CIRIA proposal 3219
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Asset management of blue green infrastructure – guiding principles

Summary

Asset management ensures the performance of engineered assets in line with the owner, or operator's requirements. While blue-green infrastructure (BGI) can also be regarded as an asset that delivers benefits, thereby having tangible value, it is often not considered in an asset management context. This project will review established generic asset management approaches and explore how these can be adapted and applied to blue-green infrastructure; taking into account functionality, the natural/ecological qualities of BGI and the need for adaptive management. A draft conceptual framework for asset management of BGI will be produced along with recommended next steps to define if and how existing asset management principles should be applied differently to BGI.

Background

Increasingly, BGI is being implemented to deliver multiple benefits and ecosystem services e.g.: flood risk management; air quality improvement; amenity provision; carbon sequestration; increased biodiversity; and health and wellbeing. To efficiently manage BGI it is important to have a framework that documents its location, cost, required maintenance, risks and potential consequences of its failure, its functional life expectancy and means of disposal or renewal. It is also important to quantify the benefits that BGI create so that BGI projects can be equitably assessed and prioritised for investment.

Asset management is defined by the International Organization for Standardization (ISO) as: *'The co-ordinated activity of an organisation to realise value from assets'*, an asset being defined as: *'An item, thing or entity or that has potential or actual value to an organisation'*.

Asset management for grey infrastructure is well established and standards for asset management have been evolving since 2008 when the British Standards Institution PAS 55 were developed. This underpinned the ISO 55000 series of standards on asset management. Core to these standards are the four 'fundamentals' of:

1. *'Value – assets exist to provide value to the organization and its stakeholders*
2. *Alignment – asset management translates the organizational objectives into technical and financial decisions plans and activities*
3. *Leadership – leadership and workplace culture are determinants of realization of value*
4. *Assurance – asset management gives assurance that assets will fulfil their required purpose'*

The Global Forum for Maintenance and Asset Management (GFMAM) Asset Management Landscape (2014) publication recognises asset management as a continual and iterative process designed to deal with complex and dynamic systems. It describes the scope of asset management within 39 subjects, divided into 6 subject areas, which are summarised in Figure 1. This is currently being revised with a renewed focus on sustainability.

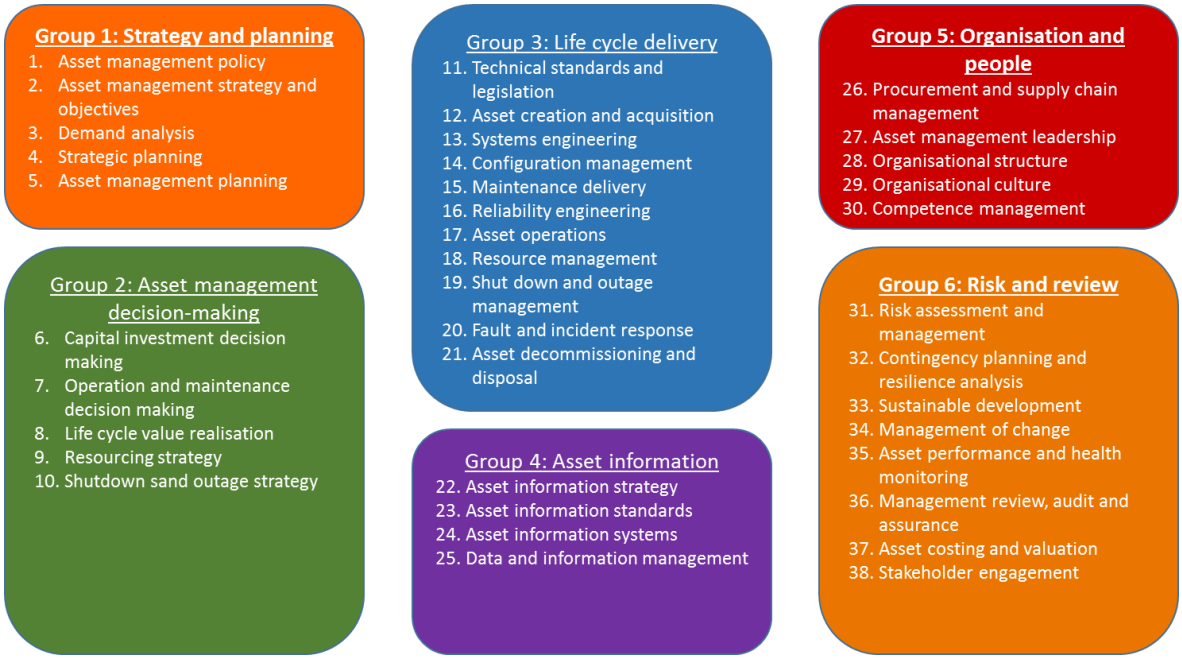

Figure 1 Alignment of the 39 Asset Management groups within the six Subject Groups. (Global Forum for Maintenance and Asset Management (GFMAM) Asset Management Landscape (2014).

