

# Civil engineering insights into alternative ways of appraising infrastructure procurement

## Overview

Empirical analysis of the benefits from infrastructure has tended to focus on exploring the impact on the economy, particularly the impact on economic output, and with strong justification: well-managed investment in infrastructure projects fuels economic growth, raises productivity and land values, and improves public services.<sup>1</sup> But this investment goes beyond economic aspects. Improving social and environmental outcomes – for example through reducing regional inequalities, providing employment opportunities, reducing greenhouse gas emissions, improving air quality and enhancing people’s health and wellbeing – all provide less obvious, albeit important, benefits.

The UK has traditionally focused heavily on lowest capex cost as the key differential when awarding contracts for major infrastructure projects. Projects often go ahead only if they make financial sense to the promoter – public or private – and not based on the total value and benefits they create over their lifetime across a number of metrics. In a 2014 survey of industry leaders conducted by the Infrastructure Alliance Group, 78% of respondents felt that UK Government procurement processes for infrastructure favoured lowest capital cost compared to best value.<sup>2</sup>

An ICE report into infrastructure forecasting shows, globally, it is incredibly difficult to forecast time and cost for major projects due to there being many unforeseen issues that can arise during delivery.<sup>3</sup> Additionally, project scrutiny is too often focused on lowest capital cost, while the whole-life benefit of a project is disregarded. In a survey of the British public included in the report, only 3% of adults felt that a low overall cost of construction should be the most important measure of success for major infrastructure projects.<sup>4</sup> This suggests that there should be an emphasis on redefining what a good outcome from an infrastructure project looks like, shifting the narrative on what success constitutes.

## Purpose of this paper

This paper provides insights into how different governments and infrastructure owners appraise the benefits of infrastructure investment as part of standard benefit-cost ratio (BCR) assessments when procuring contracts for major projects.

This paper builds on ICE’s aforementioned forecasting report to understand what the UK infrastructure sector can learn from international examples of appraising and evaluating infrastructure projects. It combines insights from ICE Fellows, industry experts and available published evidence.

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<sup>1</sup> ICE (2018), [State of the Nation 2018: Infrastructure Investment](#); London School of Economics Growth Commission (2013), [Investing for Prosperity: Skills, Infrastructure and Innovation](#)

<sup>2</sup> HMT (2014), [Infrastructure Cost Review: Measuring and Improving Delivery](#)

<sup>3</sup> ICE (2019), [Reducing the Gap between Cost Estimates and Outturns for Major Infrastructure Projects and Programmes](#)

<sup>4</sup> Ibid

## Measuring the benefits and costs of infrastructure

Cost-benefit analysis (CBA) is the primary evaluation tool at the options assessment and initiative prioritisation stages of a project appraisal process. For almost every project, this includes an estimation of internal impacts including, but not limited to, capital costs of the project over the period of construction, operation and maintenance costs, and the accrued revenue (fares, toll revenue, etc.) expected.<sup>5</sup>

Methodologies for identifying and measuring this value typically take defined categories of financial and economic benefit into account. In some developed nations, a degree of weighting is given to social and environmental factors, most notably for public-sector projects. This is the case through the UK Treasury's Green Book<sup>6</sup> and the New Zealand Treasury's Guide to Social Cost Benefit Analysis.<sup>7</sup>

In the UK, Green Book guidance is the basis of the business-case approach on which value for money is assessed and where economic value to the public purse is incorporated into the Government's policy/investment decisions. The principles have been held up as best practice and applied internationally by numerous organisations and governments.<sup>8</sup>

However, there has been criticism aimed at the Green Book and similar methodologies for not being wide-ranging enough to account for the full array of benefits at a more local level; for affording less weighting to wider benefits compared to financially driven impacts; and for not adopting best practice climate risk management systems into project appraisal.<sup>9</sup> Environmental and social impacts, which are more difficult to capture, measure and place an economic value on, are vital to making informed decisions on infrastructure projects. However, it is difficult to effectively place a price on some of these aspects in a consistent manner.<sup>10</sup> The New Zealand Treasury guidance recognises this and states that the purpose of a CBA is not to calculate the exact benefits and costs, but to reduce the degree of uncertainty that would otherwise exist for those estimates.<sup>11</sup>

## Challenges in assessing long-term project outcomes

In many cases globally, project benefits are overstated and costs understated due to a combination of factors, including optimism bias, cost misrepresentation and an unwillingness from promoters to adjust estimates from their initial base.<sup>12</sup> There is also evidence that project promoters, before any analysis has been conducted, have a strong preference towards a project that they wish to proceed with.<sup>13</sup> This means that the BCR can form part of a business case that justifies pre-determined outcomes, rather than one that considers and analyses alternative infrastructure solutions to address the problem.<sup>14</sup> New Zealand's government considers it good practice to consider several alternative options for achieving an infrastructure-related objective from the outset, with each option treated as a separate policy to be evaluated against the 'do nothing' option.<sup>15</sup>

