projects; design alterations, often resulting from ongoing discussion of the appropriate trade-offs between different objectives; optimism bias among project proponents; and strategic misrepresentation of expected costs by project proponents to increase the likelihood of approval.
2. **Demand forecasts are biased (the mean inaccuracy is non-zero).** Inaccuracy in demand forecasts varies widely between evaluations, but systemic biases are evident. This is true of road projects (tolled and untolled) and rail projects. Build (i.e. “do something”) options typically underestimate demand for new, untolled roads, while “do-nothing” or base-case scenarios overestimate that demand. By contrast, demand for new rail and toll road projects is typically over-estimated. Typically, fewer passengers and vehicles than predicted use these services on completion (Bain, 2009). Over-estimation of demand for toll roads and rail projects implies the net benefits of these projects will tend to be lower than *ex-ante* appraisals suggest. However, the situation in respect of non-tolled roads is more complex. Under-estimation of demand in the “do-something” option may imply that actual project benefits are higher than anticipated: this will be the case if capacity

constraints are not reached. However, project benefits may be lower than forecast if capacity constraints occur and significant congestion results. Similarly, over-estimation of the level of traffic (hence, congestion) in the base (“do-nothing”) scenario will lead to over-estimation of project benefits. Nicolaisen identifies potential causes for these biases, including inadequate transport demand models and a failure to deliver other external changes (e.g. land zoning) that affect demand. However, their relative importance is unclear.

3. **Demand forecasts are highly imprecise (the standard deviation of inaccuracy is substantial).** While forecasts are systematically biased towards over- or under-estimation for different project types, considerable differences exist between results for individual projects. Nicolaisen and Driscoll (2014) observe large differences between projects (and for all project types) regarding the extent and direction of forecasting inaccuracies. This variation makes it difficult to identify ways to improve forecasting, as several causal mechanisms may be involved.
4. **Appraisals do not adequately address economic effects (e.g. property value, lost opportunity cost).** Appraisals typically do not consider associated land-use impacts (Börjesson et al., 2014), partly due to difficulties in estimating these impacts. However, research indicates rail projects (and other major transit investments) frequently give rise to considerable non-transport economic benefits in the longer term when supporting investments have been made. For example, Banister and Thurstain-Goodwin (2011) found that non-transport economic benefits were up to three times as large as transport economic benefits for some projects. Conversely, the economic costs of new road projects often relate to the tendency of such projects to favour more dispersed development. While these costs are also difficult to estimate and rarely incorporated in the appraisal, their existence suggests that project benefits may be significantly overestimated in some cases.
5. **Appraisals do not adequately address non-economic effects (e.g. environmental and social effects).** While the value of travel-time savings is usually the primary rationale for transport infrastructure investments, projects also frequently address social and environmental objectives that are not directly related to economic growth (Beukers et al., 2012). While impact analyses assess some environmental effects, it is rare for appraisals to include the full range of relevant social and ecological impacts.

Lessons for appraisal practice

Nicolaisen (2021) finds that the significant observed differences between *ex-ante* forecasts of project impacts and actual outcomes result from a complex range of technical/methodological and organisational/political factors. However, they do not depend on the travel demand model used to forecast traffic volumes. He concludes that, rather than investing resources in developing new sophisticated modelling software, attempts to improve appraisal practice should focus on reducing the impact of these inaccuracies on strategic planning decisions for transport infrastructure. He proposes five strategies to achieve this end.

1. **Systematic evaluation schemes.** Adopting consistent methods and approaches to evaluation is arguably the most crucial potential improvement to its practice. While evaluations are now more common, systematic approaches remain rare. There is little standardisation of methodologies and wide variation in the quality, coverage and comprehensiveness of evaluation between countries and project types. Systematic evaluation provides the direct and regular feedback essential to learning from past mistakes (Kahneman, 2011). In their absence, forecasters will likely remain unaware of systematic biases and inaccuracies. Only systematic evaluation can ensure that fleeting

data is reliably captured, providing the necessary inputs to quality evaluation. It addresses availability bias and data noise resulting from inconsistent methodologies (Nicolaisen and Driscoll, 2014). Establishing systematic evaluation schemes would enable governments to improve their performance assessments, identify inaccuracies and locate their causes, all of which would help enhance *ex-ante* appraisal.

2. **National transport plans.** Many countries focus on case-by-case appraisals of individual projects without addressing the collective impact of transport projects on achieving strategic transport objectives. Given the dominance of CBA in project appraisal, projects that contribute to achieving strategic objectives in ways not readily captured by CBA are less likely to receive funding. An example is increasing the modal share of public and active transport. The biases highlighted above and the long-term nature of many of the benefits imply that these types of projects will fare poorly in appraisals. Adopting a national transport plan with explicit strategic objectives enables assessment of projects' ability to contribute to achieving those objectives, in addition to individual project-level appraisal.
3. **Strategic scenario planning.** Insights from evaluations can lead to methodological improvements. These, in turn, can significantly improve the accuracy of *ex-ante* appraisal. However, forecasts for large projects that form part of a complex system are subject to high levels of uncertainty. These uncertainties sometimes make it difficult to provide confidence in CBA-based outcomes. Adopting strategic scenario planning can add substantial value when assessing fundamentally different solutions. It allows the exploration of different development trajectories to see which solutions are most robust across a range of likely scenarios. It also helps identify risk factors for different projects, making essential success criteria clear to decision makers. The ITF (2021a) has previously noted that scenario analyses could add considerable value to project decision-making processes.
4. **Accounting for induced demand effects.** Arguably the largest systematic bias found in appraisals is the overestimation of road-traffic growth in the "do nothing" scenario. This, in turn, implies an exaggeration of congestion-reduction benefits and an underestimation of carbon impacts. The combination of this effect and the general tendency to underestimate traffic growth implies that building new road infrastructure creates strong induced demand effects unaccounted for in appraisals. Accurately estimating future traffic volumes is essential when deciding whether adding capacity is the best approach to addressing congestion. Incorporating recognition of this dynamic in appraisals could reduce an apparent systemic bias in favour of investing in road projects.
5. **The holistic assessment approach.** Significant differences in appraisal practice exist at different levels of government. National-level approaches typically focus on travel-time savings and construction costs. This reflects the fact that these are easier to estimate than other impacts such as changes in land value, which are often a critical focus at the local level. Nicolaisen (2021) argues for adopting a consistent and holistic approach, which incorporates as wide a variety of impacts as possible. This approach should improve dialogue and help to achieve agreement on project priorities and pipelines.

Conclusions on *ex-post* evaluation

Experts have identified numerous ways in which better evaluation practice could yield better *ex-ante* appraisal. However, substantial challenges exist and have meant that the potential contribution of evaluation to improved appraisal remains largely unrealised. One fundamental problem is that too little evaluation occurs. A corollary is that when evaluation does occur, it is rarely systematic.

Methods and analytical frameworks are not usually standardised, and policy makers rarely undertake cohesive programmes to evaluate significant numbers of comparable projects. This lack of cohesion is particularly problematic because evaluation lessons may vary according to project type, mode or other factors. Hence, there are few opportunities to draw conclusions based on comparisons of the results of a set of evaluations of similar projects. A related issue is that the scope of the evaluation must be appropriate. If it is too narrow, it risks failing to identify significant project impacts. If it is too broad, it can detract from the evaluation's ability to identify clear lessons. The absence of a systematic approach to evaluation increases the difficulty of making appropriate choices about scope.

Addressing these issues will only be possible with political support. This applies to enhancing the robustness of evaluation practice by providing more resources and requiring better processes, and to using the insights that better evaluation can provide. Such support is often lacking, as concern about the political consequences of negative evaluations of past projects can result in unwillingness to expand the scope and perceived credibility of appraisal.

An additional risk is that improved evaluation programmes may tend to undermine the credibility of *ex-ante* appraisals, both with decision makers and the public, by highlighting their inaccuracies. This could risk making appraisal less influential in decision making, potentially making for a less rationally-driven process. This risk can only be addressed if there is a sustained commitment to using the insights from evaluation to enhance appraisal and demonstrating the improvements made.

