Living Lab

Transport Infrastructure Efficiency Strategy

TIES LIVING LAB PROGRAMME

Consistent metrics for benchmarking infrastructure projects (IP5a)

October 2022

INTRODUCTION

Establishing and using performance metrics and benchmarks is widely recognised as a business necessity in the 21st century. A core aim of the TIES Living Lab Programme was to develop benchmarks that can be used to assess the whole life performance of projects – from inception to delivery and beyond. Without these tools, how can we know where there is potential for improvement? How can we know what to do to bring about improvement? And how can we demonstrate to others that we are improving?

This information paper describes how the TIES Living Lab data research team, known as the Analytical Consortium, used the test-bed of the four modern methods of construction (MMC) demonstrator projects to establish a consistent set of metrics for capturing the context and performance of projects, as well as for benchmarking to monitor improvements and for sharing to increase best practice across the industry. This work – under the project on Metrics, Benchmarking & Repository – has provided insights into the additional value that can be achieved through MMC. It also sets a framework against which future demonstrators can be assessed.

BACKGROUND

The Infrastructure and Projects Authority advocates setting metrics and using benchmarking to improve delivery performance in its 2021 publication *Best practice in benchmarking*, and the UK Government's *Construction Playbook* (2020) suggests that "Projects and programmes should undertake benchmarking to analyse information from past projects and programmes … [to provide] decision-makers with key insights and data…" to help the sector deliver ongoing improvements in project delivery and high-quality value-for-money infrastructure assets.

Benchmarking experts among the TIES Living Lab Partners have used the context of the four physical demonstrator projects as the starting point to work collaboratively to define core metrics across nine performance areas. Their objective was to select metrics that can be collected and measured consistently (benchmarked), and can then be used on future projects to understand the impact of modern methods of construction.

For this study, the Analytical Consortium adopted the following definition:

> *Benchmarking is the continuous process of measuring products, services and practices against existing best practice for the purpose of effecting improvement.*

CHALLENGES

What constitutes a "good" metric? The answer to that question depends on what the metric is going to be used for. If the aim is simply to track progress, metrics can be relatively high level. However, when the aim is to identify the cause(s) of differences between one project and the next, as the Living Lab Analytical Consortium set out to do, considerable granularity is required so that it is possible to identify precisely where differences arise, and to ensure that the projects being compared share similar features and context.

At present different parts of the transport infrastructure supply chain work with different sets of performance metrics. That makes it difficult to effectively implement a benchmarking process based around the end product or service they are tasked with delivering. Challenges include:

- Differences in organisational strategic objectives
- Differences in definitions and scope of metrics (e.g. what is included in indirect costs; what are the boundaries of the preliminary design stage?)
- Inconsistent use or absence of metrics across all stages of the asset's life cycle
- Differences in maturity levels (e.g. some metrics are a policy requirement; others are still at an embryonic stage of development)
- Metrics currently tend to be designed to report performance at a high level (e.g. total cost of a station), so cannot be used for deep-diving to investigate root causes of differences and where the potential for improvement might lie.

The Analytical Consortium identified that these challenges are both data- and people-driven.

COLLABORATION AND CONSENSUS

Extensive engagement with the TIES Partners in the four demonstrator projects (IP2, IP3, IP4 and IP14) was fundamental to help the Analytical Consortium identify appropriate metrics and benchmarks.

The engagement process itself became an important demonstrator for the Living Lab overall, through the development of Communities of Practice comprising subject matter experts from the TIES Partners and members of the Analytical Consortium drawn from partner research organisations.

The Communities of Practice approach enabled the Analytical Consortium to achieve consensus around four key questions:

- What to benchmark
- What metrics to use
- How to ensure data consistency
- How to capture the context of the data.

What to benchmark

Preliminary explorations identified nine core performance areas where benchmarking adds value to infrastructure projects: cost; schedule; productivity; quality; carbon; circular economy; biodiversity and natural capital; climate resilience; and social value.

Work on each performance area was informed by the experts participating in a Community of Practice.

In addition, for any one infrastructure asset there should be metrics that account for the typical eight stages in the asset's life cycle: pre-design; preliminary design; detailed design; construction (including manufacture, transport and installation); renewals; operation; maintenance; and decommissioning.

This implies the need to gather data for some 80 metrics per asset.

TIES Living Lab performance metrics

Performance area	Number of metrics
Cost	•••••
Schedule	••••
Productivity	•••
Quality	••••
Carbon	••••••••••••••••••
Circular economy	••••••••••••••••
Biodiversity and natural capital	•••
Climate resilience	•••
Social value	••••••••••••••••••••••••••••

What metrics to use

The key to successful benchmarking is to make data collection as effort-free as possible, while ensuring that only the most useful data – those elements of performance that have the greatest impact on out-turn – is collected.

