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From Tools to Toolbox: Sustainability and Investment Appraisal for Water Projects

Incorporating the Sustainable Development Goals into decision making

A Reidy

ABSTRACT

Public infrastructure plays a crucial role in transitioning to a more sustainable society. Many water infrastructure providers have adopted commitments to sustainability practice in corporate plans and statements, and the delivery of the organisation's portfolio of projects is integral to achieving sustainability targets that contribute to global efforts in meeting the commitments of the UN Sustainable Development Goals. Front-end decision making, based on the findings of the business case, has the greatest opportunity to influence sustainability outcomes. This paper asserts that investment appraisal for public infrastructure requires a new framing to support the selection and shaping of projects with sustainability outcomes.

Taking account of the unique characteristics of infrastructure and the public good that infrastructure may provide, a toolbox approach is multi-layered and ensures that projects align with broader strategic directions, whilst recognising that underpinning analysis should ensure robust and transparent project appraisal. Benefits assessment for infrastructure investments should align with broader policy directions and include considerations of benefit for the wider community, beyond the boundaries of the infrastructure provider. A deeper understanding of value may be gained through working with a range of stakeholders including the end users of infrastructure. This approach challenges the premise that better analysis should be focused on monetising more impacts within appraisal tools.

Keywords: Infrastructure, sustainability, benefits, value, business.

INTRODUCTION

Water infrastructure plays a critical role in shaping urban environments and supporting thriving communities across the globe. Infrastructure provides benefits that include contributions to urban cooling and climate change resilience, community well-being, health outcomes and restoring biodiversity losses (Foxon et al., 2015, Mekala et al., 2015). Infrastructure projects may also result in negative outcomes including resource depletion and air pollution, congestion, mobility impacts, human health impacts and environmental impacts. Infrastructure has unique characteristics including complex and multiple values with direct economic returns, but also wider environmental and social implications (Bryson et al., 2014). The public good aspect of infrastructure works, with long life spans and values that may change over time, means that financial metrics such as rate of return that are applied to commercial investments cannot fully represent the multiple dimensions of infrastructure investments (Canning and Bennathan, 2000).

Strategic decision making at the front end of projects, centred on the findings of a business case, can influence sustainability outcomes at a strategic level to align with

wider government policy and priorities. Investment decision making refers to project planning and analysis undertaken prior to the scope of the project being defined and the budget being allocated. The analysis in a business case would assess a number of delivery and operating options and include both infrastructure and non-infrastructure interventions, with a final investment solution being proposed (Silvius et al., 2013). The options identified would be expected to have different benefits, dis-benefits and outcomes when assessed within a sustainability framework. This approach broadens analysis beyond the justification of a pre-determined project solution. In project management practice, the findings from the business case form part of broader project portfolio structuring, project prioritisation and selection (Meskandahl, 2014).

The planning and regulatory frameworks for infrastructure investments often fail to guide decision making to appropriately address emerging issues such as climate change uncertainty (Ananda, 2014). As infrastructure agencies seek new solutions to sustainable water management, institutional structures, settings and processes often act as barriers in justifying investments in new and innovative technologies that deliver multiple objectives (Brown & Farrelly, 2009).

Using the example of the water sector in Australia, this paper examines the decision-making framework for investment decisions taking account of the water sector's policy, legislative and regulatory framework. A key opportunity for the water sector is the transition to water sensitive cities through practices such as sustainable or integrated water management (IWM) (Brown et al., 2009). In doing so, the assessment of project options needs to consider 'green' infrastructure alternatives against traditional solutions, often with lower capital costs. New approaches have the potential to yield wider benefits, often beyond institutional boundaries, but are often untested, making the full array of benefits and value difficult to capture and justify.

Transitioning to sustainable water management needs to take account of the wider value of water beyond economic value and utility pricing, and should include consideration of ecological value in sustaining ecosystems and social functions including cultural values (Brugge and Rotmans, 2007). In Australia, there have been ongoing calls for more robust models for appraisal that may support the evaluation of IWM options within a sustainability framework (Mitchell, 2006; Australian Academy of Technological Sciences and Engineering (ATSE), 2015).