These factors suggest the need to better promote the benefits of improved evaluation to decision makers and, where evaluation resources and expertise remain limited, to orient evaluation efforts toward areas with the potential for them to be most influential. This could involve assessing the potential benefits and appropriate scope of a specific *ex-post* appraisal at the planning stages of each major project. Consideration could be given to the context of each project, likely changes in the background environment (i.e. independent of transport considerations), potential unforeseen changes in travel behaviour, broader economic and political trends, the level of confidence in demand forecasts and the potential importance of the evaluation on the broader policy context.

Examples of improvements to *ex-ante* appraisal resulting from the insights from evaluation and the resulting benefits in terms of better policy outcomes should also be highlighted and widely shared. While increasing the extent of evaluation activity and making better use of the data and insights derived from it could significantly improve appraisal practices and methods, the Roundtable discussion also highlighted its potential to lead to more transformative change. Rather than simply leading to incremental improvements in appraisal methods and processes, better integration of evaluation into the broader transport planning process could help to catalyse wider changes to transport planning. As discussed in the next section, the Roundtable concluded that wider changes to transport planning are essential to ensuring the achievement of the new objectives of transport policy, within the broader context of contributing to liveable cities and societal and individual well-being.

Country examples of *ex-post* evaluation

While relatively few ITF member countries evaluate the impacts of major transport investments, France, Norway and the UK provide partial exceptions.

France

Bonafous (2021) reviews French transport appraisal practice and highlights important lessons. In France, major transport infrastructure investments are evaluated systematically. Since the 1982 adoption of the *Loi d’Orientation sur les Transports Intérieurs* [Domestic Transport Guidance Law, LOTI] and its successor, the 2010 *Code des transports* [Transport Code], all projects above a threshold value (currently EUR 83 million) require an *ex-post* evaluation.

The aims of the *ex-post* reviews are to (a) inform the public on project outcomes, especially the extent and causes of any differences between outcomes and initial estimates; (b) account for the use of public funds by evaluating the effectiveness of the investments made; and (c) provide feedback to support the improvement of future *ex-ante* appraisal practice.

The evaluation process is largely independent of the entity responsible for the *ex-ante* appraisal, although, in some cases, independence is achieved by allocating responsibility to different parts of the same entity. For example, the Audit and Risks Department within SNCF Réseau (the network manager) performs LOTI evaluations for rail projects. In all cases, however, LOTI reports are supplemented by an independent opinion from the *Conseil-General de l’Environnement et du Développement Durable* [General Council for the Environment and Sustainable Development]. Most completed evaluations relate to motorway and rail projects, meaning it is only possible to draw precise, mode-specific lessons for these two modes.

Motorways

Motorway project appraisals demonstrate systematic underestimation of construction costs, with a substantial majority of the projects identified by Bonafous (2021) experiencing cost overruns. Traffic also exceeded forecasts in around two-thirds of cases. However, most of these results occurred when motorway concessions were allocated on a non-competitive basis to one of five motorway companies (four of which were government-owned). Financially unviable projects received an implicit cross-subsidy, with one of the concession holder’s current projects receiving an extension to its concession. Thus, incentives for cost control and timely delivery were lacking.

The transposition of European Community (EC) Directive 93-37 substantially changed these arrangements. The Directive abolished the protection from competition previously provided to motorway companies. Private providers can now respond to calls for motorway tenders, and an explicit subsidy regime is now in operation. The first evaluation of a project completed under the new system (the Rouen–Alençon section of the A28 motorway) showed that both costs and traffic levels were in line with initial estimates, and the rate of return was higher than predicted. However, without further evaluations, it is impossible to draw

firm conclusions on performance improvements resulting from the improved incentive structures and enhanced transparency of the new concession system. Conversely, evaluations of *ex-ante* traffic forecasts show much greater forecasting accuracy for projects completed after 2000 due to improvements in traffic modelling and, in particular, the estimation of factors determining the growth of mobility.

High-speed rail

Data from evaluations of six high-speed rail (HSR) projects in France shows that *ex-post* rates of return were, in all cases, well below those predicted in *ex-ante* analysis. In four cases, traffic levels falling short of estimates constituted a major explanatory factor, while traffic was above forecast in the other two cases. Costs were higher than estimated in all cases. However, Bonnafous (2021) shows that construction delays have contributed significantly to lower-than-expected internal rate of return (IRR) performances. Table 1 shows the delay experienced for each project (expressed as a percentage of the planned duration of the work) and the consequent percentage reduction in the IRR.

Bonnafous (2021) argues that this experience of systematic cost over-runs and delays is likely to have been a major factor in decisions to build the three most recent HSR projects as public-private partnerships (PPPs). However, France’s high public debt/GDP ratio was also likely a factor, given the limits established by the Maastricht Treaty and the exclusion of the debts of PPP entities from accountings of public debt. The recent success of PPPs for motorway construction may also have contributed. In all three projects, construction was completed on time and within budget. If this limited evidence of significantly improved on-time performance due to the adoption of more competitive bidding processes proves robust, one could expect similar improvements in the accuracy of *ex-ante* appraisal.

Permanent observatories in the road and rail sectors

Wider economic benefits also fall within the scope of the LOTI *ex-ante* appraisal requirements (and those of its successor legislation). *Ex-post* evaluations therefore also address these benefits. However, assessing whether projects delivered on *ex-ante* claims in practice proved difficult in the evaluations reviewed by Bonnafous (2021).

For example, while the *Ligne à Grand Vitesse Nord* [North High-Speed Line, LGV Nord] was expected to provide economic benefits to locations in Lille, the evaluation concluded this was “very difficult to establish”. Bonnafous notes the challenge of identifying statistics to confirm or invalidate *ex-ante* estimates. Data – especially about tariffs offered to various users at different times – is typically “fleeting” in nature. That is, if it is not captured at the time of an activity, it requires great effort to reconstruct, if this is even possible. The loss of memory of central actors is also a well-known difficulty in undertaking retrospective research.

Table 1. Commissioning delays and profitability losses in French high-speed rail projects

	Atlantique	Nord-Europe	Interconnexion Île-de-France	Rhône-Alpes	Méditerranée	Est (Phase 1)
Delay (%)	13 %	7 %	50 %	9 %	75 %	28 %
Internal rate of return loss (%)	-4.4 %	-10.0 %	-7.3 %	-2.9 %	-3.9 %	-7.2 %

Source: Bonnafous (2021).

This experience motivated the creation of permanent observatories (in French, *observatoires*) to develop expertise and record data in real time. In the 1970s, the University of Lyon opened France's first permanent motorway observatory. It began its work when two motorways (A43 and A48) were opened. The observatory monitored demographic and economic change indicators in 245 municipalities potentially affected by the motorways. The results illustrated the greater effectiveness of permanent observation compared to *ex-post* studies. They also effectively responded to the problems of fleeting data and memory loss.

The French Ministry of Equipment and motorway concession companies have since gradually expanded the number of motorway observatories, with varying success. While seen by concessionaires as important inputs to the required LOTI balance sheet, their design and operation were neither regulated nor standardised.

Bonnafous (2021) notes that several observatories developed with university teams have delivered valuable lessons. A central example, the A39 motorway observatory (1993–2004), was established at the beginning of the construction phase and continued for six years after the motorway entered service. This meant that it could obtain detailed data on the impacts on the local economy, the operation of the infrastructure, and the level and distribution of traffic. It also made it possible to analyse the effects on local production and development.

The benefits of permanent observatories for highway investments are thus well established in France, especially in identifying and assessing indirect effects. However, this is not the case for HSR investments. None of the six projects mentioned in Table 1 benefited from a permanent observatory. Conversely, the low quality of the data gathered by retrospective academic studies of these projects highlights the limits of such retrospective analysis. This strengthens the case for adopting a permanent observatory model for new HSR projects. Increased local opposition to such projects underlines the role of observatories in quantifying their benefits.

