Infrastructure and Projects Authority

UK Government

Project Development Routemap

for Infrastructure Projects

International Module

Interactive document

Asset Management

International version of UK Government's Project Routemap

Handbook Hb 00

Rationale Ra 01 | Governance Gv 02 | Systems Integration SI 03 | Execution Strategy ES 04 | Organisational Design & Development OD 05 | Procurement Pr 06 | Risk Management RM 07 | Asset Management AM 08

Infrastructure and Projects Authority

UK Government

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Contents

Preface

The UK Infrastructure and Projects Authority (IPA)[1] is proud to present this international module on the Project Development Routemap for Infrastructure Projects.

Projects that enhance and expand access to infrastructure are critical to achieving inclusive, sustainable growth and reducing poverty. However, infrastructure projects often encounter problems in their early stages. Poor project development constrains project delivery and limits the benefits it can drive from investment.

The Project Development Routemap (Routemap) is a structured and tested methodology used to set up projects for success. It ensures best practice and learning about the most common causes of project failure are considered at crucial early stages of development. In this module, we use the term 'project' to encompass projects, programmes and portfolios.

Routemap principles are core to any infrastructure project, and especially helpful where project teams undertake complex projects that test the limits of their organisational capability. It is a structured approach that brings project stakeholders together, to improve project-specific capabilities, enable governments and supply chains to maximise value for money and, where appropriate, increase opportunities for international investment. It gives confidence to people developing projects, those approving them, and those investing in them.

Since 2012, Routemap has been applied in the UK to projects totalling over £300bn, with significant and sustained impact on public policy, professional practice and economic benefit.[2]

Routemap aligns with the G20 Principles for the Infrastructure Project Preparation Phase (the G20 Principles), the United Nations Sustainable Development Goals (in particular, supporting environmental and social sustainability) and was identified by the Global Infrastructure Hub as a leading practice in good project preparation.

This international module was produced as part of the Global Infrastructure Programme[3], sponsored by the UK's Prosperity Fund[4] to provide practical instruction on the Routemap. It builds on both UK and international experience and is tailored to the needs of audiences in a broad range of countries. The IPA would like to thank the United Kingdom's Foreign, Commonwealth and Development Office and embassies, and the governments of Colombia and Indonesia who have provided invaluable assistance in the development of the Routemap for international use.

We hope this guidance is useful, practical and will improve the quality of infrastructure development in your country.

[1] The IPA is the centre of expertise for infrastructure and major projects, sitting at the heart of Government and reporting to the Cabinet Office and HM Treasury in the UK.

[2] The Project Development Routemap has been adapted from the UK Project Initiation Routemap, 2016, now replaced by Project Routemap, 2021: https://www.gov.uk/government/publications/improving-infrastructure-delivery-project-initiation-routemap.

[3] This was a UK cross-government programme delivered by the FCO, the IPA and the Department for Business Energy and Industrial Strategy. It aimed to enable the provision of sustainable and resilient infrastructure, as a critical enabler for economic development in middle-income countries.

[4] The Prosperity Fund supported the UN Sustainable Development Goals and the 2015 UK Aid Strategy by promoting growth and prosperity in developing countries.

Introduction: Routemap Modules

The Routemap modules (modules) help you to identify and address gaps in capability across seven commonly challenging areas of project development. You should use these modules alongside the *Project Development Routemap for Infrastructure Projects: International Handbook*.[5]

The Handbook explains the Routemap methodology and describes the 10-step process for its application to projects, which results in a detailed action plan to close the gaps in project capability.

There are eight modules, one covering each of the following areas:

- Rationale
- Governance
- Execution Strategy
- Organisational Design & Development
- Procurement
- Risk Management
- Asset Management
- Systems Integration (UK module, included due to relevance for international audiences)

The module content applies to all types of infrastructure projects, including PPP and publicly funded projects. It supports project teams to identify risks to project outputs, and wider economic, environmental and social outcomes. It helps align projects to the G20 principles of 'quality infrastructure',[6] internationally recognised standards like the International Finance Corporation Performance Standards,[7] and the United Nations Sustainable Development Goals.

There are also examples of good practice to help project teams plan and improve project development. They come from the experience of UK public sector-driven infrastructure projects and from international authorities. Examples have been specifically selected for relevance to international audiences.

Routemap modules can be:

- useful when applying the Routemap 10-step process which is described in the Routemap handbook (the following diagram shows how the sections of the module support different steps in the process)
- a stand-alone resource to identify potential risks and improvements in project capability development, and relevant good practice from other projects

The modules are not a complete guide to project development, nor a substitute for business case development.[8] They are based on real-world experience from large infrastructure projects and complement best practice found elsewhere. You need to consider each project's individual characteristics and context and then you can identify what will be most helpful to the project.

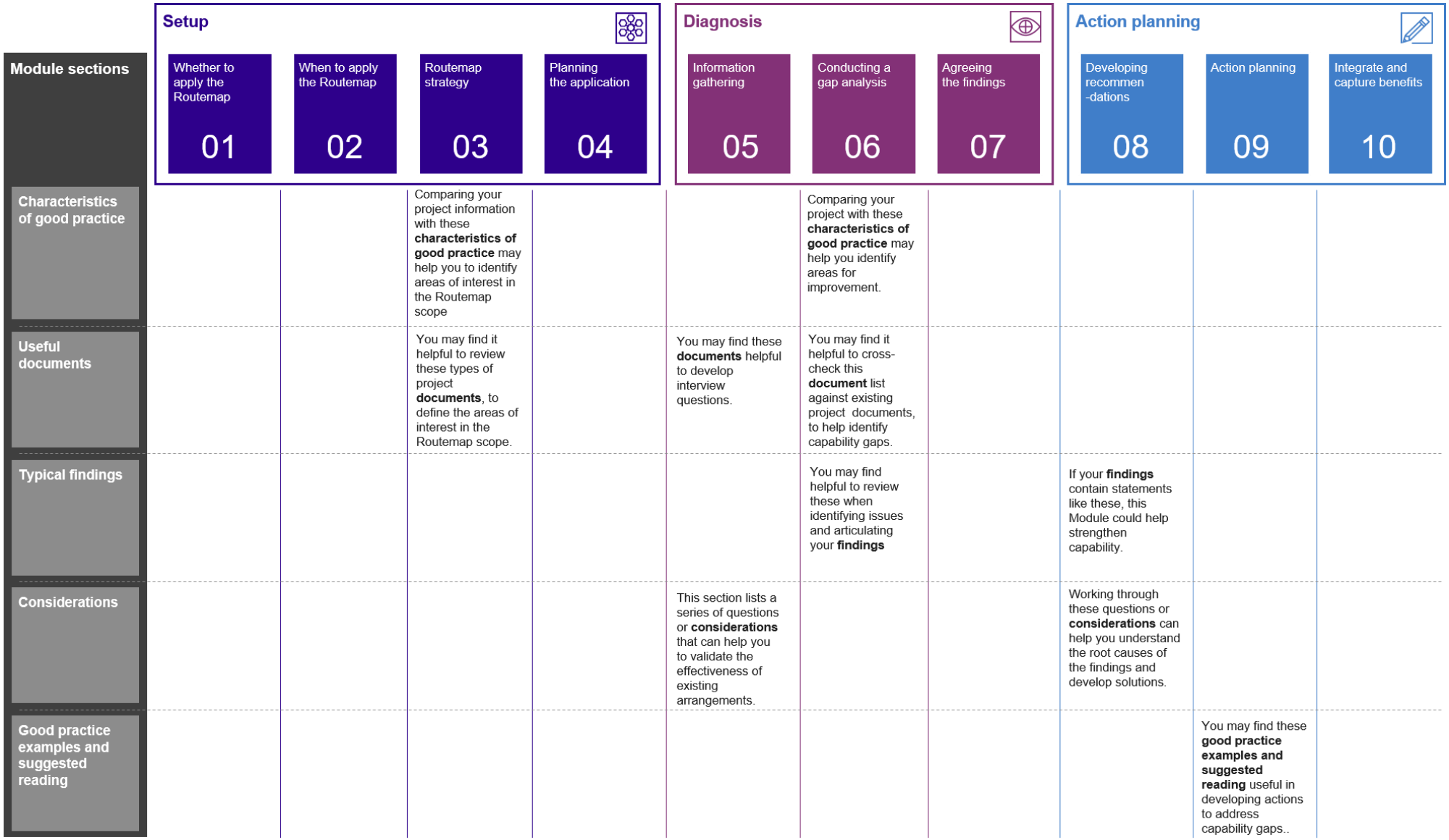
[5] Infrastructure and Projects Authority's Project Development Routemap for Infrastructure Projects: International Handbook, 2020: https://www.gov.uk/government/publications/project-development-routemap

[6] These non-binding principles reflect the G20's common strategic direction and aspiration for quality infrastructure investment: https://www.g20-insights.org/related_literature/g20-japan-principles-quality-infrastructure-investment/

[7] See Section 1 and Appendix E of the Routemap Handbook for further detail on the importance of sustainability.