SUSTAINABILITY

The United Nations Sustainable Development Goals (SDGs), adopted in 2015, present a refreshed international commitment to sustainability. The SDGs set a framework that may be applied at global, national and local levels for sustainability to remain valid into the future and for sustainability to remain a key policy focus in the public arena (Le Blanc, 2015). The SDGs also present the opportunity for governance systems to respond through both goal setting at an aspirational level and rule making that provides the behavioural prescriptions to allow goals to be achieved (Young, 2017). Commitments by infrastructure providers to the SDGs demonstrate the on-going focus on sustainability and its role in addressing global problems. The challenge for infrastructure providers is to translate these sustainability commitments to project level decision making.

INSTITUTIONAL FRAMEWORK OF PUBLIC INFRASTRUCTURE

Infrastructure agencies operate within a wider system framed within an economic and political context, based on enabling legislation and government policy. Studies across jurisdictions show that the broader government sustainability strategies are not systematically translated into decision-making practices for specific infrastructure projects (Bond and Morrison-Saunders, 2011), and that, overall, there is a misalignment between stated government policy and project delivery (Young et al., 2012; Young and Grant, 2015).

Institutional design, framed in an economic and political context, is integral to achieving sustainability objectives in decision making (Ostrom, 1990). Decision making and planning for infrastructure projects remains expert-driven and technocratic or captured by closed networks (Schatz and Rogers, 2016).

Regulatory agencies provide input to decision making based on legislative requirements in areas such as environment, health and or economics. Regulatory oversight provides a strong governance framework for decision making by public sector infrastructure providers, taking account of monopoly powers (Littlechild, 1988). However, in practice, the role of the regulator may be based on incomplete understanding of the key issues and risks. In decision making relating to projects, regulators may not be aware of the full array of

alternative investment opportunities available and regulatory decisions may not be cognisant of the interests of key user groups (Ananda, 2014). Institutional factors often determine the appraisal methodologies that are adopted, with subsequent impacts on sustainability outcomes.

APPRAISAL TOOLS

A range of analysis tools are available to support the business case for a significant infrastructure investment. A brief discussion of three tools is provided below.

In regulated settings, Cost Benefit Analysis (CBA) is the tool that is generally applied and often mandated to be used in business case development. In Australia, any submissions to Infrastructure Australia relating to projects of national interest must firstly be supported by 'robust' CBA (Infrastructure Australia, 2009). Given that CBA may be used as a 'political weapon' whereby favourable (or unfavourable) results can be used to justify politically favoured projects (Sudiana, 2010, p. 10), CBA is also well understood in the wider community as a pass/fail test for significant projects.

Political pressure and expert practice often reduce decision making to simple singular representations to deal with incomplete knowledge (Stirling, 2010). Over time, a body of research has addressed the weaknesses of CBA. Mouter et al. (2015) stated key limitations of CBA as:

- CBA studies are incomplete – there are many factors that can't be modelled or measured;
- Outcomes of welfare considerations are uncertain, particularly when forecasting the future; and
- Approximations of value are contestable and weaken the credibility of analysis.

In order to address the limitations of conventional CBA, Extended CBA seeks to broaden monetary valuation to incorporate a wider array of environmental and social factors as externalities (Bell and Morse, 2012). These may include private costs and benefits such as increases to property value. Another feature of Extended CBA may include the use of sensitivity analysis to the monetised values of costs and benefits taking account of the assumptions adopted in undertaking the analysis.

Extended CBA 'aims to optimise financial, environmental and societal (or 'triple bottom line') costs and benefits and allows sustainability risks and opportunities to be quantified in hard, monetary terms' (Hardisty et al., 2013). Where analysis requires the appraisal of complex and interconnected environmental systems (such as coastal zones), where values are contestable and considerations of equity are required, CBA must be supplemented with further analysis that better captures stakeholder interests (Turner, 2006).

Multi-Criteria Analysis (MCA) provides a means to incorporate a wider array of factors into decision making over and above financial and economic factors. Approaches to MCA vary from simple to highly sophisticated depending on the skills and number of analysts, the form of data and information used (deterministic, stochastic, fuzzy set theory methods) and use of analysis software (Huang et al., 2011). Critics of MCA see this methodology as highly subjective when compared to CBA, and potentially lacking transparency, as it does not provide a conclusive outcome. The process of assigning weights and scores is subjective, and MCA involves a risk of double-counting criteria. Where each particular problem may be subject to more tailored MCA techniques, the choice of approach may draw different conclusions in different contexts, reflecting the preferences of those conducting the analysis. (Beria et al., 2012).