Contracts for the two most recent HSR projects required the private operators to establish and finance permanent observatories to measure their environmental and economic effects. The observatory for the Bretagne–Pays de Loire line (a PPP valued at EUR 3.3 billion) must operate for ten years from contract signing. The *l'Observatoire Socio-Économique de la Ligne à Grand Vitesse Sud-Europe Atlantique* [Socio-Economic Observatory for the South-Europe Atlantic High-Speed Rail Line, OSE-LISEA] between Tours and Bordeaux (EUR7.8 billion) runs for ten years from the line's entry into service. The OSE-LISEA observatory's longer duration reflects the view that shorter analyses cannot capture such a project's full effects. This, in turn, echoes the conclusions of many previous evaluations.

The OSE-LISEA's stated purpose is to assess the direct and indirect effects of the LGV SEA on mobility, the local economy and regional planning.² Local actors (e.g. local governments) must be able to use this work to maximise the project's benefits for the local economy and society. Such actors also contribute to national reviews and discussions on the impact of HSR lines.

As a result, the observatory involves national agencies and local partners. It is managed by a specific department of LISEA, assisted by a scientific committee comprising academics who help develop the work programme. State services and local partners participate in a monitoring committee, which validates this programme and evaluates the work. This work of OSE-LISEA is also the subject of regular feedback open to all interested local partners. It addresses a range of impacts across six major axes: construction, transport and traffic (including price effects and modal impacts), development near stations, the behaviour of local actors and organisations, urban and regional dynamics, and tourism.

Lessons from *ex-post* evaluation in France have led to clear improvements in the quality of CBA methodology. Progress can be seen, for example, in the substantial reduction in inaccurate traffic forecasts. LOTI assessments have probably favoured the use of PPPs by demonstrating considerable benefits in meeting implementation time and cost targets. That said, the small number of observations of PPPs with exclusively private operators to date necessarily limits the robustness of this result.

Bonnafous (2021) concludes that the growing number of permanent observatories has improved understanding of the economic impacts of major transport projects on the local areas involved, particularly for motorway projects. It also seems that the effectiveness of observatories in capturing and processing ephemeral data, especially price changes for different modes, will deliver new types of analyses. However, assessing the effectiveness of France’s permanent observatories will remain difficult until the publication in 2022 of the first evaluation reports produced under the legislative requirements.

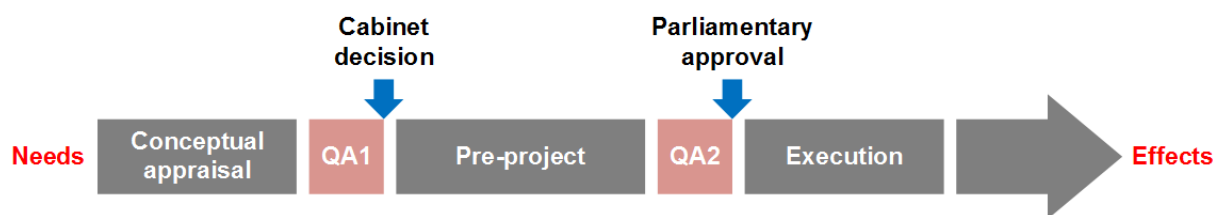
Norway

In Norway, *ex-ante* evaluation is compulsory for projects with an estimated investment cost exceeding EUR 100 million. This requirement, introduced in 2000, responded to a series of cost overruns and project failures. It is a stage-gate process that aims to ensure quality-at-entry through external quality assurance of project proposals and cost estimates.

The starting point is a conceptual appraisal by the responsible agency, which reviews the strategic case for investment and includes a CBA of different alternatives. External consultants conduct a quality appraisal (QA1) before the Cabinet decides whether to carry on with planning or not. After further planning and appraisal of the selected alternative, the full business case is reviewed (QA2). External consultants assess the quality of cost estimates and other crucial management parameters at this stage and advise the responsible department on the appropriate budget. QA2 must occur before the project is submitted to parliament for approval. The entire process (see Figure 4) helps ensure projects are sufficiently well-developed before a funding decision is made and reduces the risk of optimism bias.

Around 300 projects have been subject to this scheme, of which 120 have so far been completed (most within the budget approved after QA2). Because the strategic case is assessed at the outset, and large projects require an explicit and early political mandate, the potential for politically driven projects to obtain budget funding without being subject to proper appraisal and QA is reduced. That said, Eliasson et al. (2015) found that despite the significant emphasis placed on CBA of project proposals in Norway, CBA outcomes have little impact overall on the probability a project will be selected. They argue that the main effect of CBA may be to screen out projects with very low benefit/cost ratios at an early stage, while final project selections are more heavily influenced by other factors (e.g. regional policy considerations).

Figure 4. The Norwegian Quality Appraisal scheme for large government projects



Source: M. Welde (supplied).

Table 2. Criteria used in *ex-post* evaluations, Norway

Level of success	Evaluation criterion	Definition
Operational	Efficiency	Project implementation and performance in terms of cost, time and quality.
Tactical	Effectiveness	Whether the agreed goals have been obtained and to what extent the project has contributed to this outcome.
Strategic	Other impacts	All consequences beyond the agreed outcome that can be attributed as the result of the project, positive and negative, short-term and long-term, for different stakeholders.
	Relevance	A project is relevant if there is a need for what the project delivers. Project relevance is measured in relation to national political priorities and stakeholders' preferences.
	Sustainability	A project is sustainable if its benefits are likely to persist throughout its lifetime. The total impacts (financial, environmental and social) should be acceptable in the long run.
	Benefit–cost efficiency	Total willingness to pay for what the project delivers in relation to cost, as measured by the cost–benefit analysis.

Source: Welde (2021).

Another aspect of the Norwegian *ex-ante* appraisal system is that significant changes in project scope and external conditions often occur between QA1 and QA2. This sometimes results in projects being rejected before, during or after QA2. However, there is no formal requirement to revisit the strategic case after the initial assessment.

Projects are also subject to *ex-post* evaluation. The *ex-post* evaluation is not part of the QA scheme itself. Rather, since 2012, systematic *ex-post* evaluation has been undertaken as part of a research programme funded by the Ministry of Finance, the Concept Programme. The evaluations are based on a goal-oriented framework originally developed by the OECD Development Assistance Committee (DAC), which includes five criteria (OECD DAC, 1991). The framework has been expanded to include benefit–cost efficiency as a sixth criterion (Volden, 2018). Definitions of the six criteria are presented in Table 2.

A central feature of this evaluation framework is that it covers multiple perspectives. All evaluations are in the same format, with results summarised by applying a score for each criterion on a six-point scale. So far, 29 projects have been evaluated, of which 14 are transport projects. All are considered large-scale in the Norwegian context (i.e. cost more than EUR 100 million). The main findings of the evaluation programme to date, as summarised by Samset and Volden (2022), relate to operational, tactical and strategic success.

1. **Operational success.** Most projects receive an acceptable score on efficiency (the median score is 4 for both railway and road projects). In particular, cost performance is good in the majority of projects. There is much to suggest that the QA scheme, which requires the use of stochastic cost estimation and external scrutiny of the estimates, has improved the accuracy of cost estimates and project management practices. A study of 78 completed projects subjected to external quality assurance (Volden, 2018; Welde, 2017) confirms these promising results.
2. **Tactical success.** Tactical project success, as measured by effectiveness, was high for road projects (median score 5) whereas the four railway projects performed less well (median score 3). This is partly explained by the fact that some road projects have trivial goals (e.g. increased mobility as measured by time savings). Rail project goals, by contrast, have been over-ambitious, with goals

related to improved rail competitiveness and a green shift in the transport sector. The latter type of goals have not generally been reached, and evaluations suggest that achieving them would have required greater efforts from the railway authorities, undertaken as part of a wider strategy.