The team used the principle of "cost significance" and the "mean value theorem" to identify what to measure. In essence, this means considering only data with a higher value than average. In general, around 80% of the value of a project is contained in only approximately 20% of the items for which there is a cost. And the value and number of the remaining 20% of "significant" items can vary considerably. That principle enabled the team to guarantee that the data collected by the TIES Partners would yield most information for minimum effort.

Within that context, metrics were chosen on the basis of:

- Relevance and scope – relating to organisational strategic objectives
- Diagnostic capability – to help identify the causes of any deviation from the benchmark
- Level of detail – balancing detail and the practicality of collecting the data
- Familiarity – the more familiar a metric is to a user, the more likely it is to be used
- Coverage – some metrics might be more appropriate than others at certain project stages
- Unit of measurement – with normalisation to account for differences in, say, project size or capacity.

Data consistency

It is crucial to establish a consistent framework to ensure that different partners collect the same data in the same way.

Such frameworks do exist. For example, the starting point used in this project was the International Cost Management Standard (ICMS), which provides a consistent elemental breakdown for both building and civil engineering projects and embraces both whole life costs and carbon emissions. However, that framework required considerable modification to accommodate the needs of different partners. The Communities of Practice model proved invaluable for this part of the work.

The table below shows the common breakdown structure adopted, using a bridge as an example of an asset.

Level	Description	Example for a bridge project
Level A	Asset – whole life performance of an asset	Bridge
Level B	Stage of delivery of asset	• Preliminary design • Detailed design • Off-site manufacture • Construction/installation • Renewal • Operation • Maintenance • End of life
Level C	Group (e.g. for construction, renewal and maintenance)	• Demolition • Substructure • Structure • Non-structural work • Services and equipment • Surface and underground drainage • External and ancillary works • Preliminaries/overheads
Level D	Sub-group	Further details below sub-groups

CAPTURING THE CONTEXT OF THE DATA

Performance metrics are of limited use unless more is known about the context in which they were collected or derived. But context is a nebulous concept: in terms of infrastructure assets, "context" is best captured using an agreed series of attributes and associated values that summarise the principal physical features of a project and the conditions under which it is realised – particularly the characteristics of an asset that could have a significant impact on performance. This additional information makes it possible to:

- Compare like with like
- Determine appropriate ways to normalise data*
- Understand the drivers of performance.

*Determining the most appropriate metric for normalising results requires expertise in a number of statistical and analytical techniques. These are the subject of a separate information paper (IP9).

Examples of attributes agreed for use in the Living Lab project

Common attributes
• Brief project description Function, type, location
• Basis of pricing Fixed price, reimbursable, price ruling date, discount rate
• Procurement method Design and build, target, construction management
• Prevailing physical conditions Ground conditions, access, site conditions and constraints
Bridge-specific attributes
• Functional type Under/over, carrying road, rail, pedestrian traffic
• Principal design features Materials, complexity, design life
• Principal physical dimensions/quantities Span, height, width, deck area including ramps, number of piers
• Functional quantities Capacity

LESSONS LEARNED

- Benefits are likely to accumulate gradually, which means it is not possible, at the outset, to produce a business case justifying a change in metrics and the necessary data collection.
- Developing a culture based on joint learning is an essential part of agreeing cross-organisation metrics for benchmarking. But this can take time to develop, and requires intensive dialogue.
- The ratio "value added" to "cost of data collection" must be optimised. In this respect, application of the principle of cost significance and the mean value theorem is beneficial.
- Shared data needs to be held in a central, secure repository to which access is properly regulated and in which contributors have complete confidence.
- Communities of practice are essential for embedding consistent metrics and collaborative benchmarks across organisations.
- The process of developing consistent, cross-organisation metrics and benchmarks leads (albeit slowly) to a sharing and supportive collaborative culture.