Real Options Analysis (ROA) is a financial analysis tool that deals with uncertainty and allows flexibility to respond to events in the future through assigning value to the ability for managers to react to new information or change the course of a project to respond to new environmental conditions (Brown & Robertson, 2014). ROA incorporates decision-tree analysis to assess risks and changes that may emerge over time. For infrastructure projects, questions arise as to the ability of ROA to apply theory to real life practice, accuracies in valuation models and allocating value across multiple agencies (Garvin & Ford, 2012).

PUBLIC VALUE

The framing of the value that may be created by infrastructure investments is integral to investment appraisal. Public value theory aligns with an understanding of the wider public good of infrastructure investments. Public value 'extends beyond market economic considerations, and also encompasses ecological, political, social, and cultural dimensions of value – all that adds value to the public sphere' (Benington, 2009).

Public values are contestable, and there is a need to find ways to seek agreement on what public values are in practice (Bryson et al., 2015). Public value theorists

advocate a collective approach for measuring value, taking account of the institutions, processes of politics, public policy and government that exist in democratic processes (Moore, 2014). Public value inspires a 'deepening of the democratic and deliberative process' (Benington, 2009, p.246). Public value presents the opportunity to assess projects beyond a reconciliation of costs and exchange value, and rather provides a means to assess the wider value that infrastructure services create.

METHODOLOGY

This paper outlines findings from PhD research seeking an understanding of an optimal system approach to support project selection and decision making for infrastructure projects within a strong sustainability framework. A mixed methods (quantitative plus qualitative) study using an integrated inductive/deductive research approach was adopted with a focus on the water industry (Creswell, 2003). A sequential, staged approach to the research was adopted to allow an explanatory model to be built.

A quantitative study formed an initial stage, using a survey of industry experts to firstly test and refine an initial conceptual model. The survey provided insights into analysis techniques that are employed across the water industry. In the second stage, thirteen interviews were conducted across Australia in late 2016 and 2017. The survey and interview data was analysed using a pragmatic/constructivist 'research by designing' approach that translates specialist knowledge into guidelines and models (Lenzholzer et al., 2013). This enquiry sought to build a deeper understanding of the context and policy setting of current practice and the difficulties in applying sustainability in a regulated sector.

RESULTS

Projects that deliver sustainability outcomes are often seen as complex projects that may be typified by a combination of factors that may include:

- High capital costs;
- Long time frames associated for approvals and/or implementation;
- Involvement of stakeholders;
- Strong community interest;
- Impacts to environmental systems;
- Impacts to social or cultural groups;
- New technologies or approaches to servicing;
- The ability to shape urban form and city planning; and
- Input from a range of disciplines.

Both the survey and interviews revealed that, across the water industry, there is no uniform approach to investment analysis and no systematic approach to sustainability assessment as part of the business case. The research showed that a gap remains in systematically translating sustainability commitments, goals and targets to decision making at the front end of projects.

A variety of appraisal methods are applied in practice, with both MCA and CBA used by water service providers to support decision making. One comment from the survey noted that it 'depends on the project – best tool for the job'. The interviews also confirmed that some organisations use different techniques at different stages of project analysis. In one case, MCA is used in the early planning and options analysis stage, and then CBA is used to support decision making when a project advances into the capital works programme for delivery. With no universal approach to analysis, there is a need to provide clear direction and guidance to infrastructure providers on how sustainability may be incorporated into project selection and decision making for infrastructure projects to ensure alignment with sustainability commitments.

The adoption of participative methods as part of front-end decision making was widely supported in the survey and interviews, indicating that some organisations in the water industry have embraced and embedded participation in decision making. Interviewees acknowledged that participative processes are extremely difficult and time consuming but are also seen as critical in making the right decisions in a sustainability framework. There appears to be a wide understanding within the water industry of the need to engage with customers, and the wider community. One interviewee stated:

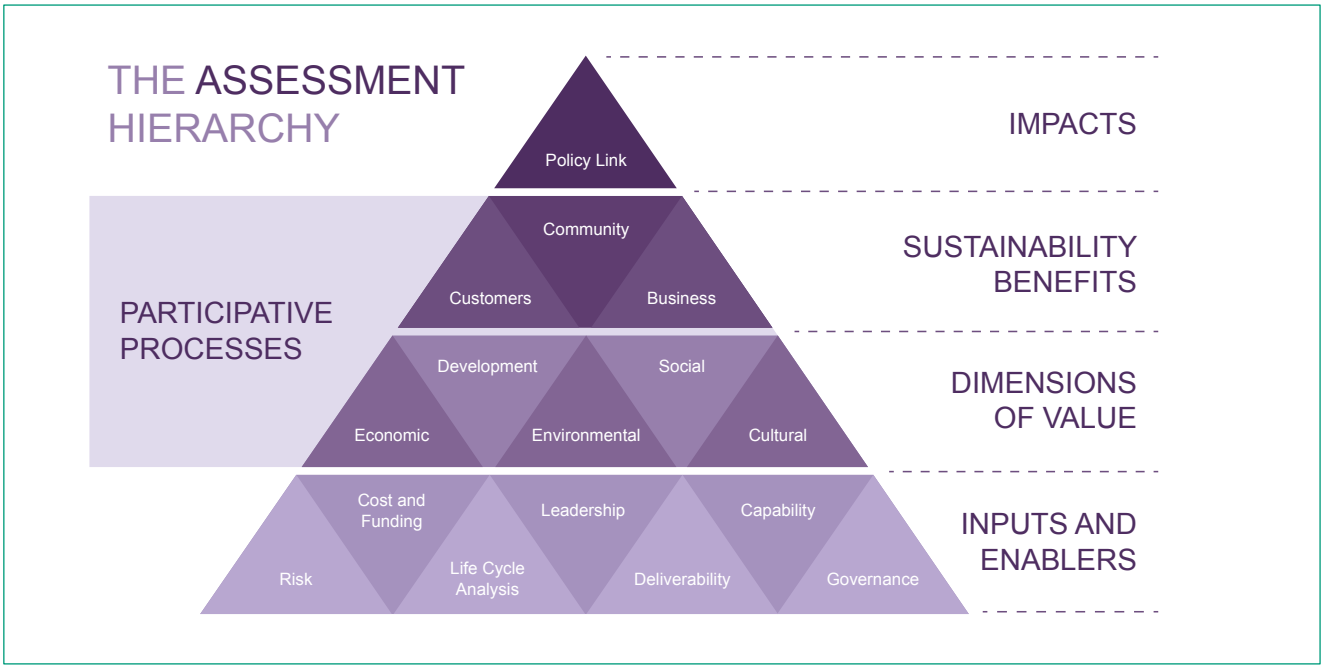
"We understand that it is probably a greater benefit to the business to spend money and time in engagement up front in the process..."

DISCUSSION

The theoretical basis for CBA assumes that the preferences of individuals are a source of value, whereby the aggregated preferences of individuals (their willingness to pay) represent benefits and aggregated willingness to accept compensation represent costs (Pearce et al., 2006). However, benefits are also used to describe the strategic performance of projects or broader impacts with linkages to policy objectives. The concepts of value and benefit are used interchangeably, and aspects of non-use value, such as cultural value, are discounted due to difficulties in assigning value. In addressing this conflation of benefit and value, the following distinction has been applied for the two terms (Chan et al., 2012; Sagoff, 2000):

- Benefits result from the production of services to society (net welfare gains)
- Value represents the relative worth of services (based on human preferences)

Infrastructure investments provide both benefits and value, and these should be captured in investment appraisal. Through the research, an evaluation hierarchy was developed that includes benefits assessment and value identification together with the consideration of impacts of project investments and the enablers and inputs to the appraisal process. Figure 1 brings together the concepts that emerged through the research, and these are explained in further detail below.



PROJECT IMPACTS

At the top of the evaluation hierarchy are the impacts associated with investments. Impacts relate to contributions of projects to broader strategic goals and are the result of the cumulative impact of a portfolio of projects and policy initiatives. Policy makers are responsible for measuring impacts of policy decisions. The impacts of infrastructure investments become more difficult to measure, are long term and may have a number of influences (Bryson et al., 2014). On the question of whether projects actually contribute to whole of government strategies, Young and Grant (2015) found a positive contribution only when strategic goals are stable, and when there is centralised oversight of strategic goals within government.

For the water industry, policy sits within a framework of legislation and directives (such as Statements of Obligations) from government, and leads to subsequent requirements for water utilities and other water agencies to develop water strategies and plans. Policy documents frame goal setting and work priorities across government departments, and across jurisdictions, and play a key role in ensuring that policy objectives relating to sustainable outcomes are understood and shared. For service providers, projects are the vehicle for the realisation of government policy and corporate strategy.