3. **Strategic success.** Four criteria measure the strategic purpose of the project. The results show that strategic success is multi-dimensional and that a project may score well on one criterion and not on another. Most transport projects were rated as acceptable in terms of *other impacts* because they had no major positive or negative external effects. Some could have done more to avoid negative side-effects on nature and the local environment. Only one project, a subsea road tunnel, clearly indicated wider economic benefits. On *relevance* and *sustainability*, both railway and road projects performed well. In particular, the railway projects were well aligned with the government's strategy for sustainable transport. The infrastructure was also considered to have sufficient capacity within planned lifespans (40 to 75 years). However, in some cases, evaluators suspected that other, more relevant (at least more cost-efficient) solutions to the problem existed (e.g. more effective route choices for some railway projects).

On *benefit–cost efficiency*, as measured by the CBA, road projects generally scored better than railway projects in the sample. The road projects all generated higher traffic volumes and lower accident frequencies, while the investment cost was approximately on budget. Generally, most road projects had better benefit–cost ratios than estimated *ex-ante*. In several cases, the ratio was greater than 1 in the *ex-post* evaluations, in contrast to *ex-ante* estimates of ratios less than 1. By contrast, all four rail projects showed low benefit–cost efficiency, and their *ex-ante* CBAs seem to have been subject to systemic positive bias. However, the shadow carbon price used in CBA was relatively low, meaning that the monetised benefits of a modal shift (if achieved) would be moderate at best. Notably, the low benefit–cost efficiency for some projects (especially rail) was known by decision makers *ex-ante*. This indicates that the results of the *ex-ante* CBA had not been crucial to project selection.

Norway's overall experience with the generic six-criteria evaluation model is positive. The model implies a broader perspective on project success than value for money as measured by the CBA. This is expected to encourage planners to focus on a wider set of strategic issues at the project selection stage. Moreover, the systematic evaluation of many projects using the same model will, over time, lead to the development of a large database that can be used to determine whether estimates made *ex-ante* are systematically biased and as a basis for improving estimation tools and methods.

The United Kingdom

The National Highways (previously Highways England) post-opening project evaluation (POPE) programme, and National Audit Office (NAO) reviews are two examples of *ex-post* evaluation in the UK.

Post-opening project evaluations

National Highways and its predecessor organisations have carried out the POPE programme for more than 15 years. Under the programme, analytical reviews to evaluate the impact of infrastructure schemes or programmes occur between one and five years after a project opens to traffic. National Highways describes them as an early mechanism to ensure the project is on track to deliver the anticipated benefits over its lifecycle (typically 60 years).³ All projects on the strategic road network with a value of more than GBP 10 million are evaluated. The POPE process aims to assess whether schemes deliver the anticipated

value for money; validate the accuracy of the estimated scheme costs, impacts and benefits identified in the business case; use the *ex-post* impact assessment to improve future appraisals; and promote transparency and accountability to stakeholders.

A recent review of POPE (Hyperion 2020) found that its highly standardised review format and clear focus have significantly increased its impact. The clear link between the *ex-post* evaluation and the *ex-ante* project appraisal provides a high level of transparency, particularly as evaluations are routinely published. The publication of the methodology used to conduct a POPE (Highways England 2022) also contributes to the transparency of the process. The evaluation is also conducted using the same methodology as the *ex-ante* evaluation, despite any changes in methodology adopted in the interim. Another feature of the programme is that independent “meta reports” are produced periodically to identify and analyse trends across the programme as a whole, thus potentially deepening the insights gained.⁴

The National Infrastructure Commission has concluded that the POPE programme has led to more accurate *ex-ante* project appraisals (National Infrastructure Commission 2018). A major recent change to the design of the POPE programme was the move to conduct evaluations within National Highways itself through a dedicated Evaluation Group. This has allowed the organisation to retain knowledge and conduct longer-term, thematic and programme-level evaluations (Hyperion 2020). In recent years the programme has also adopted a wider view of benefits, moving away from its previous focus on direct user benefits (e.g. travel time savings and accident costs). This occurred in the context of the adoption of a new Benefits Management Process, which also includes an early identification of essential data needs for evaluation purposes, as part of a new Benefits Realisation and Evaluation Plan. The review found the new process has improved the scope, governance and quality assurance of evaluations (Hyperion 2020).

National Audit Office reviews

While NAO reviews focus on value for (public) money, they contain a broader set of *ex-post* evaluations of projects (and, in some cases, programmes). The NAO has also undertaken strategic analyses, which seek to leverage the knowledge acquired by undertaking many such reviews over an extended period. The NAO has published reports on strategic topics, including optimism bias, quality assurance, and lessons learned from major rail infrastructure programmes. It has also developed a framework for reviewing major programmes (NAO, 2021), a tool for understanding the challenges in delivering project objectives and a guide for senior managers on challenging project costs. A recent synthesis report identified lessons from its reviews of major expenditure programmes (NAO, 2020) derived from eight specific insights (see Box 3).

Box 3. National Audit Office insights on major programme management

1. Ensure that the programme’s scope clearly aligns with its strategic objectives.
2. Understand the limits of cost and schedule estimates.
3. Critically examine and be realistic about the schedule.
4. Develop detailed plans to achieve anticipated savings.
5. Ensure interdependencies are identified and managed.
6. Consider operational planning from the start.
7. Ensure that programme management changes as the project develops.
8. The importance of transparency and honesty in major programmes.

The need for wider reform of transport planning

The previous section identified a range of potential improvements to appraisal methods, some of which are increasingly being adopted in practice, while others remain relatively little used. Roundtable participants agreed that, while these were valuable in themselves, a broader response to the changing objectives of transport policy is required. This should extend beyond project appraisal to encompass the entire transport planning process.

Improved project appraisal cannot change outcomes if the right projects are not selected for appraisal. This highlights the importance of ensuring that project identification reflects, or responds to, the changing objectives of transport policy. Improving the way problems are framed in light of broader policy objectives, and identifying project alternatives in line with these broader framings, are therefore critical steps before embarking on typical appraisal processes.

Addressing this issue in the specific context of accessibility and equity, Shiftan et al. (2021) argue: “An alternative to the traditional approach to transport planning would take equity seriously from the very start of the transport planning process”. This would align the transport planning process more closely with practices in other core government policy fields (e.g. healthcare, education and housing). Improving the way projects are reviewed against broader policy objectives in the initial “needs case” is therefore critical.

Extensive stakeholder engagement is crucial to achieving broad understanding of, and support for, a new set of transport policy objectives focussed on accessibility, equity, decarbonisation and urban liveability. This engagement is especially important given the extent of the change involved. The expected result is a substantial move away from the decades-long predominance of investment in road infrastructure.

Broadening transport appraisal alone is not enough; the scope of decision making must also be broadened. This requires an improved understanding of the issues that transport planning seeks to address. It implies that appraisal processes should be multi-staged and timed to begin early in the planning process, with an initial needs assessment. This needs assessment, in turn, needs to be linked to and consistent with the approaches taken in subsequent stages.

The role of strategic planning

Explicitly adopting a strategic planning process is likely to facilitate and accelerate changes in transport planning objectives. A recent ITF Working Group report, *Developing Strategic Approaches to Infrastructure Planning* (ITF, 2021a), recommended that governments adopt strategic approaches to infrastructure planning and communicate them clearly via an explicit, detailed and periodically updated strategic infrastructure plan. It noted the increasing use of independent advisory bodies to provide transparent, expert advice on long-term policy and planning, and reduce instability in the planning process due to short-term political considerations. It also recommended that governments consider establishing such bodies as a low-cost and effective means of improving and complementing existing processes.

An example of a strategic planning approach at the metropolitan level is Tel Aviv’s 20-year Strategic Plan (Tel Aviv–Jafo Municipality, 2017; see also Box 1). As noted above, the plan uses a broad range of explicitly established criteria and sub-criteria, with explicit weightings, to assess investment options using an MCA. Policy makers set the goals, criteria, and weights (Shiftan et al., 2021). Strategic plans encourage a co-ordinated and consistent approach to transport infrastructure investment that reflects long-term

objectives and priorities. This is likely to yield better outcomes than a simple aggregation of project-by-project appraisals, especially when moving towards a new and broader set of transport planning objectives.