[8] For detailed guidance on infrastructure business cases and their development process, see: Infrastructure and Projects Authority's Infrastructure Business Case: International Guidance, 2022.

The Routemap modules are useful when applying the Routemap 10-step process which is described in the Handbook. The diagram below shows how the different sections of the modules (listed in the left column) can support the different steps in the process.



Asset management, and why it is important

An infrastructure project is an intervention to either create or improve an existing asset base.

A newly built or improved asset can have both direct and indirect impacts for the public, the environment and the economy. Its ongoing operation and management is equally as important as its creation.

Assets provide value to an organisation and its internal and external stakeholders. Asset management focuses on maximising the value that assets provide. Effective asset management realises value by balancing financial, environmental and social impact, risk, quality of service and performance criteria throughout an asset's life. Only by explicitly addressing the question of what happens *after the project* can organisations ensure they have the right capability to realise the full asset value and expected benefits.

The good practice in this module can help you to deliver working assets with sustainable long-term benefits at handover into operations, and to manage risks throughout the asset lifecycle. It will help you to take a structured approach to asset management and realise more value from your project outputs.

A structured asset management approach is very important in complex publicly funded or multi-organisation projects such as PPP and consortium-led projects. Your approach should not only refer to the activities and outputs to be delivered through a specific asset but also explain how those activities and outputs will contribute to the wider organisational strategy and purpose.

When developing a project to construct an asset, it is essential to consider the capabilities of both the project team and the wider organisation, as many of the benefits will be derived long after the project is complete. This means that the client organisation must have in place the necessary capability and capacity to renew, operate and maintain the asset if the projected benefits are to be realised successfully over the lifecycle of the project.

A comprehensive asset management strategy will consider what happens after project close, encompass many organisational levels and apply to all functions and departments. It should include a value for money assessment and plan for the ongoing operational management of the asset. The assessment should take into account:

- Whole asset life costs (total cost of ownership including construction, operation and disposal) and value
- Key lifecycle performance parameters (including asset availability, reliability, quality and operational and environmental management requirements)
- The changing environmental and social risks and impacts associated with asset handover, operation, maintenance, , end of life re-uses of decommissioning, e.g. for projects related to energy generation, and how to mitigate them
- Climate risks associated with the asset over its life, and the impact of these on the asset management strategy and operational management plan
- The external physical and stakeholder environments and their impact on future performance capabilities
- Sustainable finance and investor expectations regarding Environmental, Social and Governance (ESG) criteria, such as de-risking of portfolios and longer-term value generation.

The Routemap handbook contains the asset manager capability assessment as part of the Routemap 10-step process.[9] This helps project teams understand the key constraints and requirements for operating and maintaining the asset they are developing. It also assesses if the sponsor and client organisations are able to undertake their responsibilities relating to asset management.

It is good practice to have a dedicated project asset manager or *senior user*, who has the skills and time to oversee the project from a long-term business perspective. The senior user should be appointed by the client and will have oversight over the operation of the asset, to realise the full benefits sought by the project. The senior user should have a role in the testing and commissioning of the asset, and will be responsible for its acceptance into operations and maintenance. During the project planning stages, they will specify the required availability and reliability parameters and will ensure that maintenance outages are planned in a way that ensures minimal disruption to the intended benefits. This will enable the assets delivered through the project to realise their expected benefits and make positive impacts, including for project affected persons or communities, beyond immediate outputs.

The IPA's Infrastructure Business Cases: International Guidance[10] details the steps you need to take to plan and develop asset management approaches and capabilities through the business case stages (mainly within the management case and commercial case).

Citations

'Asset Management is the systematic and co-ordinated activities and practices through which an organisation optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over the life cycle for the purpose of achieving its organisational strategic plan.'

(PAS55, 2008)

[9] Project Development Routemap Handbook, Annex D.

[10] Infrastructure and Projects Authority, Infrastructure Business Cases: International Guidance, 2022

Characteristics of effective asset management

The relationship between corporate asset management and the project team is key to successfully delivering the project outcomes. The expected benefits of the project will only be realised through the combined capability of both the asset manager and the project.

An effective asset management system should function through the whole life of the asset, looking at both short- and long- term implications in terms of cost, risk, performance and sustainability. The system should support the strategic goals of the organisation and enable the expected benefits to be realised, to justify the project. It should include:

- asset management strategy, including strategic engagement with asset operators and/or supply chain
- asset management objectives
- asset management plans, including regular reporting on environmental and social risks
- asset management implementation (capital investment, maintenance, renewals and disposals)

Organisations are more likely to realise and maximise project benefits when:

- there are clear lifecycle enabling strategies covering: operations; maintenance; asset risk management; asset information management; supply chain (operational as well as capital); and handback (which is especially important for PPP projects)
- investment is designed to deliver optimum whole life asset management outcomes, unconstrained by annual spending reviews or capital/revenue settlement splits
- the wider economic, environmental and social sustainability considerations are fully recognised and managed. These can drive additional benefits, e.g. widening the applicable customer base, or can constrain the long-term benefits of the project if not managed, e.g. future proofing to account for more energy-efficient operational regulations
- there is integrated planning for handover to operations that considers the operational capability (including ability to manage existing and emerging environmental and social risks) and information requirements (asset condition details) as well as the operational impacts
- the maintenance strategies optimise the availability of the asset, to capture the benefit streams which justified the project
- benefit delivery is confirmed and lessons learned are captured through a post-delivery review

Effective asset management is characterised by three pillars. The sponsor and client need to understand these, to develop their approach to asset management.

Pillars of effective asset management

Three key components underpin effective asset management for infrastructure projects. If one pillar is missing or out of balance, asset management will likely be ineffective or inefficient. The pillars are expanded in the *Considerations* chapter of this module.

In Routemap, these pillars support **(Step 6)** – *Gap analysis*. Considering them in the context of your current asset management strategy can help you to identify areas for improvement.

Pillar 1: Strategic alignment and outcomes

Any significant infrastructure project needs to consider:

- the asset management context within which the project is delivering
- how the physical asset portfolio contributes to organisational goals, strategy and sustainability targets
- the risks and requirements of the wider corporate asset management strategy

Pillar 2: Whole life value

- How to optimise whole life value from the project outcomes
- Understanding the total cost of ownership through a whole life cost/benefit analysis, as part of business case development
- Considering both capital and operational costs in both policy and project requirements
- Planning for decommissioning and asset disposal, particularly in the context of a circular economy

Pillar 3: Performance and information

- How to use asset performance information to shape project development and delivery of outcomes
- Lifecycle enabling strategies (including operational, maintenance, ongoing risk, supplier management and asset information management) should be considered and aligned for project initiation, to ensure realisation of project benefits upon completion. This:
  - Requires regular capture, assessment and sharing of asset information with the Senior User, with those responsible for the project's asset management function, and with wider stakeholders
  - Includes specific reporting on environmental and social risks and benefits

What is climate resilience and mitigation and what does it mean for asset management?

Under the UN Framework Convention on Climate Change,195 countries have agreed emissions reduction targets. For example, the UK has pledged to reduce emissions by 68% from 1990 levels by 2030, and 100% by 2050. But even the Convention's most ambitious target (limiting the rise in global temperature to 1.5°C above pre-industrial levels) will still result in significant climate change impacts, many of which are already being experienced – droughts, wildfires, extreme weather events, sea level rise, coastal erosion.

Climate mitigation refers to actions which governments, companies and individuals take to reduce future emissions in line with these targets. **Climate resilience**, or adaptation, refers to actions taken to protect against these future damages

Project teams, organisations and asset managers have responsibilities in both areas.

Climate mitigation

At the organisation level, mandatory reporting (as well as voluntary reporting driven by reputation, values or shareholders) will require investors, asset managers and operators to report on the lifecycle emissions of their assets. This will increasingly flow down to project-level reporting standards, e.g. GHG Project Protocol / Science-Based Targets Initiative (SBTi). Local and national regulations place further requirements on asset owners and operators which vary by sector.

In practice, mitigation strategies affect all aspects of the asset lifecycle. Many overlap with good asset management practice, e.g. efficient energy usage and intelligent maintenance scheduling, but others require trade-offs – sustainable building materials can be more expensive, and diesel generators provide more reliability and availability than on-site solar. Asset management strategies should embed climate mitigation alongside other key lifecycle parameters such as availability, reliability and value for money.