<sup>5</sup> Australian Bureau of Infrastructure, Transport and Regional Economics (2018), [ATAP Guidelines Cost Benefit Analysis](#)

<sup>6</sup> HMT (2018), [The Green Book](#)

<sup>7</sup> New Zealand Treasury (2015), [Guide to Social Cost Benefit Analysis](#)

<sup>8</sup> Arup (2018), [Making the Total Value Case for Investment in Infrastructure and the Built Environment](#)

<sup>9</sup> Ibid; Task Force on Climate-Related Financial Disclosures (2017), [Recommendations of the Task Force on Climate-Related Financial Disclosures](#)

<sup>10</sup> Bennett Institute for Public Policy (2018), [The Imperial Treasury: Appraisal Methodology and Regional Economic Performance in the UK](#)

<sup>11</sup> New Zealand Treasury (2015), [Guide to Social Cost Benefit Analysis](#)

<sup>12</sup> Institute for Government (2017), [How to Value Infrastructure: Improving Cost Benefit Analysis](#); Transport Infrastructure Council (2018), [Australian Transport Assessment and Planning Guidelines](#)

<sup>13</sup> KPMG Australia (2017), [Rethinking Infrastructure Project Selection](#)

<sup>14</sup> Ibid

<sup>15</sup> New Zealand Treasury (2015), [Guide to Social Cost Benefit Analysis](#)

The UK's National Infrastructure Commission (NIC), through a study of infrastructure procurement models, has said that the procurement of infrastructure projects risks being constrained by a lack of evidence on long-term investment outcomes.<sup>16</sup> In turn, this could impact on the UK's ability to meet growing demand for infrastructure services and to reach the net-zero emissions target by 2050. While numerous economic, social and environmental externalities are accounted for – and are becoming increasingly so, particularly in publicly funded infrastructure projects – many remain hidden or overlooked. The need to move away from short-term financial decisions when it comes to infrastructure is therefore clear.

#### ***Case study: Yorkshire Water***

*In the UK in 2017, Yorkshire Water launched a Decision Making Framework that calculates the impact of any business or project decision across 'six capitals': financial, manufactured, natural, human, social and intellectual.<sup>17</sup>*

*A key feature of this approach is that non-financial impacts and dependencies can be expressed in monetary terms. This allows different impact categories to be directly compared, providing greater insight into their magnitude and importance, and allowing Yorkshire Water to better identify opportunities to deliver greater value for money for their customers and embed this into 'business as usual' practices.<sup>18</sup> The Decision Making Framework can, for example, compare the social and environmental costs and benefits of alternative investment decisions, such as restoration of natural flood defences, against more traditional investment in infrastructure assets.<sup>19</sup>*

Since there are long timeframes involved when planning and constructing major infrastructure, decisions need to be made not just with regard to current demand but also forecast demand, which can often be uncertain. Once built, resources are committed since life cycles are long and most infrastructure has little or no alternative use value. There is therefore a risk that unforeseen factors, such as technological change, will render a particular scheme obsolete, reducing the benefits or shortening its economic life.

These risks do not automatically justify inaction. A common characteristic of infrastructure is the uncertainty of the exact benefits it can bring, which means there is a significant degree of so-called 'upside risk'.<sup>20</sup> An example of this is the Jubilee Line Extension, completed in 1999. The project was approved despite a BCR of 0.95, albeit with an expectation that there would be unquantifiable wider benefits through regeneration and job creation. Using more recent methods of transport appraisal that account for those wider impacts, it is now estimated that the project delivered a significantly higher BCR of 1.75, even after accounting for cost overruns.<sup>21</sup>

<sup>16</sup> NIC (2019), [Evaluating the Performance of Private Financing and Traditional Procurement](#)

<sup>17</sup> Yorkshire Water (2018), [The Six Capitals in our Decision Making Framework](#)

<sup>18</sup> Ibid

<sup>19</sup> Ibid

<sup>20</sup> Civil Engineering Contractors Association (2018), [The Social Benefits of Infrastructure Investment](#)

<sup>21</sup> OMEGA Centre, UCL (2009), [Project Profile: Jubilee Line Extension](#)

## International comparators

ICE's 2019 Enabling Better Infrastructure report identified, as part of the 12 guiding principles for prioritising and planning infrastructure, that CBA must embrace all of the environmental, social and governance impacts of a proposal.<sup>22</sup>

Governments globally are now interested in more than a direct cash return from a project, and must capture the wider impacts on the economy as well as the social and environmental benefits generated. Above all, however, the project must be a good strategic fit with what a government is trying to achieve and be deliverable with the resources available.<sup>23</sup>

This section outlines alternative approaches used by project promoters to appraise the benefits of infrastructure projects.