Strategic plans must be reviewed and updated periodically to ensure their continued relevance and consistency with public policy priorities. Strategic infrastructure plans should also be linked to explicit infrastructure funding envelopes. This helps ensure that they can be delivered, that conscious and soundly based priority setting is undertaken, and that project pipelines are at least broadly identified. There should also be clear linkages between strategic infrastructure plans and individual project selection processes.

The wider use of strategic planning also poses implementation challenges, including building public support for the strategic plan's objectives. Even with substantial stakeholder engagement, extreme divisions between stakeholders and the public regarding long-term future visions may persist. Opinion polling over time often demonstrates large medium-term shifts in the public's expressed policy priorities. This further complicates the task of developing a plan that can be maintained and delivered over a long time horizon.

However, it is likely that a “virtuous circle” may exist in this regard. That is, sustained engagement efforts should yield progressively better results over time, as stakeholders become better informed and more familiar with the dynamics of the consultation process, and gain more confidence that decision makers address their inputs. Convincing the public of the need for major strategic initiatives minimises objections based on so-called not-in-my-backyard (NIMBY) responses. However, doing so means explaining problems rather than simply focusing on proposed solutions.

The “design–announce–defend” model is poorly adapted to the task of convincing the public of the need for major initiatives, and recent years have seen a more general move towards more participative decision making across much of Europe and, to some extent, in the United States. Such participation is increasingly seen as a condition of legitimacy in decision making.

Despite the difficulties of ensuring high levels of stakeholder support for strategic plans, some experience shows that this can be a crucial factor in ensuring support across political parties. This support increases the chances that long-term projects will retain support and continue to be developed despite changes of government. To take one example, the development of the Grand Paris Express project included extensive stakeholder engagement, notably with the mayors of disadvantaged municipalities. The project design was modified to give priority to completing lines serving these areas over other project elements with higher benefit–cost ratios (e.g. the transversal line linking the two Paris airports). While this suggests that greater weight was given to factors other than direct user benefits, the widespread support for the project saw it survive a global financial crisis and a change of president and governing party (ITF, 2017b).

It is also essential to highlight the links between transport investment and land use in the strategic planning context. The ITF has previously argued that a critical factor in effectively addressing accessibility objectives is ensuring that changes in land use and transport planning are co-ordinated and mutually supportive (ITF, 2020a). One approach involves developing a comprehensive land-use and transport strategic plan, incorporating high-level objectives, setting broad policy directions based on these objectives, and identifying relevant quantitative indicators.

Identifying a needs case is a central aspect of strategic planning in relation to project identification, appraisal and selection. The needs case determines the criteria for justifying a decision to undertake an investment. Figure 5 describes current Norwegian practice in this respect. The investment decision is predicated on an assessment of long-term user benefits and wider economic impacts. Longer-term

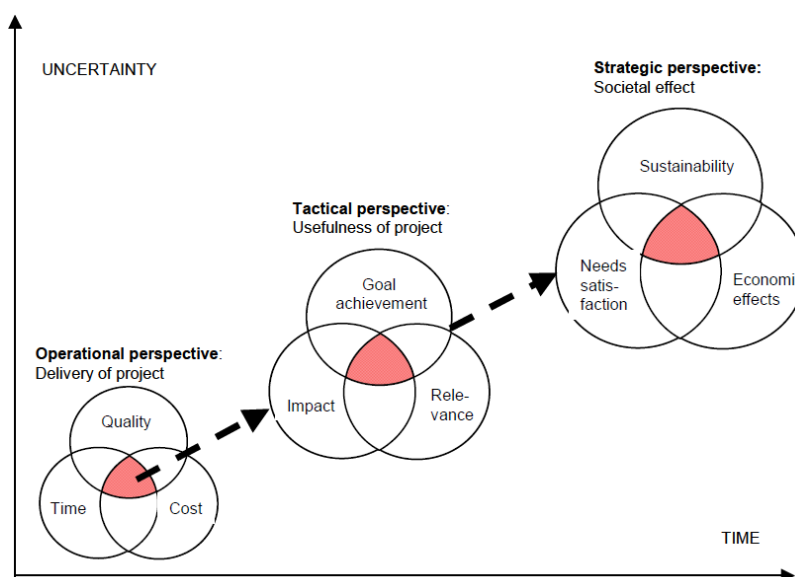
impacts on strategic objectives such as sustainability also constitute a vital part of the assessment. Of note is the explicit acknowledgement of the increasing importance of uncertainty as the time horizon extends.

Many project failures stem from decisions made in the project planning phase (Morris, 2011; Edkins et al., 2013). Norway’s experience provides clear evidence that robust planning and preparation in the early stages of a project’s lifecycle are essential for successful delivery. *Ex-ante* appraisal in Norway is based on a staged process that aims to ensure that proposed projects solve real problems, meet the needs of users and other stakeholders, and deliver value for money. Norway’s assessment process, like the “five-case model” in the UK (discussed below) incorporates a significant focus on the strategic case for the project, in addition to the narrower CBA-based value for money assessment.

A standardised model for *ex-ante* appraisal, combined with an external review, sets out the requirements that must be met for projects and programmes to continue to be developed. Norway has assigned resources to developing uniform data sets for estimating costs and benefits, better enabling comparisons across projects and sectors. This helps to identify and eliminate poor-quality proposals at an early stage and reduces the tendency for assessments to suffer from optimism bias.

However, a lengthy project development process can lead to increasing expectations from stakeholders and escalation of commitment by decision makers. In other words, there may be a tendency to justify a project proposal even if new evidence suggests that the project may be economically and strategically unsuitable. This can mean that final approval becomes inevitable: once large projects gain momentum, they may be almost unstoppable. Moreover, once the investment decision has been taken, the scope for making changes is limited. Therefore, the choice of conceptual solution is the most crucial decision in the process. Evidence from Norway shows that most projects subjected to early conceptual appraisal are implemented sooner or later, regardless of the results of subsequent value-for-money analyses. This suggests a need for intervention before the responsible agency commits funds, to identify schemes unlikely to either satisfy needs cost-efficiently or meet strategic objectives (Edkins et al., 2013).

Figure 5. Assessment of transport infrastructure investments in Norway



Source: Welde (2021).

The requirement to justify proposed investments against a broad range of strategic policy objectives has a long history in the UK. For example, in 2000 the UK Department for Transport (DfT) released its ten-year transport plan. The transport planning objectives identified in the plan included contributing to industrial competitiveness, boosting regional economic development, enhancing access and opportunity in rural areas, reducing social exclusion and lessening the impact of transport on the environment (DfT, 2000). Implementation was to be guided by a series of multi-modal studies, conducted according to the following principles of transport appraisal, which reflect the underlying strategic objectives:

- clear definition of the transport problem, formulated in terms of all relevant transport objectives
- clear exposition of the transport objectives relevant to the project proposals
- a multi-measure and multi-modal focus, to replace a “road-building mentality”
- exploration of reasonable alternatives, including identification of synergies between components, in preference to “obvious solutions”
- enhanced stakeholder involvement.

This approach was also applied at the local level, where authorities were placed under obligations to deliver an integrated transport system via local transport plans. Funding requests for major public transport or road schemes needed to include evidence that they were necessary to achieve the objectives of the applicable plan and that those objectives could not be achieved in other ways. Schemes were also to be integrated with measures to promote modal shift, and consider the scope for alternatives to major construction, including demand management (European Conference of Ministers of Transport, 2004).

As an early example of a strategic plan, the DfT plan was not linked to an explicit budget constraint. By contrast, the programme of priority infrastructure investments recommended in the National Infrastructure Commission’s 2018 National Infrastructure Assessment was based on the indicative funding envelope (of 1.2% of GDP per annum) identified by the British Government (ITF, 2021a). Further reforms to the UK’s transport appraisal processes led to the adoption of the “five-case model”, which requires an analysis of all proposed investments in terms of a five-part business case (HM Treasury 2018).