Climate resilience

Climate risk assessments should be embedded into asset risk management. It should consider the following risks:

- risks to the asset itself (during construction or useful life)
- risks to networks (supply chain, power cut affects water treatment)
- risks to service levels (low rainfall causes water distribution failure)

Climate risk assessments should be highly specialised based on risk type, e.g. flooding vs drought; asset/sector type, e.g. electricity vs. rail; local factors, e.g. topography; and network factors (see 7. Good practice). Climate mitigation and risk should be considered across the three pillars of effective asset management, see below:

Pillar	Mitigation	Resilience
1.Strategic alignment and outcomes	Asset emissions should be in line with organisational sustainability objectives and mitigate organisational risks (reputation, reporting, targets) as well as asset risks, e.g. stranded assets	Climate risk affects the asset management context; detailed climate risk assessments should inform ongoing asset management strategy
2. Whole life value	Financial costs and benefits of adopting mitigation strategies and resilience measures across the asset life should be included in whole life cost	
3. Performance and information	Emissions and other environmental impacts, e.g. on biodiversity, must be tracked as a key performance metric and included in strategy	Climate risk assessments should be updated frequently, and consider asset risk, network risk and service level risk

Useful documents

These documents, components or reports usually contain information on asset management. They may be helpful when reviewing and developing asset management arrangements for your own project.

- Asset management strategy and plan
- Asset information requirements
- Organisation information requirements
- ISO 9001 and 55001
- BIM Level 2
- Strategic risk register
- Environmental and social impact assessment (ESIA)
- Environmental and social management plan (ESMP) section on handover and operations & maintenance (O&M)

You may find it useful to review these documents to identify the areas of interest when scoping a Routemap **(Step 3)** – *Routemap strategy*.

These documents may also be helpful in **(Step 6)** – *Gap analysis*. When cross-checked against existing project documentation, they may help to identify capability gaps.

Typical findings related to asset management

This list describes typical issues that might arise during project development, and would indicate that the approach to asset management needs improvement:

- ❑ The requirements, business case and design indicate a lack of future thinking and/or inadequate links to the corporate asset management strategy
- ❑ There are no or inadequate lifecycle parameters defined in the requirements, e.g. asset reliability, availability, whole life cost assessments, cost of maintenance, operability or disposal
- ❑ There is limited use of asset information in developing project requirements and techniques such as Building Information Modelling (BIM), are not built into project development activity
- ❑ There is currently no specified requirement for lifecycle asset strategies, or plan and budget in place to develop one
- ❑ The environmental and social management plan (ESMP) fails to set out risks relating to the likely operational model, which means that key risks to project affected communities and operating and maintenance staff have been missed
- ❑ There is no clear reporting requirement relating to environmental and social risks or plans to manage those risks within the asset management system. Asset Management Plans are not assessed against internationally recognised standards
- ❑ The project does not have a strategic plan for maintenance, asset information, and risk management, before handover to operations and maintenance.
- ❑ There is no strategic engagement with the operators and/or supply chain to ensure that the project solution is defined, developed, constructed and handed over appropriately, including post-project support
- ❑ There is no process of community engagement or consultation with potential service users and operators as part of the asset management approach. This is crucial for identifying new and emerging risks and ensuring a sense of ownership
- ❑ There is a lack of consideration of how the asset will provide economic, environmental or social value in the long term, e.g., reducing resource use, achieving net zero goals; and how this may be impacted by changes in legislation or risk, e.g., climate risk

During Routemap, these example findings may be helpful when identifying issues and articulating your own findings **(Step 6)** – *Gap analysis*.

If your findings contain statements like these, this module could help you to develop recommendations to strengthen capability **(Step 8)** – *Developing recommendations*.

Considerations for effective asset management

The considerations questions help you understand the root causes of the capability gaps and suggest improvements. You may not need to review all the considerations, just use the most relevant ones for your project.

These questions will help you

- to validate an existing asset management system
- to target areas for improvement
- to test the design of a new asset management system

The considerations are grouped around the three pillars of effective asset management: strategic alignment and outcomes, whole life value, and performance and information.

The asset management approach may evolve during the project, so you should revisit the considerations at major transition points or approval points

During Routemap, working through these considerations can help you to validate the effectiveness of existing arrangements **(Step 5)** – *Information gathering*.

They can also help you identify reasons for the findings and ways to address them in **(Step 8)** - *Developing recommendations*.

Pillar 1: Strategic alignment and outcomes

Key areas/considerations

Asset management strategy

- Is there a clear strategy for the overall asset portfolio and the associated resources, information and other enablers to develop and deliver the project?
- Has the asset management strategy been informed by consultation and engagement with potential users and project affected communities? Is there local buy-in?
- Is there a sense of ownership of the project by the asset manager?
- Is there a forward looking, risk-based strategy based on an understanding of the relationship between asset operation and business outputs, e.g. levels of service?
- Does the proposed project fit within the asset management strategy and the corporate objectives?
- Have new and emerging environmental and social risks relating to asset handover, operation and maintenance been assessed?
- Has the optimum approach to the project been determined, to support a successful business case? Is this approach still appropriate in the context of the wider corporate objectives and asset management strategy? (It may be a balance of operational and capital activities, including activities elsewhere in the portfolio.)
- Is there an appropriate prioritisation mechanism for asset interventions, linked to the organisation's corporate goals?
- Is there appropriate and aligned decision making (planning, capital and operational) that consistently considers the whole asset life and value, including wider environmental and social sustainability considerations?
- Does the asset management strategy consider how to contribute to a circular economy, i.e. one in which waste is limited and resources are used for as long as possible?

Requirements and objectives

- Are the measures of success aligned to achieve corporate objectives and target parameters, including least whole life cost, optimum value, and wider environmental and social outcomes?

Key areas/considerations

- Does the corporate asset manager understand the environmental and social standards to which the new asset should be aligned?
- Does the asset manager have an environmental and social management plan (ESMP) or strategy to ensure compliance with these standards?
- Do the requirements cover key operational parameters? Are these consistent with achieving the expected benefits of the project? These include:
  - operability
  - availability
  - reliability
  - maintainability
  - efficiency
  - change management/contract variation
  - handback
  - decommissioning/disposal
  - contingency plans/management
- What design standards are being used? Does the corporate asset manager support these? Is it clear who will assure designs against these standards? Are these standards aligned with the measures of success?

Capability

- Are operations and maintenance staff involved and trained appropriately in:
  - designing the operability and maintainability of the assets
  - keeping asset registers up to date
  - identifying and designing the hazard and operability study and legal/regulatory requirements
  - maintaining services during construction
  - managing environment and social risks
  - monitoring and maintaining assets according to local, national and international standards
  - gender mainstreaming
  - engaging with communities and service users
  - grievance redress processes and procedures
  - updating emergency response plans

Key areas/considerations

  - capturing all the information about events the asset may experience, e.g. remodelling, a breach, formal inspection
  - planning the asset testing

- Are the required standards, regulations, codes of practice, and codes of conduct in place for all operations and maintenance staff to enable them to work safely and to prevent unethical and harmful behaviours, e.g. exploitation, abuse and harassment of workers or community members?
- Have the operational capacity and competency requirements been defined?
- Are the capabilities aligned to the asset management, commercial and procurement strategies, e.g. contract management capabilities?
- Do the project plans include developing the required operational capacity and competence? Are there resources to facilitate capacity building as required?
- Is there a defined role, or roles, and responsibilities to consider the whole life business perspective on the project, including environmental and social risk and sustainability considerations?
- Are there adequate ‘person specifications’ for these roles, focusing on appropriate lifecycle skills and experience, with final accountability entrusted at an appropriate level of seniority in the organisation?
- Have the potential implications for staff changes been considered and appropriately planned for? This might include staff moves, e.g. from a public to private sector organisation, and the associated impacts on their terms and conditions of employment.

Pillar 2: Whole life value

Key areas/considerations

Efficiency, risk and value

- Has the potential technological development during the asset life been assessed? Has this been built into the requirements?
- Is there an appropriate method for assessing the balance of costs and benefits (value of risk mitigated) over the life of the asset? Does the method include environmental and social costs and benefits?
- Has the energy efficiency (for projected energy costs, CO2 - embedded and operational costs) and resource efficiency, e.g. water usage, been considered? Does the asset contribute to net carbon neutral goals?
- Are there targets in place in relation to energy and resource efficiency during the various stages of the asset life cycle?
- Have all measures for minimising negative environmental and social risks and impacts been considered? Are these clearly set out in the environmental and social management plan (ESMP)? Are these evaluated and updated periodically?
- Have any operational requirements for flexibility in asset use/performance been considered?
- Have the other operational efficiencies such as labour, consumables, hired and contracted services been considered?
- Have the asset resilience risks including external factors been evaluated?
- Does the risk strategy take account of asset interactions and integration?
- Have any requirements for contingency and business continuity planning been considered?
- Is the supply chain strategy for operations and construction developed?
- Does it align with the asset management strategy and the service standards?
- Does the supply chain have the required asset management capability to optimise lifecycle performance?
- Is there a clear strategy and plan for cascading environmental and social requirements and standards through the supply chain?
- Does the supply chain have the required understanding and capability to uphold environmental and social standards imposed by the asset manager? Are there procedures in place to monitor supply chain actors with environmental and social standards?