### Existing methodologies

In northern European nations such as the UK, France and Sweden, the majority of efforts to improve project appraisal models in recent years have involved extending and evolving existing frameworks, rather than replacing them with alternatives.<sup>24</sup> These extensions have taken the form of accounting for an ever-widening array of impacts, including effects on environmental capital and international business markets, as well as flexibility on a project-by-project basis on what is assessed to be significant.<sup>25</sup>

Even with the aforementioned constraints of the Green Book, the UK itself is widely viewed as having among the most mature frameworks for assessing, appraising and prioritising infrastructure investment.<sup>26</sup>

### Multi-criteria analysis

Australia operates slightly differently to the UK in its wider use of multi-criteria analysis (MCA) alongside CBA. MCA is presented as a guide to decision-making as opposed to a decision-support tool and is typically seen as more transparent.<sup>27</sup> Australia has launched its Transport Assessment and Planning (ATAP) guidelines, used to assess demand and undertake economic appraisals.<sup>28</sup> Despite these specific guidelines, there has been criticism that reliance on BCR and net present value as the deciders for whether a project proceeds are limiting infrastructure prioritisation.<sup>29</sup> Estimates using these metrics tend not to take account of factors such as flexibility or the potential impact of disruptive mobility trends.

### Additional weighting towards projects in lower-income regions

Germany, as a country with a federal government, has various methods for assessing projects depending on the different tiers of government. Alongside CBA and environmental assessments, federally funded infrastructure investments have a Spatial Impact Assessment conducted to evaluate the quality of accessibility and connectivity for different regions.<sup>30</sup> In this process, additional weighting is given to infrastructure schemes which serve low-income regions, moving away from a traditional approach based on journey time savings to one centred on addressing deficiencies in connections between regional and metropolitan centres.<sup>31</sup> This approach is markedly different to that of the UK, where evidence has shown there to be a methodological bias in decision-making towards already-productive and economically active regions, notably London and the South East, resulting in disproportionate investment across the UK, particularly on transport

<sup>22</sup> ICE (2019), [Enabling Better Infrastructure](#)

<sup>23</sup> Ibid

<sup>24</sup> OECD/ITF (2017), [Quantifying the Socio-Economic Benefits of Transport](#)

<sup>25</sup> Institute for Transport Studies, University of Leeds (2013), [International Comparisons of Transport Appraisal Practice](#)

<sup>26</sup> KPMG International (2016), [Assessing the True Value of Infrastructure Investment](#); Institute for Transport Studies, University of Leeds (2013), [International Comparisons of Transport Appraisal Practice](#)

<sup>27</sup> Institute for Government (2017), [How to Value Infrastructure: Improving Cost Benefit Analysis](#)

<sup>28</sup> [Australian Transport Assessment and Planning \(ATAP\)](#)

<sup>29</sup> McKinsey & Company (2019), [Australia's Infrastructure Innovation Imperative](#)

<sup>30</sup> A. Dahl et al. (2015), [New Trends in Cost-Benefit Assessment of Public Investments in France and Germany](#)

<sup>31</sup> Ibid; Institute for Transport Studies, University of Leeds (2013), [International Comparisons of Transport Appraisal Practice](#)

infrastructure.<sup>32</sup> Recent measures, such as the Department for Transport introducing its 'rebalancing toolkit' as supplementary guidance for building the case for investment, have been called a 'welcome step in the right direction' by the House of Commons Transport Committee, but their impact on making a material difference has been viewed with scepticism.<sup>33</sup>

### Involving the public in infrastructure decision-making

Alongside a conventional CBA approach, France, since the 1990s, has utilised its Commission Nationale du Débat Public (CNDP) as a form of public deliberation to also inform infrastructure decision-making.<sup>34</sup> A wide range of methodologies has been developed in order to monetise the costs and benefits of an evaluated project, with the CNDP then providing an institutional framework to facilitate the participation of local stakeholders.<sup>35</sup> All participants – for or against a project – are given equal resources to make their case, with the views summarised in a report that the project promoter must respond to. While there is no obligation on the project promoter for the views to influence a project, the process is nonetheless viewed as a valuable exercise in the appraisal process and can identify hitherto unknown benefits and costs that feed into a BCR process. On 61 projects between 2002 and 2012, 38 made modifications based on evidence from the public debates, with 25 of those choosing an entirely new project option.<sup>36</sup> Involving stakeholders at the right time is crucial: CNDP guidance suggests not to hold public debates too early (as the project will be too unspecific) and not too late as all aspects will have been effectively decided.<sup>37</sup>

### Climate risk management

The Asian Development Bank's climate risk management approach aims to reduce risks resulting from climate change to infrastructure investment projects in Asia and the Pacific. The framework identifies climate change risks to project performance in the early stages of project development, and incorporates adaptation measures in the design of projects at risk – lessons learned are then transferred into the evaluation of adaptation options for future investments.