The content of the five cases is directly relevant to effective project appraisal, selection and delivery. However, a proliferation of analytical requirements risks obscuring core messages and reducing decision makers’ ability to assimilate the information provided and focus on vital strategic considerations and trade-offs. This risk was countered by establishing a requirement to prepare a summary appraisal table (see Table 3 for an example) to present the main results of CBA and other dimensions of appraisals side by side. The table also includes commentary on aspects of the project that support or run counter to the overall strategic objectives of the government of the day and highlights critical trade-offs.

The summary table approach, which is also recommended in Israel’s appraisal guidelines, has important advantages as a tool for communicating with decision makers and stakeholders. In contrast to summarising performance against all dimensions via MCA weightings, it enables the performance of each option on each of the four performance dimensions to be seen at a glance, with separate reporting of the scores for impacts expressed in monetary, other quantitative, and qualitative terms, as well as a distributional impact score.

Table 3. An example of an appraisal summary table

Impacts	Summary of impacts	Assessment			
		Quantitative	Qualitative	Net present value	Distributional (7pt scale)
Economic Business users, transport providers, reliability impact, regeneration, wider economic benefits					
Environmental Noise, air, greenhouse gases, landscape, townscape, historic environment, biodiversity, water					
Social Commuters and other users, reliability impact, physical activity, journey quality, accidents, security, access, affordability, severance, option/non-use values					
Public accounts Cost to transport budget, indirect tax revenues					

Note: Scores for each sub-heading are presented separately in the original table. They are presented together here for reasons of legibility.

Source: Adapted from <https://www.gov.uk/government/publications/webtag-appraisal-tables>.

The summary table format enables an assessment of the overall performance of the proposed investment against the core elements of the original needs case. This allows updates to the needs case to incorporate new data or changes to the scenario(s) on which it was originally based. As Welde (2021) notes, in Norway, the initial project appraisal decision judges the project's likely success in terms of the business case. This business case identifies all the project goals, rather than the (less comprehensive) CBA. A well-structured summary table can facilitate this process, ensuring that decision makers focus on the overall strategic rationale when deciding whether to proceed with investments.

Decision processes and transport planning practice

As part of the discussion of the need for broader reform to transport planning processes, the Roundtable discussed the fitness for purpose of the decision models used in transport planning and how these could be reformed to support better outcomes. The central challenge is the extreme complexity of the decision

environments for most major transport infrastructure projects. Cascetta and Carteni (2021) cite Rittel and Weber (1973), who characterise the problems of social policy as “wicked problems”, to which there is no definitive solution:

The search for scientific bases for confronting problems of social policy is bound to fail, because of the nature of these problems. They are “wicked” problems, whereas science has developed to deal with “tame” problems. Policy problems cannot be definitively described. Moreover, in a pluralistic society there is nothing like the undisputable public good; there is no objective definition of equity; policies that respond to social problems cannot be meaningfully correct or false; and it makes no sense to talk about “optimal solutions” to social problems unless severe qualifications are imposed first. Even worse, there are no “solutions” in the sense of definitive and objective answers. (Rittel and Weber 1973)

Cascetta and Carteni (2021) argue that these characteristics mean that such problems entail a high probability of planning failure. Technical limitations and errors, which constitute one cause of these failures, can be at least partially addressed by methodological and process improvements. However, a second fundamental cause of failure is uncertainty about key input variables such as demand behaviour parameters, the project context (including political cycles) and the attitudes of major stakeholders. These issues are partly outside the control of transport planners. At the same time, a high-quality planning process must recognise their importance and act to minimise the risks they pose to planning outcomes.

Approaches to stakeholder engagement constitute a central factor. Major transport investments, in common with other large infrastructure projects, typically involve a diverse range of stakeholders with a wide range of perspectives and objectives. Moreover, as Cascetta and Carteni (2021) note, some stakeholders (e.g. officials from the area in which a project will be built) typically hold a degree of veto power. Stakeholder opposition is therefore a substantial risk and a major cause of planning failures, rendering the “decide—announce—defend” approach to decision making unfit for purpose, or at least highly risky. Thus, decision-making styles that incorporate effective and sustained stakeholder engagement are likely to reduce the risk of such failures substantially. The need to obtain consensus on pursuing a substantially modified set of transport planning objectives further underlines this point.

The technical rational decision-making model

Transport planning is dependent on both technical elements and societal responses. This poses the problem of ensuring that decisions reflect both an adequate degree of “technical rationality” and an acceptable level of stakeholder consensus. Cascetta et al. (2015) argue that many of the problems in transport planning are related to the gap between the traditional technically based approach and the nature of real-life decision-making processes. As a result, “Transport-related decisions can be a-rational or ‘sub-optimal’ with respect to stated, formal objectives and still ‘rational’ in the context of a wider and less defined set of contrasting objectives including maximizing consensus and/or minimizing opposition to proposed solutions” (Cascetta et al. 2015).

Much of the research literature on decision making under uncertainty adopts a four-part taxonomy of uncertainty types and levels (see Table 4). Transport planning decision processes should take account of this taxonomy to maximise the probability of delivering good decisions about which set of potential transport investments to adopt. Cascetta and Carteni (2021) propose that good decisions address widely recognised problems or needs; do so effectively and efficiently; have widespread support, or at least acceptance, among decision makers; and be based on the best available information on the expected impacts of the decision options.

Table 4. A taxonomy of uncertainty in decision making

Level	Description
1	Futures are essentially predictable, either because the time horizon is a short-term one or because the evolution of the system can reasonably be anticipated.
2	There are a limited number of possible futures to which occurrence probabilities may be attached.
3	A large number of possible futures does not allow for the calculation of relative occurrence probabilities.
4a	There is a potentially infinite number of possible futures, with outcomes lying between extreme values.
4b	There is no information at all (i.e. the completely unknowable future) and not even the direction of future key variables may be known.

Source: Cascetta and Carteni (2021).

Decision-making processes should also deliver rational decisions. However, the uncertainties highlighted above, including questions over stakeholder responses, imply that strictly rational decisions, in the technical sense, may not be achievable. Recognising this, Cascetta et al. (2019) propose that rational decisions, in such contexts, are those that are:

- consistent, both internally (not contradicting the stated objectives and existing constraints), and externally (non-conflicting with decisions taken in other interacting contexts or at different moments in time)
- comparative, considering more than one alternative (including the option of “not deciding” or looking for other possibilities not yet included in the choice set)
- aware, based on information about the options, the context and their likely impacts whenever knowable
- flexible, open to changes due to new information on alternative options and their effects, to changes in the economic, physical, and institutional contexts, and taking into account “decision opportunity costs” (i.e. postponing unnecessary decisions).

Recognising that major, long-term infrastructure investments are subject to major uncertainties has implications for the type of decision-making model, or set of processes, that should be adopted in order to maximise the quality of the resulting decisions.

Cascetta and Carteni (2021) note that strongly rational models implicitly assume stable preference functions and constraints and expect economic actors to choose utility or profit-maximising courses of action accordingly. Such models require a unique system of preferences to order the possible alternatives (typically identified via CBA-based processes) and are strongly sequential in process terms. They can be applied where there are low levels of uncertainty regarding impacts, all alternative options can be identified and analysed effectively, and decision-making power is located at a single point, or within a small cohesive group.

However, this model comes under pressure as problem complexity arises. It may be impossible to comprehensively analyse large numbers of alternative options or achieve sufficient consensus among stakeholders with varying or conflicting objectives and the ability to exercise a veto. As uncertainty rises through the levels identified in Table 4, the problem becomes progressively more acute. A large proportion

of major transport decisions are made using this model. In such circumstances, transport planning decisions have a high risk of planning failure.

Formal project identification, appraisal and selection processes in most developed countries largely reflect the strongly rational model described above. However, many of the most important decisions they inform, especially in relation to major, long-term transport infrastructure investments, are taken in contexts characterised by high levels of uncertainty and complex stakeholder environments. A modified decision process, operating according to a different decision logic, could yield better planning outcomes in such circumstances.