BENEFITS

Project management practice continues to concentrate efforts on project outputs and efficiency (within a time, cost and quality triangle) and may ignore the broader organisational context to which projects contribute. In sustainability practice, projects contribute to broader outcomes or effectiveness that align with organisation objectives and stakeholder needs. In order to create a link between an organisation's business strategy and the projects that support strategy, the discipline of investment management or benefits realisation management (BRM) has been adopted.

Investment logic mapping (ILM) that is promoted by various governments across Australia including Victoria (Department of Treasury and Finance or DTF) and, according to DTF guidance, ILM is a tool to 'tell the investment story' whereby every investment should be able to 'describe how it is contributing to the benefits the organisation is seeking' (State of Victoria, 2017). Benefits are performance measures represented by Key Performance Indicators (KPIs) to explicitly link goals to outcomes and outputs. Formal reporting processes provide a disciplined approach to monitoring and reviewing performance against benefits envisaged.

Where benefits management and benefits realisation processes are in place, the challenge remains to ensure that the strategic outcomes sought through wider government policy are actually delivered through projects (Young et al., 2012, Young & Grant 2015). Benefits management and benefits realisation are evolving areas of practice with the potential to broadened to include sustainability benefits (Keeys, 2017).

Examples of benefits that are sought from water infrastructure investments that were highlighted in the research included: assessing a project's contribution to reducing organisational greenhouse gas emissions; reducing nutrient levels in receiving water bodies; contributions to urban cooling (and negating the impacts of heat stress); urban liveability improvements and employment targets for vulnerable groups within the local population.

The research identified three key dimensions of sustainability benefits associated with water infrastructure investments. Community benefits relate to the wider benefits of projects that are generated beyond the boundaries of the initiating organisation. For a water utility, community benefits may accrue through investments in integrated water management that recognise the broader benefits that extend to other organisations such as local councils or beyond physical boundaries. Customer benefits are derived for all those interacting with the organisation, and may include direct customers for services such as businesses and residents, but also developers requiring approvals and other local service providers.

In shifting service levels beyond compliance with regulatory rules, water utilities may also recognise the importance of understanding the preferences and needs of customers through working with customer groups and undertaking regular customer surveys to deliver optimal customer benefits. A focus on customer benefits may also lead to organisational or business benefits. For an infrastructure provider, the shaping of infrastructure investments may take account of the wider societal issues that the organisation seeks to support though its operations. As monopoly powers, public sector entities require 'legitimacy and support' to create public value (Moore and Khagram, 2004).

VALUE

Value relates to the outputs of the investment decision, and the tangible and intangible value created by an investment. The ability to fully represent the value created from public infrastructure continues to be a central challenge of the investment appraisal process. Analysis often neglects the broader values of infrastructure that may be positive (recreational, aesthetic, environmental and community value) or negative (the impacts on local social or cultural values). A narrow framing of value in analysis may preclude innovative and sustainable project solutions with opportunities to address liveability aspirations and contribute to community development.

Approaches to assessing and representing value vary. One approach in current practice seeks to better represent value through applying monetary valuations across known economic, environmental and social factors within CBA practice. Alternative approaches allow a combination of both monetary valuation and qualitative assessments, where qualitative assessment addresses factors that are considered difficult or impractical to measure or monetise.

Recognising that infrastructure contributes to social, economic and environmental consequences, five value propositions have been adopted as building blocks for infrastructure investments (derived from (Foxon et al., 2015). These value dimensions are:

- Economic value: the contribution to economic activity associated with an infrastructure investment may be measured through factors such as business activity, increased job opportunities and improved workforce participation;
- Development value: infrastructure investments are often the catalyst for opportunities for creating value both within infrastructure corridors (such as hosting a range of other public or private services), as well as providing a catalyst for urban development and more productive land use;
- Social value: the assessment of social value may include measurable factors (these may include health and well-being impacts), and deeper, underlying social dimensions that apply at a local level such as perceptions of amenity and liveability;
- Cultural value: with multi-dimensional aspects and no common unit of measurement, cultural value includes spiritual, aesthetic, social, historic, symbolic and authenticity value; and
- Environmental value: environmental/ecological economics provides a framework to assess the value of ecosystem services, however evaluations in areas such as biodiversity value, connectivity value and long term impacts due to climate change are complex and difficult to attribute marginal values at a project level.