Key areas/considerations

- Does the supply chain strategy drive continuous improvement in asset management?
- Is there a process for driving continuous improvement in the way the asset operates over its life?
- Has end of life reuses or decommissioning and disposal been considered?

Scenario planning

- Has the decision-making taken account of data uncertainty, e.g. regarding current asset condition?
- Are alternative options being generated and considered at every stage?
- Has scenario planning been informed by consultation and engagement with key stakeholders including project affected communities and potential service users?
- Are there appropriate drivers for Opex/Capex decisions, e.g. are 'no requirement for capital' options properly considered?
- Are options (both capital and operational) consistently assessed using the risk-based cost/benefit methodology?
- Has the projected asset life been defined, based on operational experience and requirements?
- Has the accuracy of the data and the decision-making tools been considered?
- Has the likely refurbishment or upgrade timescales and costs been considered?

Funding

- Is there a separation between the capital funding for the project and the future revenue/operational funding? If so, are there conditions attached to each funding stream and how do these align to the asset management outcomes expected of the project? Is there a conflict of interest? For example, in a PPP scheme, the interests of the private sector provider might not always align with the interests of the public sector client.
- What certainty is there that the future maintenance and operational phases of the project will be funded? How does this feature in the project scope and requirements? Is there adequate funding allocated for managing environmental and social risks during operations and maintenance phases?
- Does any split between capital and revenue funding cause resource/capability constraints to the project team, e.g. by impacting the possibility for direct recruitment or the allocation of capability from within corporate asset management?

Pillar 3: Performance and information

Key areas/considerations

Data and information

- Is there an up-to-date asset register with associated asset condition reports?
- Is there an appropriate allowance in the project costings to account for any inaccurate/out-of-date information about asset condition?
- Are the asset unit costs captured to support asset management?
- Are embedded environmental and social costs, including carbon costs, captured?
- Have all the operational costs been captured? These include manpower, consumables including energy usage and costs, hired and contracted services and disposal.
- Have all the maintenance costs been captured? These include planned maintenance, reactive maintenance, strategic spares.
- Have activities and costs associated with ongoing/periodic assessment and management of environmental and social risks been captured?
- Is there an existing asset information strategy? Does this project align with it?
- What asset information is required or generated during the project ('Project Information Model') that will be needed in operations; or that will be needed for decision making, during the project, which impacts on whole life operations?
- Are there procedures for periodically gathering data and information on environmental and social risks and impacts?
- What are the asset information strategy requirements beyond handover (the asset information model)?
- Is there an efficient, structured and managed process for providing the 'as-built' asset information, in line with BIM Standards?
- Have operations/maintenance already been consulted on the information requirements, including asset identification and asset layout? If not, is there dedicated resource and funding to do this during the early stages in the project?

Performance

- Has the probability of failure (reliability and its deterioration over time and/or usage) and the impact of failure been captured?
- Has the asset's resilience to low likelihood, high impact operational events been considered?

Key areas/considerations

- Has the impact of failure on corporate objectives (loss of service, income, reputational damage, etc.) been assessed?
- Have environmental and social costs of failure been considered?
- Are there clear and regular reporting requirements for environmental and social risks and impacts?
- Have any potential disposal cost and timescale issues (especially for hazardous or polluting material) been assessed?
- Has the future operational strategy already been defined?
- Have any supporting change management and training requirements been identified?
- Is there an existing maintenance strategy this project should fit with?
- Is there dedicated resource and funding in the project, to define optimal maintenance approaches and schedules?
- What effective learning and feedback mechanisms are there, to improve future projects and asset decisions, and asset planning more generally?
- Are the asset operational cost models for the project built on actual operational data?
- Is it clear where contract management and performance management responsibilities lie?
- Is there structured monitoring of operational issues after project-handover? Are the monitoring requirements for operations and maintenance set out clearly in the environmental and social management plan (ESMP)?
- Is data and information on environmental and social risks and impacts used to periodically evaluate performance against targets and metrics set out in the ESMP?
- Is technical support provided to operations and maintenance for an appropriate period after handover?
- Are there grievance mechanisms planned or in place for workers (all operations and maintenance workers) and for community members (including service users)? Have these been made accessible and been clearly communicated to stakeholders?

Good practice examples

This section offers supporting material to plan improvements for effective asset management.

We give examples of good practice to help you:

1/2. Understand how the project contributes to the wider organisational asset management strategy and key considerations for project development and delivery, including the Five Capitals

3. Implement a whole life value approach, whilst taking into account the organisational context

4/5. Incorporate asset management requirements into all stages of policy and project development and delivery, and to ensure policies remain responsive to change.

6. Consider whole life costs and benefits in project decision making.

7. Embed climate risk assessment into asset management

These examples will not be relevant to every project. They are a collection of good practice that may be helpful, in specific circumstances. It is important to assess and tailor any good practice to the specific project and its wider context.

Likewise, the suggested reading is a starting point for further research. You should look for other sources relevant for your project, to support capability strengthening.

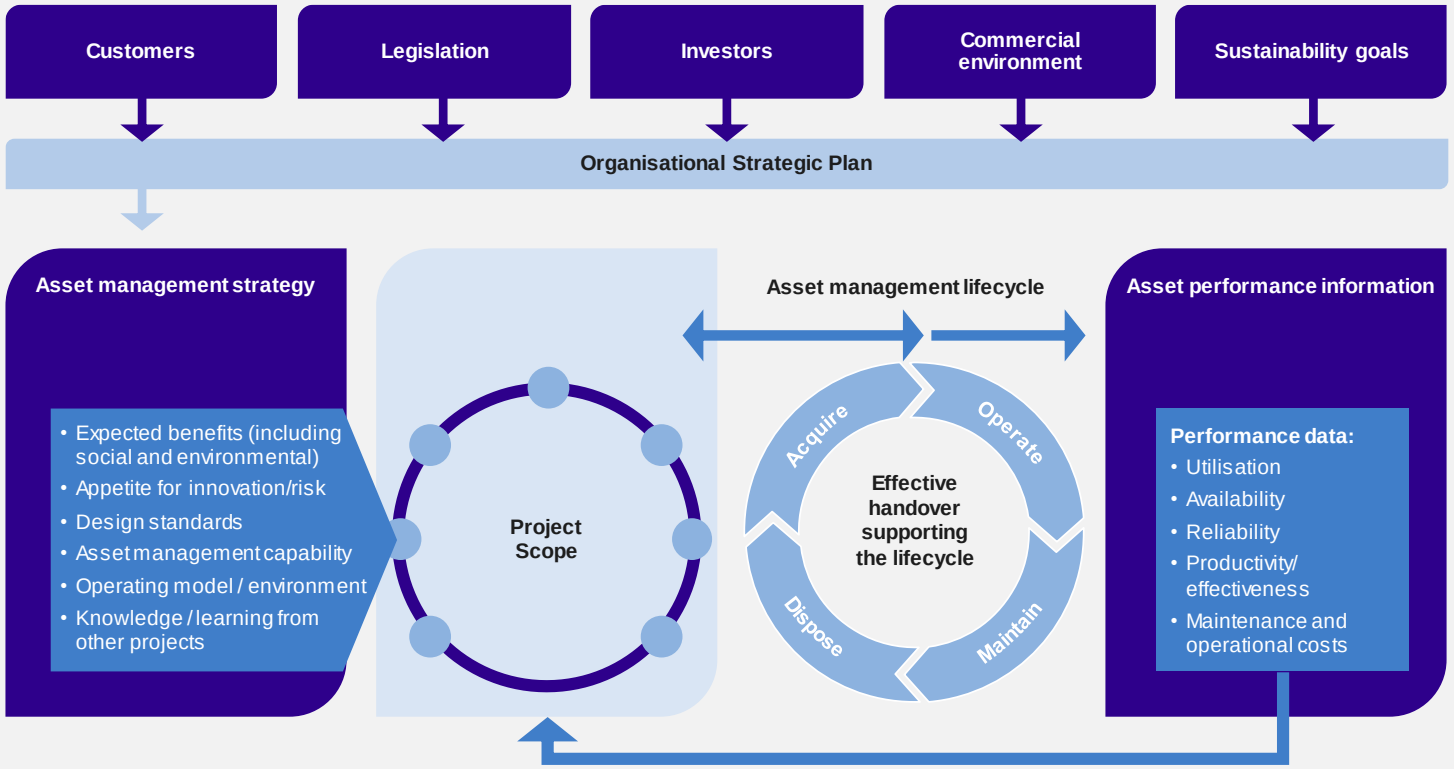
Within Routemap, the examples of good practice support capability strengthening in **(Step 9)** – *Action planning*.

1. Good practice: The relationship of the project to the asset management lifecycle

Here, we illustrate how the project should contribute to the organisational asset management strategy, and key considerations for project development and delivery.