The cognitive or multi-stage rational decision-making model

Cascetta and Carteni (2021) propose a “cognitive” or multi-stage rational decision-making model, which is iterative in nature, in response to this problem. The essence of the model is to capture the dynamic nature of the decision process by dividing it into sequential decision stages and delaying decisions where sufficient data, agreement or both may be lacking. The model draws on the learning theory of dynamic decision-making processes. It is fundamentally a multi-step decision-making process, with each decision based on monitoring and evaluating the outcome of the previous decision step. The model responds to the uncertainties inherent in the transport planning process by reducing the opportunity cost of ill-informed decisions and providing enhanced opportunities to build larger coalitions via stakeholder management at the sequential decision stages.

The model is “cognitive” in that it depends substantially on the learning undertaken by the actors during the process about the effects of prior decisions, what objectives are achievable in practice and to what extent, and what possible trade-offs exist. It remains “rational” to the extent that the four conditions for rational decision making identified in Cascetta et al (2019), and cited above, are met.

A central element of the model is that stakeholders are involved in all process stages. Cascetta and Carteni (2021) argue that:

. . . it’s important that stakeholders are involved at the beginning of the “planning stage” where problems, objectives, constraints and the “rules of the game” are discussed before any specific proposal/evaluation is considered.... [They benefit from]...the “learning process” as the decision-making process develops within stages and between stages and in doing so they develop a sense of participation and commitment to the choices made that legitimates the process and stabilises it with respect to changes in political and/or context changes (reduces context related uncertainty levels).

This engagement extends as far as participating in defining and choosing between options. At each stage of the process, planning scenarios are formulated and assessed, in both technical terms and in terms of judgements regarding the degree of support or opposition among participating stakeholders.

Technical analyses can be based on different techniques, with the choice of technique(s) at any given time being based on judgements as to the level of (un)certainty that exists with respect to key variables. Thus, if high levels of uncertainty (i.e. level 3 or level 4 in Table 4) are identified, techniques such as scenario discovery or approaches based on regret theory may be used. Engaging stakeholders in this context allows the risk attitudes of the communities involved to be taken into account in decision making. It also provides opportunities to convince communities of the need for major initiatives, thus helping to avert NIMBY dynamics. This is likely to constitute a major advantage of the model, when contrasted to processes based on the design–announce–defend paradigm.

A significant element of the process is therefore the interaction of decision makers, officials and experts in planning activities, as informed by the combination of the results of technical analyses and stakeholder values and expectations. Fundamentally, the model is based on the three connected elements of technical assessment, process management and public engagement. The central role of public engagement implies that appraisals must identify and model all impacts relevant to stakeholders and that the results of analyses must be presented in ways that they understand readily.

The iterative decision process will therefore continue until decision makers are sufficiently confident that the conditions for success have been met in respect of each of the three connected elements. That is, there must be:

- adequate information to underpin confidence in the results of the technical assessment
- a sufficiently robust and detailed planning process (both technical and in terms of stakeholder engagement) to be generally regarded as legitimate
- confidence that there is a sufficiently broad and durable consensus in favour of the project among major stakeholders as to minimise the risk it will subsequently fail due to the withdrawal of consent.

Cascetta (2021) identifies several lessons, or success factors, in the practical application of the model, based on the experience of its application in the development of the Regional Transportation Plan of Veneto, Italy. These are:

1. The support of an efficient and committed regional administration is critical to the successful implementation of the model.
2. The high level of stakeholder engagement implies the need for a regional community accustomed to participation in such processes and comfortable with them.
3. The stakeholder engagement process is likely to be useful in helping identify additional sources of uncertainty that were not visible *a priori*, as well as some potential solutions to these other problems.
4. Objective distinctions between variants and options can be useful in defusing conflicts about specific choices, and enabling the deferral of some decisions until more complete information can be obtained and analysed.
5. The long-run/short-run and variant/option framework allowed the regional administration to be more flexible, and the plan more robust, with respect to the relatively high levels of uncertainty recognised at the outset.

In sum, the cognitive, rational model proposed by Cascetta and Cartegni (2021) responds to the major causes of transport planning failures in four main ways. First, it implies expanding the range of analyses undertaken during the process, and fitting the choice of analytical tools used to the project context – notably the time horizon involved and the associated nature and extent of uncertainty regarding critical variables. The scope of the analysis undertaken must include qualitative variables such as the degree of consensus in favour of different options.

Second, stakeholder engagement is a core element, at all stages of the planning process, with stakeholders having multiple roles. Third, the model incorporates multiple feedback loops as a core element. It formally acknowledges that decision making in the presence of high levels of uncertainty and long project timelines should be a multi-stage process and that prior decisions may need to be revisited in the light of new information.

Fourth, the changed nature of the decision model – notably its features of multi-staged or iterative decision making and sustained stakeholder engagement – implies that the role of quantitative data must expand beyond those it plays in traditional decision-making contexts. There should be a focus identifying and modelling the impacts of high relevance to stakeholders, together with presentation and explanation of results for non-experts. Assessment methods that allow the more effective evaluation of impacts such as levels of vertical and horizontal equity and the degree of consensus should be used. In addition, the model's explicit recognition that many crucial decisions are taken in a context of high levels of uncertainty implies the need to adopt new assessment tools, such as scenario discovery and minimal regret analyses.

The authors propose the model as an alternative to the strongly rational model, based on the primacy of CBA and embodying a design–announce–defend approach. They argue it is appropriately used where there are high levels of uncertainty regarding technical variables and the level of stakeholder support. This is often the case when decisions on major, long-term transport investments must be made.

Arguably, adopting the cognitive rational model would largely have the effect of formalising and make some existing dynamics of the transport planning process more predictable. That is, while the strongly rational model formally constitutes the basis of project appraisal and choice, it is widely acknowledged that political decision makers frequently make choices other than those the model recommends. This is typically because they perceive and seek to avoid the political problems that strict conformity to its dictates would cause. In particular, elected decision makers will necessarily be sensitive to the views of core stakeholders, at least where the issue in question may have wider ramifications.

Welde and Volden (2021) note that, in practice, decision makers are often more interested in impacts other than those that are central to CBA. For example, local and regional impacts are often considered paramount, even though they frequently constitute transfers between regions rather than net economic benefits to the economy as a whole. Thus, a central property of the cognitive rational model is arguably that it formalises the use of political rationality as a factor in appraisal and decision making, along with economic rationality. By more formally accommodating political dynamics, the use of the model could thus tend to favour more rational outcomes.

Conclusions and recommendations

Conclusions

The strategic objectives of transport planning are undergoing fundamental change. The previous focus on ensuring high levels of mobility is shifting towards an accessibility-based approach that emphasizes the importance of social, regional and gender equity. At the same time, the imperative of responding to climate change means that decarbonisation and enhanced infrastructure resilience are increasingly important objectives, while climate change policy also contains an increasingly prominent social justice focus. Finally, the decarbonisation imperative combines with greater focus on the liveability of major cities and increased awareness of the health impacts of different transport choices to make achieving a shift towards public and active transport a core objective. Growing recognition of the need to take account of the complex interactions between transport and land-use planning increases the complexity of the planning task in both areas.

There is also increasing recognition that the transport planning process, at least in relation to large-scale, long-term infrastructure projects, has long been subject to a high probability of failure. In many cases, projects are abandoned or substantially modified after extensive development and expenditure, while numerous completed projects fail to deliver the full anticipated benefits.

The combination of these factors points strongly toward the need for substantial changes to transport planning and appraisal practice. Numerous opportunities exist to expand and improve the specific methodologies and processes employed in transport appraisal in ITF countries. However, changes to specific methodologies will not be sufficient to address the identified challenges to transport planning. Instead, a broader set of reforms is needed to improve both the appraisal process and the wider practice of transport planning.