The research highlighted the importance of fully investigating and understanding the range of values attributable to infrastructure investments. In the interviews, it was noted that:

- Some values, such as cultural values, are recognised through government priorities and policy, but these are complex and cannot be represented in a singular dimension of monetary impacts;
- A clear understanding of the range of values associated with investments may allow the trade-offs between value dimensions to be fully transparent; and
- A clear articulation of the value created by investments may support the justification of a preferred solution particularly in dialogue with regulators and broader stakeholders.

Value assessment should avoid the simplistic, but often used, approach of compartmentalising values into the sustainability domains, with each domain having equal weighting (Jackson, 2006). Instead, the evaluation of value must recognise the linkages between value domains. Valuation studies should adopt a 'value pluralism' approach rather than the use of a singular unit value to most effectively inform decisions in the urban domain (Gómez-Baggethun and Barton, 2013).

Complex decision making often involves 'trade-offs' relating across the multiple dimensions of goals and value. In standard economic analysis, these trade-offs may be approached through aggregating techniques that reflect the values and preferences of the decision maker (Walker, 2000). In sustainability practice, the consideration of trade-offs should recognise that decision making is complex and should not be allocated to a single decision maker. This takes planning and analysis outside the domain of engineers, technical specialists or economists, and broadens the assessment to take account of local knowledge that may not be formally documented. Trade-offs are not a simple cognitive balancing of costs and benefits, but rather these often involve emotional, moral or ethical issues.

INPUTS AND ENABLERS

The evaluation hierarchy is underpinned by the inputs representing the need for robust analysis that addresses financial surety, risk and operational readiness, and enable functions for sustainability practice. Cost and funding models are required as part of budgeting processes and funding allocations, risk management is critical to effective overall project management, and considerations of resource capability and long term operational and maintenance matters are vital inputs to investment analysis. In a sustainability framework, these inputs to analysis are necessary to ensure accountability and transparency. The assessment of value and an understanding of the gains that have been delivered from an investment may also inform who should contribute to funding infrastructure (including where there may be a case for government contributions through general revenue).

Enabling factors relate to institutional settings around leadership, capability and deliverability, together with

appropriate governance arrangements that ensure an understanding and commitment to sustainability at all levels. In terms of capability, the interviews revealed competencies required for business case development that is focused on sustainable outcomes. These include: critical thinking and the ability to identify the wider context of problems; the ability to lead and direct a multi-disciplinary team or work with multiple agencies; negotiation capabilities; and the ability and drive to develop complex concepts through to implementation. Further characteristics identified in other studies include: systems understanding, emotional intelligence, values orientation, compelling vision, inclusive style, innovative approach and a long term perspective (Visser & Courtice, 2011). These competencies are not typically learnt through tertiary studies, and it may be argued that technical training alone does not provide the skills to deal with non-routine problems and complex analysis.

PARTICIPATION

Participation refers to collaborative processes of working with multiple stakeholders, including end users, to build knowledge, to develop trust and understanding, and to manage uncertainty in decision making. Participation in infrastructure decision making looks beyond models within political systems such as voting, lobbying and protesting, and instead looks at deliberative processes that allow the considered examination of the technical, environmental and social aspects of a given initiative.

In sustainability practice, the assessment of benefits and value should involve participation by a range of interest groups to ensure deliberation, negotiation and debate, providing an integrated understanding across the value domains. Deliberative processes should be employed with considerations of shared value or benefits accruing to the community, customers and the infrastructure provider. Participation in the identification of value provides a level of transparency and accountability for infrastructure providers in ensuring that the values that are identified are real and appropriate.

In addressing the impacts of key sustainability issues, participation provides a means to address ‘wicked problems’ in infrastructure provision, characterised by uncertainty and multiple dimensions, resulting in the need for trade-offs between value dimensions (Schäfer and Scheele, 2017). For infrastructure providers, participation activities are aligned with a sustainability approach in the delivery of major initiatives to address Goal 17 of the UN SDGs.

CONCLUSION

To address emerging sustainability pressures, investment appraisal must focus on the effectiveness of project solutions that align with sustainability commitments of infrastructure providers. Current approaches to investment appraisal that rely solely on a reconciliation of costs and benefits fail to fully represent the complexity of infrastructure networks and systems.

