



THE POTENTIAL BENEFITS OF OUTCOME BASED ASSESSMENTS OF INFRASTRUCTURE PERFORMANCE

Andrew Edkins¹, Paul Jeffrey², Paul Nightingale³, Tim Brady⁴, Andrew Davies⁵

1. The Bartlett School of Construction & Project Management, UCL.
2. Cranfield Water Science Institute, Cranfield University
3. Science Policy Research Unity, University of Sussex
4. Centre for Research in Innovation Management, University of Brighton
5. The Bartlett School of Construction & Project Management, UCL.

Who Should Read This White Paper?

The primary audience for this white paper is those engaged in planning physical infrastructure systems and evaluating their performance. Professionals from both the utility and regulatory fields as well as legislators will find the content worthy of attention. Many of the arguments put forward in the paper will resonate with academics and students studying the financing and governance of networked services and those with broader interests in the relationships between engineered systems and social value.

Key Messages from the White Paper

1. An outcomes perspective encourages deeper consideration of adaptive, resilient and multi-purpose infrastructure solutions.

Elaboration: Promoting the use of outcomes can change the basis for infrastructure decision making, business model development, attitudes towards interdependencies and the value of adaptable resilient infrastructure

2. Outcomes based performance metrics for infrastructures present multiple challenges.

Elaboration: In particular, assessing the precise unique contribution of an investment on the target outcome is very challenging. Such challenges need to be identified, discussed and addressed if a transition away from the tendency to base metrics on easier to measure 'outputs' is to occur.

3. Outcomes, as compared with outputs, typically accrue over extended time horizons, which often bridge investment, political and regulatory cycles.

Elaboration: This is important because the use of outcomes creates a risk of Mission creep (in terms of changes to outcome priorities) which can overtake an asset, and compromise the ability to demonstrate the value of an asset.

Abstract

The human race's progress as a species has involved the creation of many types of artefact with arguably one of the most important being the construction of physical infrastructures. From working out how to build our own shelters and securing water supplies, we have identified and pursued the creation of the technologies and networks that we need to allow

us to function in ever larger groups and communities. Thus, as a society we have generated a paradigm comprising both players and principles for assessing which infrastructure to invest in based on a combination of political decision making and a rationalist economic assessment, where measurable estimates of both the benefits and costs are evaluated. The traditional focus of regulators on the magnitude and quality of resources needed (inputs) to deliver a particular level of service or improvements to services (outputs) is now being challenged by an alternative view which assesses higher-level objectives that infrastructure investments seek to achieve, often in terms of customer experience and utility. Such Outcome based evaluations specify the outcome required but leaves the specific measures to achieve that outcome up to the discretion of the infrastructure builder and operator. Through the use of cases and examples from a number of sectors we review the different forms of benefit which infrastructure provides to our communities and examine what performance might mean in the context of such physical systems. This narrative prefaces an analysis of three particularly challenging aspects of outcomes based infrastructure evaluation: Who's outcomes are to be valued? What constitutes an outcome? and How are we to deal with the temporality of outcome realisation? The nuances around these debates will shape both the nature of outcome metrics and arrangements for their auditing.

Keywords

Infrastructure, Value, Outcomes, Performance, Metrics

Connections to Other ICIF White Papers

- People and Infrastructure Based Services: An opportunity for engagement
- Institutional and community Learning journeys and Infrastructure Services: A game changer for effectiveness
- A Critique of Current Infrastructure Performance Indicators: Towards best practice
- Emerging Approaches and Issues in Regulation and Governance of Infrastructure Based Services
- Understanding the Value of a Service-Oriented Approach to Infrastructure Management

Where Can I Find Out More?

For more information please contact: Andrew Edkins. Andrew.edkins@ucl.ac.uk

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The Potential Benefits of Outcome Based Assessments of Infrastructure Performance

1 Infrastructure function and value

Infrastructure pervades and shapes our lives in a number of profound ways. Importantly, a balanced appreciation of the role and value of infrastructure and the services it provides needs to recognise the 'rich mix' of daily experiences that provides the higher levels of utility that economists would seek to estimate and maximise. In the most advanced economies the presumption is that this rich mix of infrastructure will simply be there and work. As consumers or producers, we simply expect the lights to work, the water to flow, the toilets to flush, the wireless internet to be there, trains to run to their timetable, and so on and so forth. Failures of infrastructure based services (power cuts, train cancellations, traffic jams, etc.) cause significant disruption to both our lives and livelihoods (e.g. the economy).