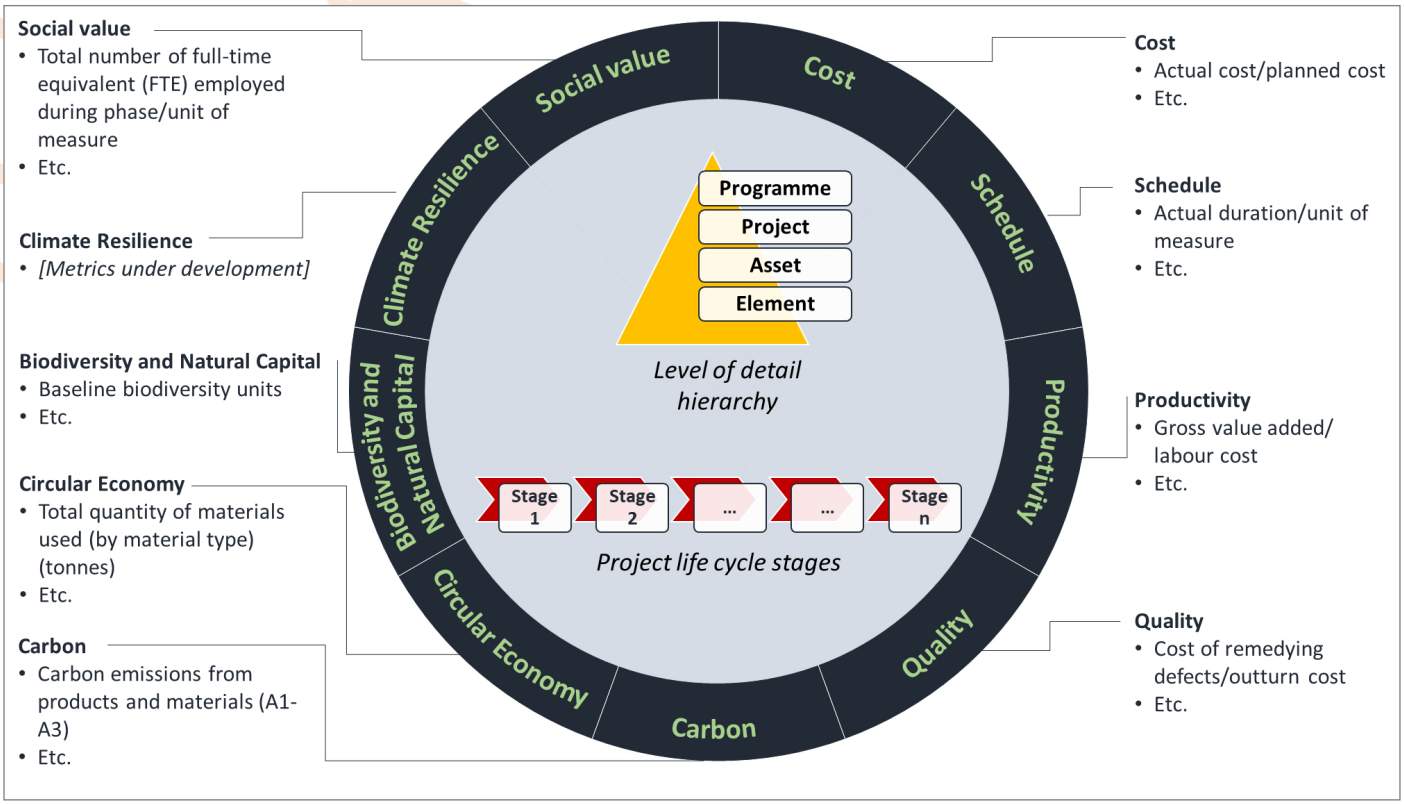
LEAVING A LEGACY

The communities of practice are responsible for implementing the benchmarking legacy of the TIES Living Lab and subsequently using benchmarking to inform investment decisions.

The legacy is encapsulated in a set of protocols which specify:

- What data is to be collected
- How it is to be collected
- How it is to be cleansed, stored securely and analysed
- The principles of governance to be implemented.

The protocols are also the subject of a separate information paper (IP8).



Project life cycle stages

The figure above illustrates the nine performance areas with examples of the agreed metrics for one asset type.

This work, under the project on Metrics, Benchmarking & Repository, was coordinated by Doug Forbes of Whole Life Consultants Limited and delivered by experts from the TIES Living Lab Analytical Consortium (Accelar, Loop, University of Dundee, University of Leeds, University of West of England (UWE Bristol), and Whole Life Consultants Limited), overseen by the Cost and Performance Benchmarking Steering Group (Network Rail, National Highways, HS2, East West Rail, Transport for London, Department for Transport and the Infrastructure & Projects Authority).

Living Lab

Transport Infrastructure Efficiency Strategy

The TIES Living Lab is a transformative collaboration of 25 partners together with Government, i3P and the Construction Innovation Hub that use data, technology and Modern Methods of Construction within live transport infrastructure projects to deliver significant value-adding benefits across the transport infrastructure sector. The programme is funded via a grant from Innovate UK through the Transforming Construction programme, plus contributions from the Department for Transport, HS2, Transport for London, Network Rail and National Highways.

The four strategic outcomes of the collaboration are to:

1. Improve the way Transport Infrastructure projects are set up to maximise value
2. Achieve better assurance of project and programme value and what assets should cost (benchmarking)
3. Accelerate the wider adoption of MMC
4. Establish the TIES Living Lab as a catalyst for long term cultural change across sectors by making a compelling case for long term HM Treasury funding to scale this facility.

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