With questions arising on the ability of current infrastructure systems to address future climate change pressures, there is an opportunity to shape new investments through a better understanding of the benefits that may be delivered, and the value that may be created. Hence, infrastructure solutions may contribute to wider societal benefits and public value across a spectrum of value domains, in areas such as liveability and place making, public health, and economic and cultural development.

To maximise opportunities for investments that create value, the institutional settings need to support sustainability practice. Collaboration across jurisdictional boundaries and sectors may ensure that projects take account of wider system interactions. In addition, there is a need for policy development, project assurance guidelines, and regulatory processes to align so that these may support project level decision making.

This paper outlines a sustainability evaluation framework for project appraisal. A range of tools are used across the industry to support investment decision making, and often the analysis from these tools form a pass/fail rule for projects to advance. But a focus on analysis tools alone does not ensure sustainability practice. A sustainability approach takes analysis beyond closed economic evaluation to an inter-disciplinary, participative process that includes broader stakeholders and the wider community. The evaluation hierarchy that is presented builds on the understanding that infrastructure investments are multi-layered and also contribute to wider policy goals.

REFERENCES

Ananda, J., 2014. Institutional reforms to enhance urban water infrastructure with climate change uncertainty. *Economic Papers: A journal of applied economics and policy*, 33, 123–136.

Australian Academy of Technological Sciences and Engineering (ATSE), 2015. ATSE Submission to the Senate Environment and Communications References Committee Inquiry into Stormwater Resource in Australia.

Beria, P., Maltese, I., Mariotti, I., 2012. Multicriteria versus Cost Benefit Analysis: a comparative perspective in the assessment of sustainable mobility. *European Transport Research Review*, 4, 137–152.

Bell, S., Morse, S., 2012. Sustainability Indicators : Measuring the Immeasurable?, 2nd ed. Taylor and Francis, Hoboken.

Bond, A.J., Morrison-Saunders, A., 2011. Re-evaluating Sustainability Assessment: Aligning the vision and the practice. *Environmental Impact Assessment Review*, 31, 1–7.

Brown, A., Robertson, M., 2014. Economic evaluation of systems of infrastructure provision: concepts, approaches, methods (IBUILD /Leeds Report). University of Leeds.

Brown, R.R., Farrelly, M.A., 2009. Delivering sustainable urban water management: a review of the hurdles we face. *Water Science and Technology*, 59, 839.

Brown, R.R., Keath, N., Wong, T.H.F., 2009. Urban water management in cities: historical, current and future regimes. *Water Science and Technology*, 59, 847–855.

Brugge, R. van der, Rotmans, J., 2007. Towards transition management of European water resources. *Water Resources Management*, 21, 249–267.

Bryson, J.M., Crosby, B.C., Bloomberg, L., 2015. Public Value and Public Administration. Georgetown University Press, Washington, DC.

Bryson, J., Pike, A., Walsh, C., Foxon, T., Bouch, C., Dawson, R., 2014. Infrastructure Business Models (IBM) Working Paper. iBUILD Briefing Note 2.

Canning, D., Bennathan, E., 2000. The social rate of return on infrastructure investments. World Bank Policy Research Working Paper.

Chan, K.M.A., Satterfield, T., Goldstein, J., 2012. Rethinking ecosystem services to better address and navigate cultural values. *Ecological Economics*, 74, 8–18.

Creswell, J.W., Hanson, W.E., Plano, V.L.C., Morales, A., 2007. Qualitative research designs selection and implementation. *The Counseling Psychologist*, 35, 236–264.

Foxon, T.J., Bale, C.S., Busch, J., Bush, R., Hall, S., Roelich, K., 2015. Low carbon infrastructure investment: extending business models for sustainability. *Infrastructure Complexity*, 2, 1–13.

Gómez-Baggethun, E., Barton, D.N., 2013. Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, 86, 235–245.

Gosling, J.P., Pearman, A., 2014. Decision making under uncertainty: methods to value systemic resilience and passive provision. iBUILD/Leeds Report 43.

Haavaldsen, T., Lædre, O., Volden, G.H., Lohne, J., 2014. On the concept of sustainability – assessing the sustainability of large public infrastructure investment projects. *International Journal of Sustainable Engineering*, 7, 2–12.

Hardisty, P.E., Sivapalan, M., Humphries, R., 2013. Determining a sustainable and economically optimal wastewater treatment and discharge strategy. *Journal of Environmental Management*, 114, 285–292.