To demonstrate the pervasiveness of infrastructure, take for example the UK's current problem with poor labour productivity compared with the country's peer group (G8 countries). Why is it that since the Global Financial Crisis of 2008, despite increasing rates of job creation leading to record employment there has been no commensurate improvement in the UK's productivity? Whilst there is no single answer to this, the Chancellor of the Exchequer stated in his budget of 8th July 2015 that building more housing on brownfield sites has the potential to address the UK's labour productivity dilemma. This is relevant as housing in this context is unarguably an infrastructural element – it is a fundamental on which we all depend. If we can build this housing infrastructure where it is needed - and the labour market will make it clear where this need is - then we will have economically active people well placed to work – avoiding the need for excessive travel. Thus housing located near to workplaces reduces economic friction (commuting) and thereby boosts productivity.

This is precisely the same argument behind the proposed transport link improvements that lie behind London's Crossrail, HS2 and the transport links that will create the 'Northern Powerhouse', as well as the need to expand airport capacity in the south east. Whether it is a speed improvement or capacity increase, the argument is that more and better infrastructure (in the above cases – that of transport) encourages and leads to better economic performance and greater attractiveness for business and investment.

In addition to infrastructures that underpin economic activity and performance (most notably transport and energy) there is a raft of infrastructures that are dedicated to our social concerns, from the health and education sectors, through the defence and law enforcement sectors, to the cultural and leisure sectors. These forms of infrastructure play a vital role in providing social cohesion and individual wellbeing. Indeed, they are representative of the full scope of human concerns as captured by Maslow's hierarchy of needs – from basic concerns about our health, to the highest levels of 'self actualisation' resulting from the fulfilment to be gained from advanced learning or cultural appreciation.

Infrastructure also has substantial impacts on our society and the environment. In the worst cases, wars and battles are fought over infrastructure as the rights to control it can yield substantial sovereign, political, and economic power. In history we have seen this with wars over control of ports, harbours, bridges and so forth. More recently western European countries that are very heavily dependent upon gas and oil supplied by Russia pay great attention to the troubles in the Ukraine and even more recently we all observe with trepidation the growing problems being played out both on the oil market and in war-torn parts of the middle east as tensions rise between Saudi Arabia and Iran. There are also

emerging political strains along the course of many transboundary river basins where upstream impoundment threatens downstream economic development.

Engineered infrastructures have a contentious relationship with our natural environment.

Much of our built environment and many of our transport systems have become increasingly dependent upon fossil fuel use that has led to the planet's warming through the emission and concentration of greenhouse gases. There is great concern in the scientific community that with ever more infrastructure provision and use the demand for energy arising from fossil fuel use will grow with very real potential for catastrophic and irreversible harm being done to the planet's atmosphere. Without active intervention, it is now increasingly clear that the lag between creating the global warming problem and suffering the effects of the problem means that those in positions of authority will have to use sanctions or radically alter markets in order to change patterns of use and behaviour. Yet given man's ability to do great harm to the environment, infrastructure can limit and channel man's activities to restrict, reduce or even eliminate this detrimental impact. Take for example the sewerage and waste water treatment industries that are part of a country's infrastructural base. By investing in sewerage systems and water treatment facilities, the damaging pollution that man produces *en masse* is both channelled and made more benign. Indeed, contemporary developments in energy and nutrient recovery are driving a transformation in the value of sewage treatment processes and infrastructure with wastewater treatment works becoming producers of energy and agricultural fertiliser rather than simply pollution remediators. This modification to the use to which infrastructure is put provides an illustrative example of the core theme of this paper: the advantages and challenges of new ways of valuing infrastructure systems, value systems which prioritise outcomes over outputs. We describe the fundamental differences between these two ways of evaluating infrastructure performance below but, in order to illustrate the

difference in thinking that is required, it is worth noting that, in the case described above, the removal of nutrients rather than their recovery during wastewater treatment has been the traditional focus of performance measures in the water sector, and that energy recovery has not been used as a direct metric. If the outcomes sought from such systems were the supply of nutrients, energy as well as the obvious need to clean the water then one starts to see the radical transformation that can ensue.