An infrastructure project either creates or improves an existing asset base. To define and then successfully deliver the outcome expected from the project, you must first understand the context of the wider business asset management approach.

Key considerations for project development and delivery are described in the diagram shown here.



2. Good practice: An asset management value framework

A consistent methodology for assessing the whole life value of a project can ensure that investment activities are aligned with the strategic aspirations of an organisation.

In this example, a UK utility company aimed to achieve a significant reduction in its carbon footprint. A capability assessment showed that to achieve this goal, the organisation would need to develop a method for objectively comparing all alternative investment options across their portfolio of projects and programmes (from operational site upgrades to laptop replacement programmes). This would need to take into consideration:

- whole life costs, including ongoing operational and maintenance costs, and
- their respective benefits, based on a consistent definition of value which takes account of long-term commitments (such as reducing carbon emissions to meet net zero)

The organisation developed their first value framework (shown overleaf), aligned to the Forums for the Future's Five Capitals and subsequently developed a cost-benefit assessment methodology to apply the framework.

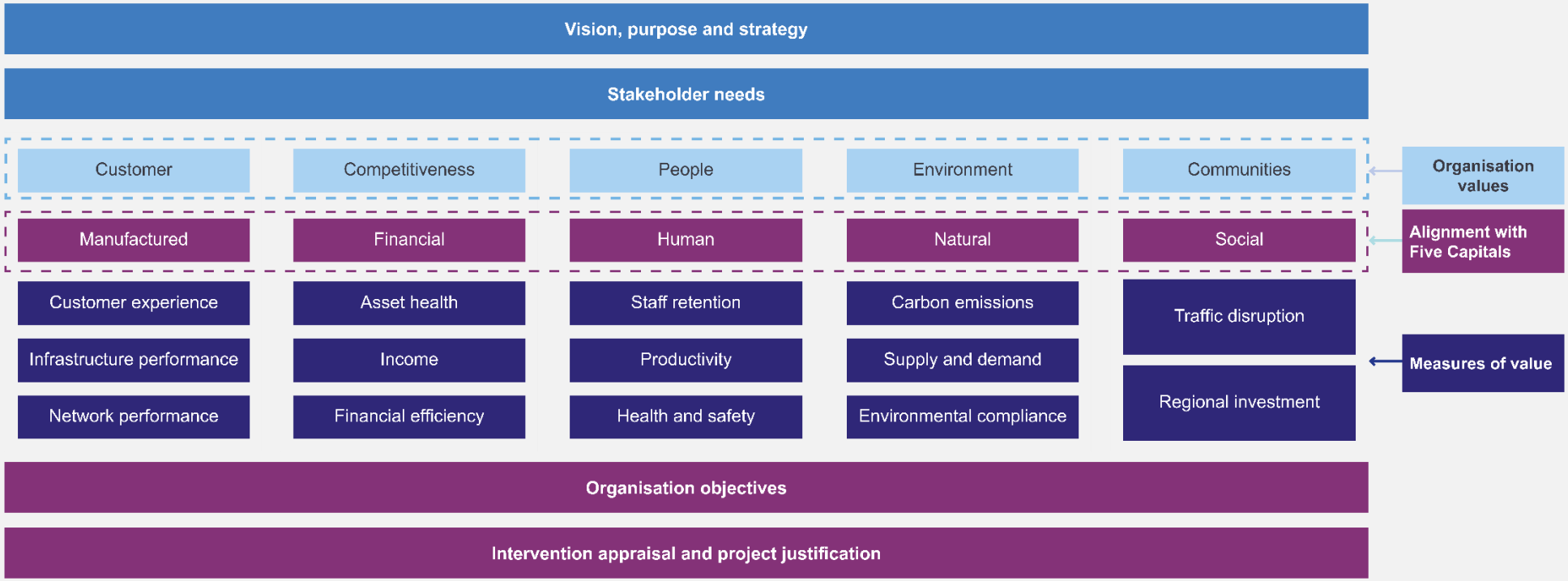
Measures of value were developed for each of the Five Capitals, so that risk, performance and benefits could be quantified consistently based on available data. Using industry guidance on cost-benefit assessment in combination with these measures, the organisation now challenges their investment plans from an informed position on whole life cost, benefit-cost ratio, payback and other useful metrics.

For example, to measure the value of an investment from the perspective of its carbon emissions, the organisation would:

- identify sources and types of carbon emitted within their asset portfolio (kg of CO2 emitted)
- quantify the cost of their carbon emissions using spot prices on carbon trading markets and ISO140641
- examine the reduction of carbon emissions as a financial saving using the above measure, against the level of investment required to realise this reduction, to determine if the project was viable

The Five Capitals
Manufactured capital comprises material, goods or fixed assets which contribute to the production process rather than being the output itself. For example, tools, machines and buildings.
Financial capital plays an important role in our economy, enabling the other types of capital to be owned and traded. For example, shares, bonds or banknotes.
Human capital consists of people's health, knowledge, skills and motivation. All these things are needed for productive work.
Natural capital is any stock or flow of energy and material that produces goods and services. For example, farmland, water and mined minerals.
Social capital concerns the institutions that help us maintain and develop human capital in partnership with others. For example, families, communities and businesses.

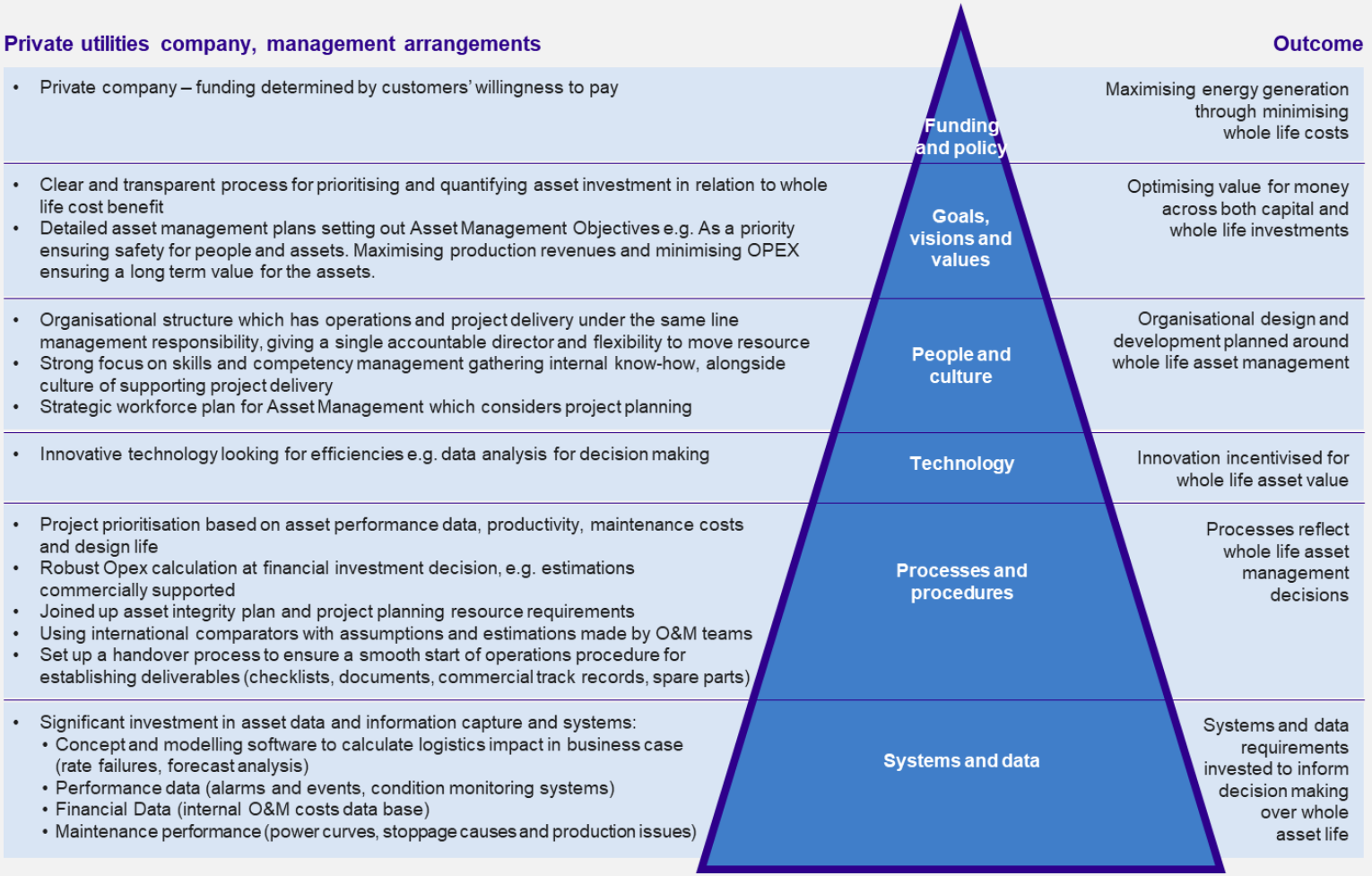
This framework allows asset owners to compare alternative investment options, and to identify those which may provide similar value but at a lower cost. With senior leaders owning and developing the value framework, other business priorities beyond commercial concerns are now being considered in the planning process that were previously not measured.