Huang, I.B., Keisler, J., Linkov, I., 2011. Multi-criteria decision analysis in environmental sciences: Ten years of applications and trends. *Science of The Total Environment*, 409, 3578–3594.

Infrastructure Australia, 2009. Getting the Fundamentals Right for Australia's Infrastructure Priorities. Infrastructure Australia.

Jackson, S., 2006. Compartmentalising culture: the articulation and consideration of Indigenous values in water resource management. *Australian Geographer*, 37, 19–31.

Le Blanc, D., 2015. Towards Integration at Last? The Sustainable Development Goals as a Network of Targets. Sustainable Development 23, 176–187.

Lenzholzer, S., Duchhart, I., Koh, J., 2013. 'Research through designing' in landscape architecture. *Landscape and Urban Planning*, 113, 120–127.

Littlechild, S., 1988. Economic Regulation of Privatised Water Authorities and Some Further Reflections. *Oxford Review of Economic Policy*, 4, 40–68.

Mekala, G.D., Jones, R.N., MacDonald, D.H., 2015. Valuing the Benefits of Creek Rehabilitation: Building a Business Case for Public Investments in Urban Green Infrastructure. *Environmental Management*, 55, 1354–1365.

Meskandahl, S., 2014. The influence of business strategy on project portfolio management and its success — A conceptual framework. *International Journal of Project Management* 32, 719–892.

Moore, M.H., 2014. Public value accounting: Establishing the philosophical basis. *Public Administration Review*, 74, 465–477.

Mouter, N., Annema, J.A., van Wee, B., 2015. Managing the insolvable limitations of cost-benefit analysis: results of an interview based study. *Transportation*, 42, 277–302.

Ostrom, E., 1990. Governing the commons: The evolution of institutions for collective action. Cambridge University Press.

Pearce, D., Atkinson, G., & Mourato, S. (2006). Cost-benefit analysis and the environment: recent developments. OECD.

Reidy, A. (2018) Incorporating sustainability in investment decision making for infrastructure projects. PhD thesis, Queensland University of Technology.

Reidy, A., Kumar, A., Kajewski, S., 2014. Sustainability in Infrastructure Investment- Building the Business Case, in: Practical Responses to Climate Change. Presented at the Engineers Australia Convention 2014, Engineers Australia, Melbourne, Australia.

Sagoff, M., 2000. Environmental economics and the conflation of value and benefit. *Environmental Science and Technology*, 34, 1426–1434.

Schäfer, E., Scheele, U., 2017. Making Infrastructure Climate Resilient: Bridging the Transformation Gap with "Living Labs"?, in: Deppisch, S. (Ed.), Urban Regions Now & Tomorrow: Between Vulnerability, Resilience and Transformation. Springer Fachmedien Wiesbaden, Wiesbaden, pp. 219–253.

Schatz, L., Rogers, D., 2016. Participatory, technocratic and neoliberal planning: an untenable planning governance ménage à trois. *Australian Planner*, 53(1), 37-45.

Silvius, A.J.G., Kampinga, M., Paniagua, S., Mooi, H., 2017. Considering sustainability in project management decision making; An investigation using Q-methodology. *International Journal of Project Management*, 35(6), 1133-1150.

State of Victoria (Department of Treasury and Finance), 2017. Investment Management Standard 2017.

Stirling, A., 2010. Keep it complex. *Nature*, 468, 1029–1031.

Turner, R.K., 2006. Limits to CBA in UK and European environmental policy: Retrospects and future prospects (CSERGE Working Paper EDM No. No 06-17).

Young, O.R., 2017. Conceptualization:, in: Governing through Goals, Sustainable Development Goals as Governance Innovation. MIT Press, pp. 31–52.

Young, R., Grant, J., 2015. Is strategy implemented by projects? Disturbing evidence in the State of NSW. *International Journal of Project Management*, 33, 15–28.

Young, R., Young, M., Jordan, E., O'Connor, P., 2012. Is strategy being implemented through projects? Contrary evidence from a leader in New Public Management. *International Journal of Project Management*, 30, 887–900.

Walker, W.E., 2000. Policy analysis: a systematic approach to supporting policymaking in the public sector. *Journal of Multicriteria Decision Analysis*, 9, 11.

THE AUTHOR

Dr Angela Reidy

Dr Angela Reidy is a civil engineer and Principal at Inxure Consulting. With over 30 years' experience working across infrastructure sectors including water, her work is centred on project assurance processes and sustainability.