Through the use of cases and examples from different sectors to illustrate our arguments, we review the different forms of benefit which infrastructure provides to our communities and examine what 'performance' might mean in the context of such physical systems. This narrative prefaces a detailed deliberation of the challenges and potential benefits of outcomes based regulation. Our primary intent here is to analyse three particularly challenging aspects of outcomes based regulation: Who's outcomes are to be valued? What constitutes an outcome? and How are we to deal with the temporality of outcome realisation? The nuances around these debates will shape both the nature of outcome metrics and arrangements for their auditing.

2 Assessing the value(s) of infrastructure

For normally logical historical reasons, much infrastructure is seen as being 'owned' by those who funded or invested, designed, built, operated and even set policy for that infrastructure. Thus, today we do not have a single 'infrastructure sector' but rather many infrastructure sub sectors. In the UK this fragmentation of infrastructure is mirrored in the plethora of regulatory bodies overseeing various infrastructural elements – [OFGEM](#) for energy, [OFCOM](#) for communications, [OFWAT](#) for water and sewerage, [ORR](#) for rail and road, [CAA](#)

for aviation, and so forth. This infrastructural sector specialisation has strong justification – whilst there are commonalities in terms of structures of networks and distributed utility, the economics underpinning each market as well as the technologies and resources which comprise any one of the above infrastructures are specialist and often complex. A common concern across all infrastructure sectors has been and remains that many infrastructures lend themselves to natural monopoly. Therefore, there is a need to establish rules and regulations for economic conduct to ensure societal fairness and equity in access to, and benefits arising from, service provision.

Thus, as a society we have generated a paradigm comprising both players and principles for assessing which infrastructure to invest in based on a combination of political intervention (since much infrastructure investment requires such approval), and a rationalist economists' assessment, where measurable estimates of both the benefits and costs are evaluated. This fractional and independent assessment is increasingly being questioned in our modern world; a world that is intensely linked and interdependent. As individuals, as well as a society and an economy, we do not move from infrastructural silo to silo, but rather we interact with many infrastructures in the course of our daily lives and these infrastructures themselves interact with each other. The increasing role of digital information and the digital infrastructure that supports us now means we can be using multiple infrastructures concurrently, indeed as an example of this, the transport infrastructures are working very hard to ensure uninterrupted passenger access to digital networks regardless of location at any point in time as well as having greater appreciation of what is happening and how their networks and its assets are performing.

With this as a backdrop, we can now turn to the critical consideration: how to consider the performance of the infrastructure we have or are considering providing? The answer has been historically technocratic – the functional performance of the infrastructure element. In a resource rationed world, the aim has been to deliver the best ratio of functional performance per unit of cost spent. But even with this seemingly straightforward metric we have issues: what do we mean by functional performance and what are we considering as cost? In a tightly defined and commonly used sense, the functional performance is the technical performance of the asset procured and cost is the cost of provision. An example of this would be a road that allows traffic to use it, built on the basis of the lowest estimated cost of building it. What is wrong with this? Well, consider a situation where the road is to be built between two places that no-one wants or needs to travel between and that for reasons not made clear at the time (cannot have been known or were not considered) the actual cost of the road built is far higher than the estimated cost. Thus we have the prospect of producing a more expensive road than initially thought and in so doing providing a road (or other infrastructural asset) that is not used – this is not sensible, yet it is too often a sad reality.

A major, yet still transitional step is the move to a world where these challenges are handled not by the consideration of *inputs*, but to one that is based on *outputs*. In our road example, measures of output performance might be the utilisation of the provided road (measures of traffic use demonstrate a successful road) and the cost consideration is the 'out-turn' cost that was actually incurred. Again there is widespread use of this type of thinking and practice, resulting in far more interest in the risks that are being implicitly traded between parties. In our roads example the concern will be for those being paid to deliver the road to do two things very well indeed: first – to be certain you can build the road for the price you estimate; second, to do all that you can to be able to predict the amount of traffic that will use the road

once built. In both these areas of consideration there remain factors that are not certain and controllable, but this is true of life in general and at least by focussing collective minds on it one hopes that reasonable proposals are made that on balance prove more true than false.

The question then raised is simple: is the focus on providing such outputs as perfect as we can achieve or as reasonable as we can tolerate? The answer to both these queries would appear to be in many cases no. Whilst it does appear that delivering the outputs sought is better than simply focusing on the provision of collections of inputs, outputs of themselves have not produced the nirvana state some may have hoped for. If we return to our road example we may find that we provide a high quality road that allows traffic to flow on it all the time. The result of such an 'attractive' road may well be it becomes very popular and through what would be commonly known as 'sheer weight of traffic' – to economists it is 'derived demand' – our road becomes clogged as it becomes a victim of its own success. Exactly the same happens on the internet when specific sites become popular and 'crash'. If one focuses on simply outputs, does one simply add more and more lanes to our motorways and highways, build ever bigger planes, ships and trains? Or do we rethink the challenges we are facing?