3. Good practice: The relationship between organisational context and whole life value

This example demonstrates the relationship between the wider organisational context and a successful whole life asset approach. It is based on a private utilities company that has aligned its funding model, asset management strategy and project delivery.

The organisational context, within which a project is commissioned, will significantly influence the success of delivering the asset management outcomes. Factors such as the funding model, policy decisions and any associated conditions imposed by sponsors can compromise achieving the asset management benefits.

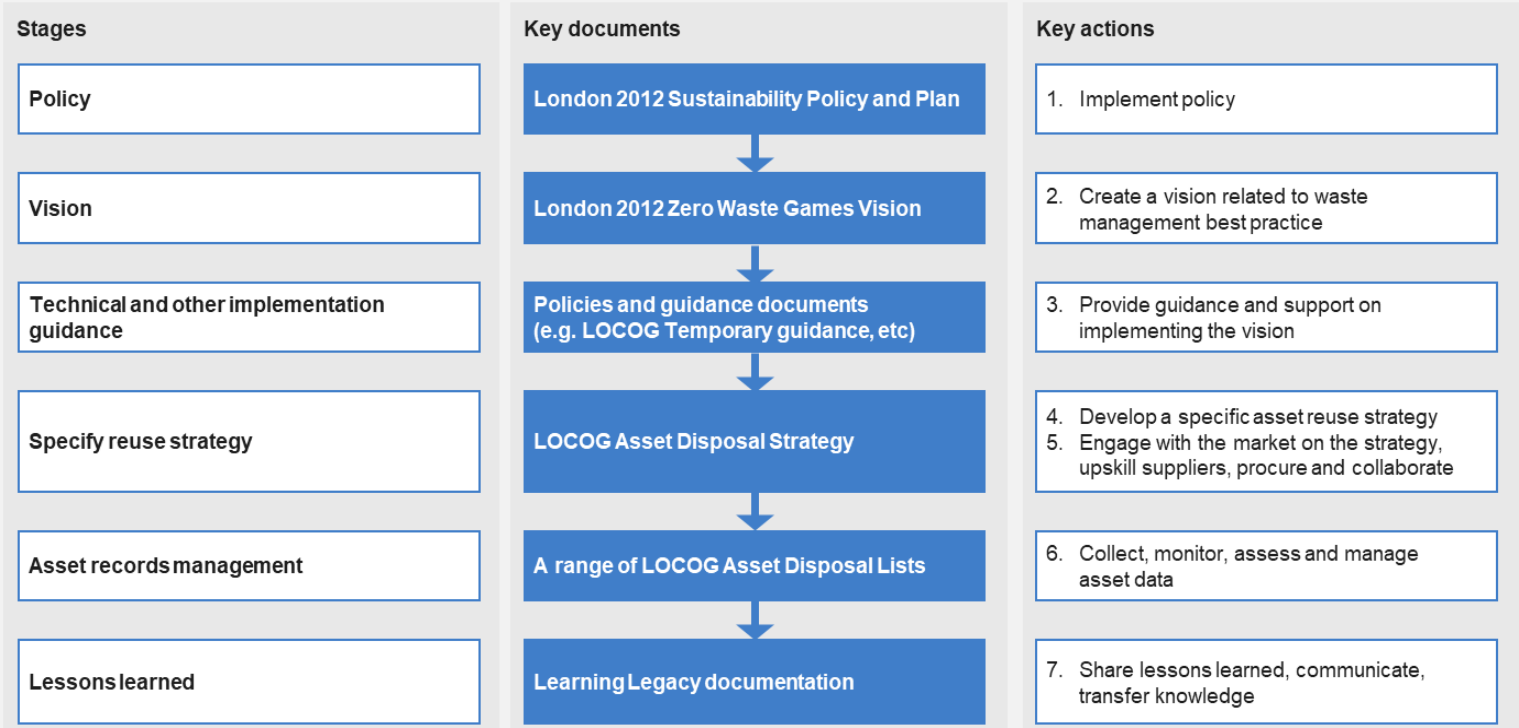


4. Good practice: Incorporating asset management requirements into all stages of project development and delivery

This diagram demonstrates how the London Olympic Delivery Authority incorporated their asset management sustainability ambitions into all levels of the programme requirements.

Requirements should be reviewed to ensure that asset management deliverables are included at all stages of project development and delivery.

London Olympics Committee of the Olympic Games (LOCOG) strategic approach to asset reuse



5. Good practice: Considering the external environment when developing asset management policies

It is important to manage the implications of external change throughout the asset lifecycle. This example supports you to design and implement policies flexibly, aligning the interests of those who are responsible for the asset and those who use it.

Stakeholders are organisations, individuals and groups that can make an enforceable claim on some of the value of the project. These include investors, local and national government, regulators, project affected persons and communities, NGOs and the media, amongst others.

A stakeholder management strategy is an important part of business case development. This should recognise and attribute the potential value of the project and asset amongst its stakeholders and use this to inform engagement activity. This will help to satisfy them, and the sponsor, that the project should proceed. Examples of value sharing include undertakings to mitigate noise and traffic at night, placing a percentage of contract value with local businesses and funding apprenticeship schemes for school leavers.

These plans must be sufficiently flexible to respond to external changes. These changes may relate to stakeholder needs, markets, wider society or the economy. Failure to consider how circumstances may change over time can lead to investment in policies which quickly become obsolete. Policies need to be designed and implemented with sufficient flexibility and progress should be reviewed to ensure the intended policy benefits are still being delivered. To inform this, it is vital to conduct continued, quality engagement with stakeholders, including service users and project affected persons, from business case development and throughout the asset lifecycle.

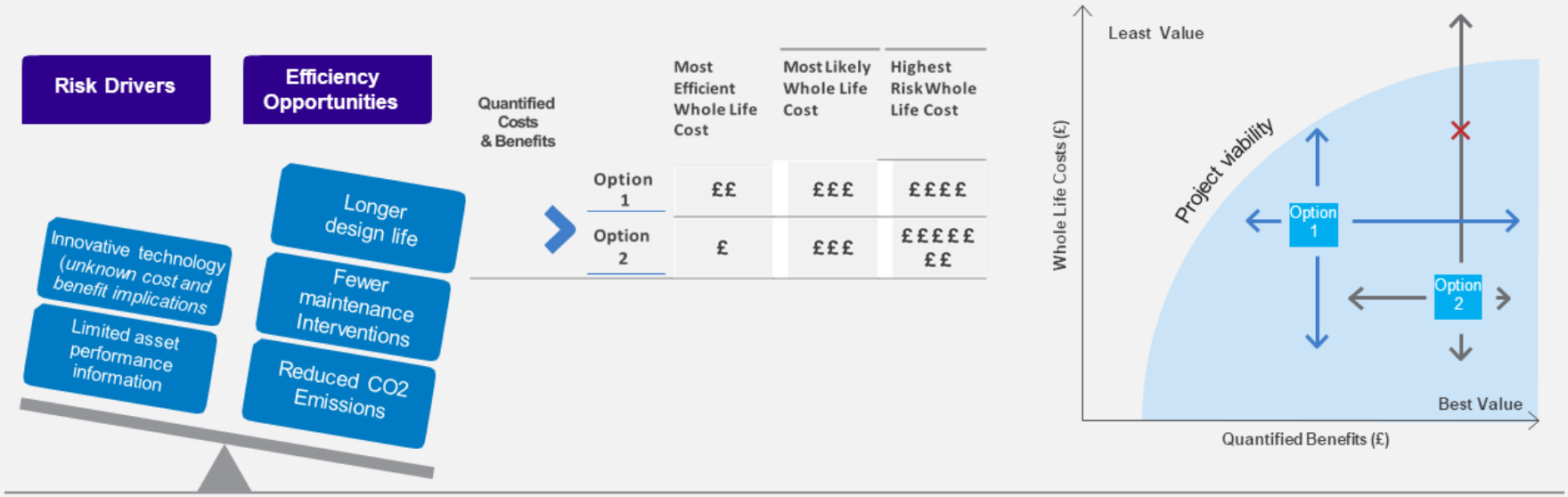
	Key actions for flexible policy-making:
1	Make use of scenario-planning exercises to assess all the various potential impacts of the policy.
2	Identify and define options to cover different future scenarios and provide meaningful choices to decision makers.
3	Ensure options clearly set out technical feasibility, potential implementation requirements and opportunity costs.
4	Consider whether the policy, and proposed delivery mechanisms, are sufficiently flexible and resilient to cope with changes. Consider whether policy owners can respond rapidly and flexibly to shifts in technology, consumer behaviour, socio-economic and environmental trends.
5	Establish processes to regularly review and retest the underlying assumptions of the policy, and to reconsider whether the policy should continue in its current form.