Governments and transport planners should adopt a strategic approach to assess the ability of transport investments to contribute to achieving long-term policy objectives, in addition to their specific, project-level impacts. This is most likely to be achieved if governments adopt long-term strategic plans that explicitly identify and explain these objectives and their inter-relationships.

In addition, the decision-making processes by which projects are identified, assessed, and chosen should not lose sight of the overall transport and broader policy objectives the investment is intended to advance. This means that they should recognise the high level of uncertainty that typically exists in relation to long-term infrastructure decision making and the fundamental importance of processes to achieve a high level of agreement among stakeholders on the objectives and means of achieving them.

Recommendations

Develop long-term strategic plans that explicitly identify transport policy objectives

Strategic plans should explicitly identify crucial long-term objectives, explain their importance and set out the major directions of policy and investment required to achieve them. Explicitly stating these objectives can help ensure the appraisal of individual projects systematically accounts for broader strategic orientations. This is especially vital as a wider range of objectives – including accessibility; social, regional and gender equity; decarbonisation; and infrastructure resilience – assume increasing importance and urgency.

Ensuring an adequate level of support for the objectives and orientations of the strategic plan is essential. This is often difficult to achieve due to the widely differing objectives and priorities of different stakeholder groups. Thus, consistent engagement, based on transparency, adequate data and information, and responsiveness to stakeholder inputs, is crucial. Revising strategic plans at regular (but infrequent) intervals helps ensure their continued policy relevance.

Broaden project appraisal to ensure its processes and practices take account of all transport policy objectives, as embedded in strategic infrastructure plans

Performance in relation to many of these additional objectives can be assessed effectively through enhanced CBA, using a range of indirect valuation techniques and recent methodological innovations. CBA guidance and practice should require the adoption of these broader approaches. Aggregate CBA should be supplemented with a disaggregated appraisal of project costs and benefits on population groups of concern because of income, gender, location or other factors. However, additional analytical tools can yield further insights in many cases, and should be adopted as required.

Incorporate accessibility indicators, or other relevant tools, to assess equity impacts in transport project appraisals

The increasing focus on accessibility as transport policy's fundamental objective means that appraisals should incorporate purpose-specific measures to ensure accessibility and any other relevant dimensions of equity are clearly identified and effectively assessed. The methods adopted should be chosen for their ability to clarify the specific issues at stake.

Provide detailed guidance on appropriately accounting for climate-change impacts in appraisal, incorporating clear linkages between shadow carbon prices and emissions reduction commitments

CBA can constitute a robust methodology for addressing climate-change impacts during appraisal. However, its ability to do so depends on ensuring all relevant impacts are incorporated in the analysis and using appropriate shadow prices. In particular, it is critical to ensure that recent moves in some countries to ensure shadow carbon prices reflect realistic estimates of the cost of meeting emissions reductions agreements over time are widely adopted. Social willingness to pay measures must also be incorporated in the analysis. Addressing resilience requirements for new and upgraded infrastructure in the light of expectations about future extreme weather is another core requirement.

Present the results of transport project appraisals in a transparent and concise format that highlights needs-case assessments

The results of broader project appraisals that assess performance against a wider range of policy objectives cannot readily be expressed in terms of a single metric. Decision makers and stakeholders will necessarily

differ as to what impacts are important and what weights should be attached to them. This implies that, to support well-informed discussion and decision making, appraisal results should be presented in a multi-dimensional format that separately presents the performance of potential projects across different measures, and in terms of different underlying policy objectives.

Multi-stage appraisal processes are widely used in assessing transport investment and are necessary to examine all the dimensions relevant to the decision to invest. However, periodic review and streamlining of procedures is recommended to counter any loss of focus on the needs case at the outset. This most strategic part of the appraisal must be protected from the risk of becoming simply a preliminary exercise in CBA that sees added detail in successive rounds of assessment of economic, financial and business cases. The results of the needs-case assessment and the summary appraisal report are the most important elements of effective communication of meaningful results to decision makers. Preserving this focus is as important as innovating with new methods of assessment.

Ensure decision-making processes for large investments in transport systems account for the uncertainties involved and the need for broad stakeholder support

Major, long-term infrastructure investments are subject to high levels of uncertainty, much of which is exogenous to the transport planning process and so not susceptible to being treated via improvements to appraisal processes or methods. This uncertainty, combined with the critical need to ensure adequate stakeholder support for major projects to enable them to proceed, constitutes a major cause of transport planning failures. Ensuring that decision-making processes are properly adapted to these critical environmental factors can help to avoid transport planning failures and support the timely delivery of projects that contribute to strategic transport policy objectives.

For such investments, the decision process should be multi-staged, with feedback loops ensuring the results of monitoring and evaluation of the outcomes of previous decisions are systematically incorporated into subsequent decisions. Stakeholder engagement should commence at the early stages of the process and be maintained throughout. Adequate information should be provided, while stakeholders should be seen as vital sources of information and potential problem-solving resources, rather than as interest groups whose consent is required to realise plans. Scenario analysis should be adopted as part of the appraisal, to provide decision makers with a sophisticated understanding of the implications of the different uncertainties identified.

Integrate technical assessment, process management and public engagement in decision processes for major transport infrastructure investments

Effective stakeholder engagement can significantly reduce uncertainty in complex, long-term infrastructure investment projects, both by acting as a source of additional information and insight into policy options during project identification and appraisal and by increasing the level of support for, and legitimacy of, project decisions. Successful stakeholder engagement requires careful process management, ensuring that all relevant voices are heard and discussions are as fully informed as possible. The results of technical assessments should be made available promptly and effectively communicated to non-technical audiences. Integrating these three elements of the decision process will help ensure that decisions meet efficiency, equity, and other underlying objectives and enjoy broad support, thus enabling them to be implemented effectively and without unnecessary delay.

Undertake systematic *ex-post* evaluation for all transport infrastructure projects entailing expenditure above an identified level

Ex-post evaluation can contribute significantly to improving appraisal methods over time. Increasing the currently limited number of evaluations and moving to standardise the methods and processes is essential to ensure these gains are realised in practice. Ensuring evaluations cover a sufficiently long period to enable longer-term impacts to be identified and weighed is also essential to evaluation quality. Evaluations should be conducted by entities independent of project sponsors or stakeholders.

Consider the merits of the permanent observatory model as a means of maximising the quality of evaluations

Meeting the substantial data requirements is a major challenge when conducting evaluations. The fact that much data is fleeting in nature, and difficult or impossible to obtain *ex-post*, underlines this problem. Permanent observatories, established at or soon after project inception, appear to be a promising means of addressing this and other quality control issues and maximising the value of evaluations of larger infrastructure projects.

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Notes

1 A further tension exists, which makes choosing a specific discount rate for use in the context of policies responding to climate change problematic. On the one hand, these appraisals necessarily consider very long timeframes. The costs and benefits to future generations in the far future are of great importance, but will only influence the results of the analysis significantly if very low (or even zero) discount rates are applied. On the other hand, the pace of climate change is currently very fast and not in the right direction. This creates a level of urgency for action which, if reflected in discount rates, would require a high rate to encourage immediate policy responses.

2 See <https://www.lisea.fr/observatoire-socio-economique-de-la-lgv-sea/>.

3 See <https://nationalhighways.co.uk/our-roads/post-opening-project-evaluation-pope-of-major-schemes/>.

4 See <https://www.gov.uk/government/collections/post-opening-project-evaluation-pope-of-major-schemes>.

Annex A. List of Roundtable participants

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Participants provided their affiliations at the time of their participation in the Roundtable meeting.

Broadening Transport Appraisal

This report examines what ongoing shifts in the objectives of transport policy mean for transport project appraisal and planning processes. Many countries are rethinking their transport policy and planning objectives. Their focus is increasingly shifting from providing mobility to ensuring accessibility; giving greater priority to equitable access for all; recognising the urgency of decarbonising transport; and making urban environments healthier, safer and more liveable. The report summarises the findings of a discussion among 44 experts from 21 countries at an ITF Roundtable held from 29 September to 31 October 2021.

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