3 Moving from Outputs to Outcomes

As previously noted, infrastructure provision plays a critical role in any nation's society and economy. It has the potential to play a pivotal role not only in national performance, but on all citizens' lives. Recognising this allows the consideration of infrastructure to move from the assessment of the *outputs* produced to the *outcomes* achieved. In so doing we increase the complexity of the challenge as we need to think carefully about what we mean by 'outcome'

and also infrastructure's role. This is best illustrated through example, so we return to our fictional road.

In an output measured world we have a road that cost to build what we expected and the traffic flow is as predicted – indeed traffic flow is higher! What is the outcome? Well consider what purpose a road serves: it allows the movement of people and goods. Information transportation now can take place through the digital and telecommunications infrastructural worlds, so this is about moving tangible 'stuff' – you, me and the goods we buy/need or that go into the things we buy/need. So moving people and goods around via roads must be linked to employment, production, prosperity and well-being – all good. But in using roads we use predominantly internal combustion engines running on fossil fuels – so we produce greenhouse gases and other noxious gases that are a detriment to our natural environment and health – not good. Is the net outcome positive or negative? The answer depends entirely on the paradigm taken. The current view is that the net positives (social and economic connectivity) outweigh the environmental damage. But this is a dynamic consideration. Coal fired power stations were, and in some countries still are, economically and socially advantageous as coal may be cheap, accessible and abundant. But coal burning is capable of serious environmental damage as the London smogs of the 1950s proved and as Chinese provinces and cities have more recently discovered. Organisations concerned with human health will argue that access to reliably clean potable water would save the lives and improve the wellbeing of millions of people. Providing education has been shown to affect not only economic performance (as would be obvious) but also to help stem runaway population increases. The use of social media (via the telecommunications and digital infrastructures) spread the uprising known as the Arab Spring. It is now a major factor in the spread of religious fundamentalism that is fuelling international terrorism. Thus

infrastructural provision can have a very complex set of outcomes that are capable of being argued over by differing sections of a society and economy.

The traditional focus of regulators on the level of resources needed (inputs) to deliver a particular level of service or improvements to services (outputs) is now being challenged by an alternative paradigm which audits the higher-level objectives that investments seek to achieve (outcomes) – often in terms of customer experience and utility. Outcome Based Regulation (OBR) specifies the outcome required but leaves the specific measures to achieve that outcome up to the discretion of the regulated firm. Outcome based regulation is currently the espoused preference for a number of regulatory bodies in the UK including the Office of Gas and Electricity Markets (Ofgem), the Water Services Regulation Authority, (Ofwat), the Prudential Regulation Authority (PRA), and the Financial Conduct Authority (FCA). Outside of the UK the approach has been adopted by agencies in the USA, Canada and Australia.

OBR allows service providers to be sensitive to local circumstances with service users shaping performance metrics, many of which will be influenced by geography, legacy, and preference. It also provides more freedom in solution selection as performance is not tied to a particular technology or form of intervention. This, in turn, promotes innovation to a greater degree than input or output based regulation. The approach is, however, not devoid of potential weaknesses. For example, the evaluation of high level objectives can be problematic as they might be poorly articulated, dimensionless, or abstract (even figurative) in definition. The value of a networked service can be difficult to express and quantify and outcomes based targets are therefore often formalised as a reduction / eradication of poor infrastructure performance. Furthermore, Outcomes may be influenced by factors outside the direct control of the infrastructure owner thereby confounding any causative association between

investment and impact. Finally,, customer consultation can only go so far in supporting infrastructure design, construction, and operation. Communities will necessarily have variable preferences for different performance aspects of the same piece of infrastructure. Whilst resolution of conflicting service performance preferences is not always necessary, where it is needed we are left with either a reliance on some democratic verdict or a utilitarian analysis which establishes a preferred course of action as a function of total value across all communities (not an uncontroversial approach to settling disputes in this context).

These issues are non-trivial and their resolution is central to any sustainable OBR programme. We argue that in moving from measures of inputs and outputs to measures of outcomes the assessment is not only more complex, but it is also more subjective. This makes the assessment of infrastructure via outcome measures both problematic and contentious. It is, however, a challenge worth tackling as society seeks to better understand the fuller consequences of its actions – both on itself and on the rest of the natural world..