6. Good practice: Whole life risk and value planning

This example demonstrates the importance of considering whole life costs and benefits in project decision making.

Good scenario planning should quantify the risk drivers and efficiency opportunities for the different options. Quantifying risks and opportunities makes it easier to compare and evaluate the most appropriate options to take forward. The accuracy and value of this exercise is underpinned by the quality of the asset information available to the project team. There is a key role here for BIM, both in ensuring robust asset information is available and in facilitating scenario planning. The very nature of whole life asset planning means it has a significant impact on the cost drivers for project options when considered over the whole life of the investment.

It could be that other factors such as market capability, project team skills and innovation in design will impact more on the initial capital investment cost whereas, in terms of whole life value for money, understanding the asset management context and correctly using performance data will more likely drive project success. On this basis it is important to consider whole life cost/benefit including appropriate sensitivity analysis in project decision making.



7. Good practice: Embedding climate risk assessment into asset management

Climate risk is a function of the likelihood of a climatic event, the magnitude of the associated impacts, and assessment of resilience / adaptation measures. A risk analysis must consider a wide range of possible climatic scenarios and their outcomes, both positive and negative. Moreover, such assessments should be specific to the project and/or asset. Organisational climate risk assessments can then be aggregated from asset-level assessments (and other factors). Project/asset-specific climate risks assessments should consider:

(i) Analysis of climate variables - future (e.g. 30/50/100 years) projections of temperature, rainfall, storm surges, wind speed - if the asset is based in a particular location, then projections should be localised

(ii) Characterisation of each infrastructure asset - fragility (against different risks -heat, cold, wind), capacity (impact if it fails)

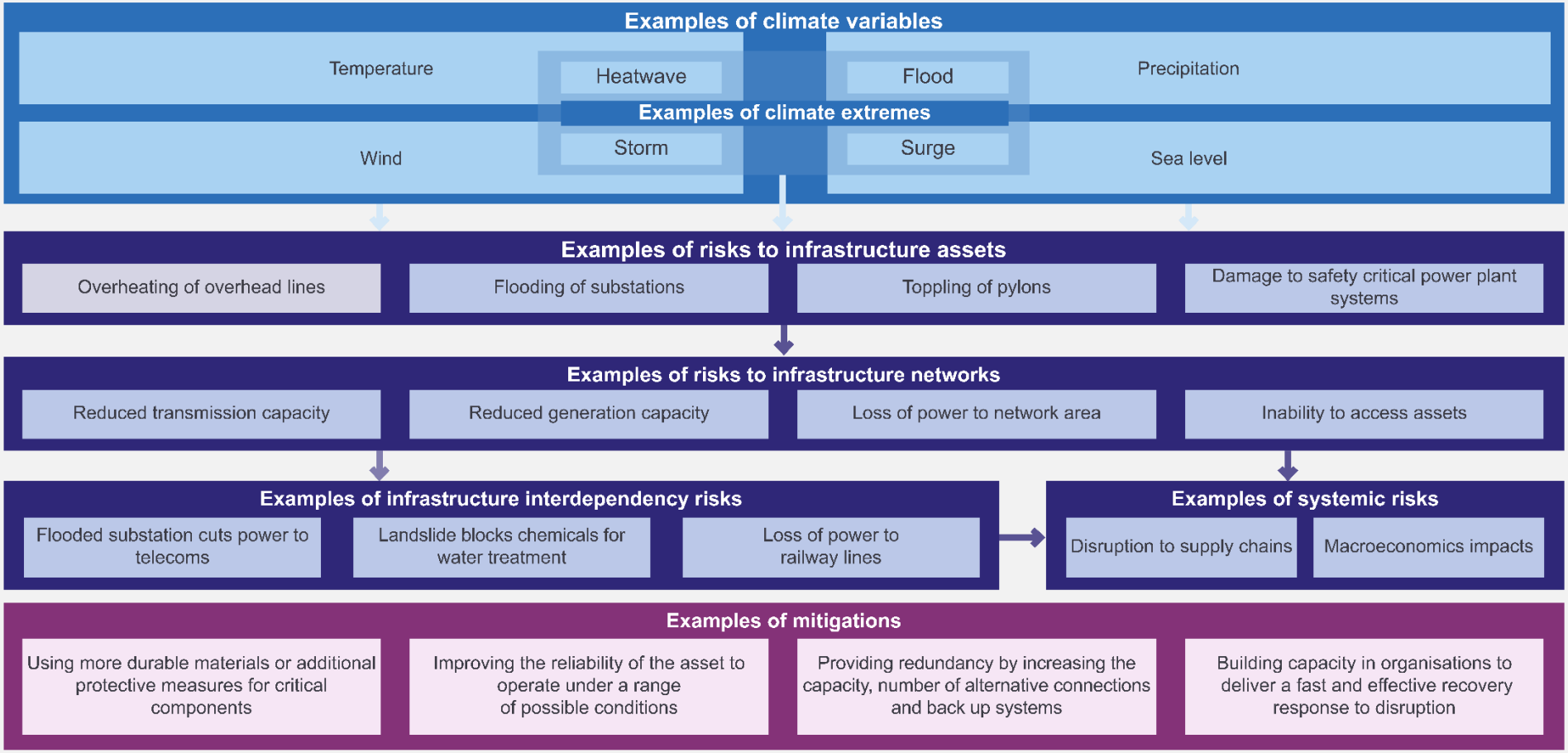
(iii) Network-wide effects - impacts on multiple components and/or system functions and existing mitigations (backup, redundancies)

(iv) Analysis of interactions and interdependencies between infrastructure networks - to understand ‘cascading impacts’, e.g. an electricity outage shutting down a water treatment plant

(v) Assessment of systemic risks - loss of infrastructure services that lead to indirect impacts on economic growth, social wellbeing and environmental protection

(vi) Assessment of adaptations/resilience measures - existing or planned including society-wide policies, e.g. national water usage restrictions would increase the resilience of the water supply network

Climate risk mitigations might address risks at the asset level (such as the installation of fire suppression systems) or at higher levels (such as back up assets to improve network resilience). These mitigations should be considered in the context of the economic, environmental and social benefits that the project or portfolio is seeking to realise.



Source: Committee for Climate Change, UK Climate Change Risk Assessment 2017 Evidence Report / Technical chapters / 4. Infrastructure, 2017

Suggested reading

Within Routemap, the suggested reading supports **(Step 9)** – *Action planning.*

Project Development Routemap for Infrastructure Projects: International Handbook, Infrastructure and Projects Authority, 2020
https://www.gov.uk/government/publications/project-development-routemap

Business Case Development for Infrastructure Projects: International Guidance, Infrastructure and Projects Authority, 2020
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1062669/Infrastructure_Business_Case_International_Guidance.pdf

Asset Management: an anatomy, v3, Institute of Asset Management, 2015.
https://theiam.org/media/1781/iam_anatomy_ver3_web.pdf

BSI ISO 55001:2014 Asset Management. Management systems – requirements.
https://www.bsigroup.com/en-GB/Asset-Management/Getting-started-with-ISO-55001/

BS EN ISO 19650-1 Organization and digitization of information about buildings and civil engineering works, including building information modelling -- Information management using building information modelling: Concepts and principles
https://www.bsigroup.com/en-GB/iso-19650-BIM/

BS EN ISO 19650-2 Organization and digitization of information about buildings and civil engineering works, including building information modelling - Information management using building information modelling: Delivery phase of the assets
https://www.iso.org/standard/68080.html

BSI PAS 1192-3:2014 Specification for information management for the operational phase of assets using building information modelling
https://shop.bsigroup.com/Sandpit/PAS-old-forms/PAS-1192-3/

BSI PAS 1192-4:2014 Fulfilling employers information exchange requirements using COBie – Code of practice
https://shop.bsigroup.com/ProductDetail?pid=000000000030294672#:~:text=BS%201192%2D4%3A2014%20defines,the%20subsequent%20in%2Duse%20phase.