Based on the climate risks and vulnerabilities assessed, this involves estimating and comparing the cost and benefits of the project based on two different scenarios: (i) the project under climate change without adaptation measures, and (ii) the project under climate change with adaptation measures. It aims to identify which adaptation option yields the highest net benefit, as well as the incremental cost of adaptation. Recognising that investing in adaptation measures may be costly and that future benefits may be uncertain, the economic analysis can also point to the best timing for investing in adaptation.<sup>38</sup>

## Emerging thinking

There is momentum building towards a more holistic approach to measuring benefits and costs, with the likes of EY, KPMG and PwC all proposing approaches towards measuring the total value of infrastructure and other capital projects.<sup>39</sup> Research from Arup has shown that current decision-making frameworks globally for infrastructure projects are producing

<sup>32</sup> Bennett Institute for Public Policy (2018), [The Imperial Treasury: Appraisal Methodology and Regional Economic Performance in the UK](#); Sheffield Political Economy Research Institute, University of Sheffield (2015), [Public Infrastructure Investment and Business Activity in the English Regions](#)

<sup>33</sup> House of Commons Transport Committee (2018), [Rail Infrastructure Investment](#)

<sup>34</sup> T. Marshall (2016), [Learning from France: Using Public Deliberation to Tackle Infrastructure Planning Issues](#), International Planning Studies

<sup>35</sup> S. Damart, B. Roy (2006), [Limitations of Cost Benefit Analysis to Support Public Debate: The Case of Public Transportation Decision-Making in France](#)

<sup>36</sup> T. Marshall (2016), [Learning from France: Using Public Deliberation to Tackle Infrastructure Planning Issues](#), International Planning Studies

<sup>37</sup> Ibid

<sup>38</sup> Asian Development Bank (2014), [Climate Risk Management in ADB Projects](#)

<sup>39</sup> KPMG (2014), [A New Vision of Value: Connecting Corporate and Societal Value Creation](#); EY (2016), [Total Value: Impact Valuation to Support Decision-Making](#); PwC (2013), [Measuring and Managing Total Impact: A New Language for Business Decisions](#)

suboptimal outcomes. Arup has designed an approach for assessing and quantifying the total value for infrastructure investment decisions, which makes wider benefits visible.<sup>40</sup>

The Institute for Government has proposed the use of CBA that accounts for 'dynamic effects', that is to say the effects generated by an intervention that emerges as a result of capital and labour movement.<sup>41</sup> An example here is investment in a major piece of transport infrastructure: the static effects of this, which are well understood and often form the basis for a positive BCR, would be a reduction in travel time and improved productivity, with increased tax returns for the Government. The dynamic effects, however, could be that the improved infrastructure causes individuals and businesses to relocate from elsewhere in the country, or for international investment to be directed into the area, fundamentally changing land use, raising land value, accelerating economic activity and delivering productivity gains.<sup>42</sup>

However, incorporating these wider, dynamic impacts is challenging and has its own risks. The International Transport Forum (ITF) has said that broadening the set of mechanisms that are studied as part of a CBA risks legitimising a situation that may never occur, or at least exaggerates its effects.<sup>43</sup> In the case of investment in a major piece of transport infrastructure, a CBA may concentrate on where this investment expands economic activity while ignoring areas from which this activity may have been displaced.

The ITF has researched the effectiveness of different models, such as the Land Use Transport Interaction model and Spatial Computable General Equilibrium model, to capture wider impacts of a project. These models, however, require a large amount of data to be effective, while the complexity of the modelling can undermine transparency.<sup>44</sup> With further research, the ITF believes there may come a point where these larger models become responsive, accurate and affordable enough to be the preferred project appraisal approach; however, they are currently unable to adequately capture all relevant impacts, particularly on a regional basis rather than national.<sup>45</sup>

## About ICE

Established in 1818 and with over 95,000 members worldwide, the Institution of Civil Engineers exists to deliver insights on infrastructure for societal benefit, using the professional engineering knowledge of our global membership.

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<sup>40</sup> Arup (2018), [Making the Total Value Case for Investment in Infrastructure and the Built Environment](#)

<sup>41</sup> Institute for Government (2017), [How to Value Infrastructure: Improving Cost Benefit Analysis](#)

<sup>42</sup> Ibid

<sup>43</sup> International Transport Forum (2016), [Incorporating Wider Economic Impacts within Cost-Benefit Appraisal](#)

<sup>44</sup> International Transport Forum (2017), [Quantifying the Socio-Economic Benefits of Transport](#)

<sup>45</sup> Ibid; Institute for Transport Studies, University of Leeds (2013), [International Comparisons of Transport Appraisal Practice](#)