4 Responsibility for the Outcome

Before we move on to consider three particular challenges associated with implementing OBR it is worth briefly commenting on the sometimes awkward forms of infrastructure legacy and the influence that the passage of time has on perspectives of infrastructure value and performance. Providing infrastructure is no meek undertaking and once underway projects can rapidly mount up enormous costs – many of them of them irreversible, irrecoverable and therefore 'sunk'. Both private and public sector actors require persuasive and clear reasons to undertake specific courses of action as such bold endeavours will always be accompanied by alternatives and options. With much modern infrastructure being prone to

natural monopoly, the public sector will often find itself in the 'driving seat' and the spotlight will fall on politicians to make critical go/no-go decisions – and like any big decision – it is never easy nor clear. Whilst we may all hope to live in a world where there is transparency, honesty, objectivity and impartiality, the reality is that infrastructure provision can make dramatic differences to the fortunes and prospects of those affected, and the veracity and relevance of arguments, evidence, and data used to justify decisions are often difficult to ascertain. The consequences of getting decisions wrong can be so profound that politicians can and do exercise themselves greatly to ensure they are seen to handle the decision-making in the most appropriate way. Such decisions have often been generated through bold and assertive leadership – triggering references back to the time of the Great Depression when Roosevelt oversaw the New Deal in the US or when Churchill led the UK Government of National Unity during the Second World War, or much more recently when the UK government appointed an independent expert commission to make the recommendation on how best to expand airport capacity in the south east of England. However the decision is made, once it is made, its impact is both significant and abiding. If the decision was good at the time and proves to be good long after, then everyone is happy, but this is far from being the norm. Although there has been a transition from public to private dominance in infrastructure delivery over the past 50 years, the many Victorians to whom we of the 20th and 21st centuries are still indebted for infrastructure provision, came to rue the investment decisions they made to install the infrastructures we know (and still much appreciate) today. Why? For reasons as familiar today as they were around 150 years ago – the projects took longer, cost more, were far more technically demanding and didn't generate the expected revenues as quickly as predicted. Into this historical basket we can place the Channel Tunnel, which, like its Victorian predecessors, persists as an artefact and service even if its original proponents failed to find the commercial success they expected.

The example of the Channel Tunnel raises an important point about the enduring nature of infrastructural assets and the obligations that come with such a legacy. Whilst there will always be embodied carbon in substantial infrastructural assets that will have to be written off if the asset is abandoned, there can be beneficial exploitation from repurposing. Take, for example the creation of artificial sea-life breeding areas created by the deliberate and carefully planned sinking of offshore oil and gas rigs. To simply 'dump' these at sea would be a justified environmental violation, but to work with marine scientists and other experts offers the opportunity of turning a derelict infrastructural asset (indeed now an infrastructural liability) into a marine asset that could provide a positive outcome for generations. With ever advanced technology we can see easier and cheaper ways of remediating land contaminated by previous use, although there would appear to be nothing that will render harmless easily or speedily all that we do with in the area of nuclear fusion. Long-term deep storage for the waste generated with clear 'stay away for tens or hundreds of thousands of years' signs still seems the only viable option for this form of infrastructure.

5 Three challenges for effective outcome based regulation

Three particularly challenging aspects of outcomes based regulation require resolution: Who's outcomes are to be valued? What constitutes an outcome? and How are we to deal with the temporality of outcome realisation? As noted above, the answers to these queries will shape the mechanisms and methodologies used to monitor and audit performance. These aspects are challenging for one ubiquitous and rather obvious reason. The impacts of infrastructure systems are not all good ... and not all bad. The objective evaluation of impact will vary through time as circumstances and priorities change, and opinions will differ as a function of perspective and experience. To return to our road example, the outcome of the

road could be social cohesion as people move around to interact, we may well have economic prosperity as people and goods move around to produce economic activity that results in net economic benefit. But this same road may lead to accidents, divide communities, exclude those who cannot travel on it, result in congestion, pollution, and damage to the natural environment. Investment choices and design specifications can be strongly swayed by subjective weightings applied to any or all of these benefits and impacts.