ISO: Asset Management – achieving the UN Sustainable Development Goals
https://committee.iso.org/files/live/sites/tc251/files/guidance/ISO%20TC251%20SDG%20March%202018.pdf

Digital Twin Programme
https://www.cdbb.cam.ac.uk/what-we-do/national-digital-twin-programme#:~:text=CDBB%E2%80%99s%20National%20Digital%20Twin%20programme%2C%20delivered%20by%20its,The%20National%20Digital%20Twin%20and%20the%20Gemini%20Principles

Government Soft Landings, NHS Scotland Interactive Navigator
https://www.cdbb.cam.ac.uk/files/nhss_sl_process_map_28.02.2020.pdf

Green Book Supplementary Guidance: Risk
Early Management of the Risks to Successful Delivery A framework for action, with tools and guidance , HMT
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191514/Early_management_of_the_risks_to_successful_delivery.pdf

Infrastructure Tool: Sexual Exploitation, Abuse and Harassment (SEAH), DFID 2019
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/855899/ICED-Safeguarding-Infrastructure-Tool2.pdf

BSI ISO 15686 -5:2008 Buildings & constructed assets – Service life planning – Part 5: Life Cycle Costing
https://landingpage.bsigroup.com/LandingPage/Series?UPI=BS%20ISO%2015686

The IAM Competences Framework Requirements, 2014
https://theiam.org/knowledge/competences-framework/

BS EN 50126 1:2017 Railway applications. The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
https://shop.bsigroup.com/ProductDetail?pid=000000000030330404

Handbook of Systems Engineering and Management, 2nd Edition, Sage and Rouse, 2011
https://www.academia.edu/2007805/Handbook_of_systems_engineering_and_management

Property Asset Management Capability Assessment Model, 2014
https://www.gov.uk/government/publications/property-asset-management-capability-assessment-model

Embedding ESG Issues into Strategic Asset Allocation Frameworks
https://www.unpri.org/embedding-esg-issues-into-strategic-asset-allocation-frameworks-discussion-paper/4815.article

Transforming Infrastructure Performance, 2017
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664920/transforming_infrastructure_performance_web.pdf

ISO Asset Management Achieving the UN Sustainable Development Goals.
https://committee.iso.org

Embedding [Environmental, Social and Governance] Issues into Strategic Asset Allocation Frameworks, Principles for Responsible Investment
https://www.unpri.org/download?ac=6981

Building Information Modelling (BIM), 2012
https://www.gov.uk/government/publications/building-information-modelling

Global Real Estate Sustainability Board (GRESB)
https://gresb.com/nl-en/

ISO 14064-1: Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals, 2018
https://www.iso.org/standard/38381.html

Glossary

This glossary identifies key terms for the asset management Routemap module. The *Project Development Routemap for Infrastructure Projects: International Handbook* contains a comprehensive glossary of terms related to the Project Development Routemap generally.

Asset: Anything tangible or intangible that can be owned or controlled to produce value and benefit.

Asset lifecycle: The set of stages that any asset will be expected to go through, including planning, procurement, deployment, usage, (potential) upgrade, decommission, and disposition.

Asset manager: The asset manager is the organisation (or parts of) responsible for day-to-day operations and maintenance of the asset. The asset manager may be a part of the sponsor or client organisations, or a separate entity. Similarly, the operator and maintainer of the assets may be separate entities.

Asset management: Asset management is the coordinated activity within and between organisations, to realise value from their assets.

Building information modelling ("BIM"): A process for creating and managing information on a construction project across the project lifecycle which develops the building information model - a digital description of every aspect of the built asset. This model uses information collected collaboratively and updated at key stages of a project. Creating a BIM model means that interaction with the building is optimised, resulting in a greater whole life value for the asset.

Capability: Routemap uses capability to describe the ability of the sponsor, client, asset manager and market to organise for effective and efficient delivery. It refers to a part of the business and not the individual, as most barriers to best-practice are institutional and not individual actions. Stakeholder perception of capability is assessed by capability assessments.

Capability gap: The difference between the existing organisational capability and the capabilities required to successfully deliver the proposed project or programme.

Capex: Capital expenditure

Client: The client is the organisation that is responsible for undertaking the work to fulfil the sponsor's requirements and deliver the benefits. The client translates the requirements from the sponsor and manages the delivery outcomes. The client selects, procures and manages supplier/s to meet project objectives. The client organisation may be referred to as the implementing agency or the government contracting agency. The client may be internal or external to the department or line ministry.

Client model: The client model refers to how the client organisation structures and resources the project execution activities between the client, advisors/partners and supply chain (e.g. in-house vs. external). This is a key consideration in determining organisational design and procurement strategies.

Complexity: Project complexity is a measure of the inherent difficulty of delivering a project. This is assessed on factors such as the stability of the wider delivery environment, the level of innovation required, and the number of stakeholders involved.

Delivery model: The delivery model refers to the organisational entity that will be appointed to deliver the project, e.g. establishment of a special purpose vehicle. This is a key consideration in determining governance arrangements.

Economic, environmental and social value: the impact a project has on the environment, economy, and society. This may be global or localised, and may result both from meeting the project's objectives (e.g. improved transport link) and from by-products of delivery (e.g. job creation). It relates to reducing negative impacts as well as increasing positive impacts, and it is important that value delivered against one category is not at the expense of another, e.g. delivering economic development, but at significant cost to local biodiversity.

Environmental, social and governance (ESG) criteria: These are key criteria for sustainability reporting, in response to widespread investor and consumer demand. They are also increasingly used to inform investment decision making.

Environmental and Social Impact Assessment (ESIA): An environmental and social impact assessment is conducted to identify and evaluate environmental and social risks in projects.

Environmental and Social Management Plan (ESMP): An environmental and social management plan contains mitigation measures and actions in order to mitigate environmental and social risks and to maximise potential environmental and social benefits over the life of a project.

Grievance mechanism: Process that workers, community members and services users can access to make complaints or report concerns relating to any aspect of the project development process.

Handback: When the procuring authority gains full control and responsibility over an asset at the end of the PPP contract.

Handover: When the contractor transfers the control of an asset to the procuring authority and operating authority (where different).

Infrastructure: Infrastructure includes the physical and organisational networks and systems that supply and support reliable and effective domestic and international transport, digital communications, energy, flood protection, water and waste management, health and social services.

Market: A market is a group of organisations that integrates and competes to provide goods or services to one or more clients.

Nationally Determined Contributions (NDCs): National targets for reductions in greenhouse gas emissions that countries set as their contributions to the achievement of the Paris Agreement goals.

O&M: Operations and maintenance of the asset.

Opex: Operating expenditure.

Optimism bias: The demonstrated and systematic tendency to overemphasise positive benefits and opportunities and undervalue the costs and negative risks of projects.

PPP: Public Private Partnerships (PPP) is a form of contract between public and private sector whereby, characteristically, the private sector design, build, finance and operate a publicly provided service against payment by the Sponsor (for an Availability based PPP) or by users

(for a Concession based PPP). There are many different possible definitions.

Prime contractor: The contractor responsible for the day-to-day oversight of a project, including management of vendors and traders and the communication of information to all involved parties throughout the course of the project.

Project: Throughout this document, the term *project* means project, programme or portfolio.

Project affected person: Someone who has been or would be affected by the project due to loss of land, housing, other immovable assets, livelihood or a combination of these due to project activities.

Risk: The uncertainty of outcome, whether positive opportunity or negative threat, of actions and events.

Risk management: The process for identifying and assessing risks, responding to them and then monitoring their resolution.

Safeguarding: The organisational system in place to prevent harm or unethical behaviour being perpetrated by individuals [engaged in project development and delivery].

Scenario planning: A method to help predict uncertainties within an organisation. Scenario planning involves predicting what future conditions or events are probable, what their consequences or effects might be and how to best respond to them.

Sexual exploitation and abuse (SEA): Any actual or attempted abuse of a position of vulnerability, differential power or trust for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another (UN Glossary on Sexual Exploitation and Abuse 2017, World Bank 2019). Sexual abuse is the actual or threatened physical intrusion of a sexual nature, whether by force or under unequal or coercive conditions (UN Glossary on Sexual Exploitation and Abuse 2017, World Bank 2019).

Sexual harassment: Any unwelcome sexual advances, request for sexual favours, and other verbal or physical conduct of a sexual nature.

Sponsor: The sponsor organisation secures the funding, owns the business case and is responsible for specifying the requirements to the client. In some contexts, the sponsor and client could be from the same organisation.

Sustainability: This means making the necessary decisions now to stimulate economic growth, maximise wellbeing and protect the environment, without affecting the ability of future generations to do the same.

Stakeholders: Individuals or entities that have an interest in a project. They may have a positive or negative influence on project completion. They may be inside or outside organisations that sponsor a project or have an interest or a gain upon successful completion of a project.

Target operating model: The end state of how the asset will be: used, funded, owned, operated and maintained.

UN Sustainable Development Goals (SDGs): Adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. The 17 SDGs are integrated and recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.

Value for Money: The optimum combination of whole-of-life costs and quality or fitness for purpose of a good or service that meets the user's requirements (though there are many different possible definitions).

Whole life costs: These include the total cost of an asset over its whole life and incorporating costs from a number of different angles. They take into account initial capital cost, operational, maintenance, repair, upgrade and disposal costs.

Whole life value: An assessment of a project based on its long-term economic value and its environmental and social sustainability impacts.

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