As performance metrics, Outcomes should reflect the social and economic impacts and value of an asset base. In this sense they are user driven, reflecting directly or indirectly the benefits which individuals, communities and society accrue from infrastructure operation. But users and their political / regulatory representatives don't hold the infrastructure itself responsible for performance (this would be unfair to an insentient artefact), rather they charge the current owners / management of the infrastructure with operating the asset base effectively, efficiently and, above all, responsibly; thereby securing the intended benefit from the asset base. But are the intended social, economic, and environmental benefits of the infrastructure system (Outcomes) closely enough aligned with the operational space available to the operators to make any evaluation fair on the operator ... and who should we be holding to account if Outcomes are not being met? How do we distinguish at the level of Outcomes between failings in planning (e.g. poor option selection) and weaknesses in operation (e.g. poor maintenance scheduling)? An equitable Outcomes evaluation model will be premised on being able to differentiate between the various facets of infrastructure delivery as both artefact and service when judgement is made at multiple scales and from multiple perspectives. Outcomes based assessment offers the promise of capturing a wider, more inclusive appreciation of value but faces a challenge common to many evaluative processes which seek to gauge public benefit; they need to find some way of efficiently and impartially

aggregating individual views and preferences so that well rounded shared opinions can be used to inform investment and measure performance. They also need to construct user engagement processes which offer real influence for stakeholders and manage expectations around how responsive investment can (or often can't) be to changes in priorities. This democratisation of infrastructure planning and delivery is to be welcomed and recent debates in the field of political economy may offer guidance to those wishing to develop associated consultation processes and performance metrics. The work done in the transportation sector by Theodore Grossardt (University of Kentucky) and Keiron Bailey (University of Arizona) is instructive in this context as it translates the combined objectives of distributive, procedural, and access justice into practical public consultation processes.

Our second challenge around the nature or form of outcome measures is often closely aligned with the intended function of infrastructure (i.e. why did we build it in the first place) and, as noted above, with user priorities. The often obscure and complicated network of cause-effect relationships between infrastructure provision and outcomes for communities, the environment, or the economy coupled with the multitude of non-infrastructure related factors which can influence wellbeing, environmental quality, and economic health make the specification of outcome measures and interim components problematic. For example, improvements in car journey times can be influenced by petrol price rises just as readily as by more / better roads with the latter mechanism arguably having negative value for the environment. The transition from Outputs to Outcomes propels the evaluation challenge into a genuinely complex setting, one not only where the magnitude of elements and their connectivities are large but where the pattern of connectivities and range of influencing factors change over time. What to measure or assess becomes arguably impossible in the absence of a wider appreciation of those processes which affect the objective function(s).

An interesting addendum to the 'who' query posed above is the sense in which inter-generational judgments on the achievements or failings of infrastructure investments are made by politicians, historians, and communities which had no say in the design or purposing of the artefacts (the temporality of outcome realisation). Outcomes therefore require a set of assumptions to be made about the continued functionality of infrastructure as well as about the relevance and role of an infrastructure in an ecology of inter-related physical systems and value propositions. In this sense, we argue that effective Outcome specification requires belief in a particular future, the realisation of a specific assembly of conditions; something that is not the case for Outputs. Consequently, many external factors will influence Outcomes, the most capricious of which is perhaps political expediency. Both the setting and evaluation of Outcomes are therefore inherently partially 'political' (with a lower case p) processes. The grand reasoning for scheme construction is often contentious at design stage and will be obscured by subsequent fluctuations in the ambition, emphasis, and claims to justification of succeeding administrations (whether political or commercial). Similarly, in terms of changing circumstances, infrastructure can become repurposed as performance priorities change around an ageing asset base (remember the wastewater treatment example given above). The economic or social value delivered by the system can be enhanced or completely transformed by previously unidentified desires or developments – as was the case with the early railway systems in the UK that never envisaged transporting people as the railway was intended as a way of hauling freight only. Seemingly redundant or failed investments can catalyse other initiatives with value both distinct and different from their original intended benefit. How then should we allow for such transformations in our evaluation of Outcomes and, more directly, can the Outcomes of infrastructure investment be fairly judged at any single point in time? Indeed, should we be comfortable with post-hoc

rationalisation of infrastructure benefit or constraint infrastructure operators with an inflexible set of metrics which we deem appropriate for all conditions? Formulating measurable outcomes which go beyond often nebulous appreciations of customer or user satisfaction with service levels (reliability, time to repair, value for money etc.) becomes a major challenge for infrastructure operators where users are given the power to determine target outcomes. Investment in supporting infrastructure user communities to formulate and articulate outcome targets and measures will be rewarded in this context

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