CIRIA is recognised for developing collaborative guidance on the planning, design, construction and management of infrastructure assets. It has produced good practice guidance for different sectors on a variety of different assets types for transport, drainage, flood risk management and the water industry. CIRIA's recent guidance on grey infrastructure includes for example:

- Structural health monitoring in civil engineering (C788; 2020)
- Degradation modelling of civil engineering infrastructure assets (C784F; 2019)
- Culverts, design and operation (C786; 2019)
- General fixings: Guidance on selection and whole life management (C777; 2019)
- Guidance on embedded retaining wall design (C760; 2017)
- Hidden defects in bridges. Guidance for detection and maintenance (C764; 2017)
- The International Levee Handbook (C731F; 2013)
- Infrastructure embankments - condition appraisal and remedial treatment. 2nd edition (C592; 2003)

Blue-green infrastructure (BGI) consists of a strategically planned system of natural and semi-natural components comprising water (blue) and landscape elements (green) at various scales to deal with climate challenges which also provide multiple economic, environmental and social benefits.

CIRIA has focused on the delivery of guidance on BGI including Sustainable Drainage Systems (SuDS) and Natural Flood Management (NFM). These BGI components contribute to many organisations' sustainability objectives, such as; Capitals Accounting approaches and delivering benefits and a social contract with communities. They also support UK government objectives for adapting to and mitigating climate change as set out in its 25 Year Environmental Plan and achieving its net zero carbon ambitions. Examples of CIRIA's BGI guidance include:

- The SuDS Manual (C753; 2015)
- Guidance on the construction of SuDS (C768; 2017)
- B£ST: The Benefits Estimation Tool for valuing blue green infrastructure (W047a and W047b; 2019)
- Delivering GI along linear assets (C771; 2019 and C772 2021)
- BGI perspectives on planning, evaluation and collaboration (C780a; 2019)
- BGI perspectives on water quality benefits (C780b; 2019)

CIRIA is also working on the development of guidance for the delivery of NFM (RP1094) and blue roofs (RP1099).

CIRIA's experience in delivering guidance for both engineered infrastructure assets and for BGI makes it well-placed to develop guiding principles for asset management of BGI, focussing on SuDS and NFM.

Justification

As the use of BGI to overcome challenges and deliver multiple benefits increases, there is a growing need for a common approach to how it is mapped, monitored, evaluated and managed in a similar way to the traditional ('grey') assets it sits alongside or connects with.

While traditional grey infrastructure can be multi-functional and subject to the unpredictability of weather and nature, BGI measures are often specifically designed to reduce the impacts of extreme weather, be more resilient and to mitigate and/or be adaptable to the effects of climate change. The core function of BGI may change dependent on weather conditions, for example a large sunken grassed area in a park may be primarily used for social gatherings but during an extreme rainfall event its core function is to temporarily slow the flow of runoff and store water. This area will need to be managed to deliver multi-functionality.

BGI differs from traditional assets in that it always includes some natural elements, however these can be combined with grey infrastructure. The key differences between BGI and traditional assets are:

- that they include natural elements which are subject to change and are likely to be more dynamic than pure grey infrastructure
- the natural and ecological qualities of BGI will impact their performance, risk, value and costs differently over time and different contexts
- BGI measures are more likely to provide multiple benefits beyond their core function which could create added complexity in their management and valuation including:
    - multiple performance metrics across different benefit categories that may have technical, environmental implications and may more directly interface with the local communities they serve
    - shared responsibilities for maintenance and renewal of BGI that may be split amongst multiple stakeholders, requiring clarification and management
- BGI can mature and has an element of self-renewal. The adaptive management of BGI under constant change needs to be considered as do different stakeholder interactions and requirements related to BGI interventions (e.g. through public engagement).

Responsibility and requirements for asset data collection for grey and blue-green assets differs between organisations. Developing a common approach to AM for BGI will provide a framework for data collection which could be stipulated as part of approval for delivery. This will generate an improved understanding of the efficacy of different BGI measures, and will support their recognition as assets which have value and deliver recognised functionality. This will assist with broader implementation of BGI as part of the iterative process of asset management.

For BGI measures to be recognised as assets, they need to be managed as such throughout their lifecycle. A proportionate approach to asset management for BGI is required in order that its delivery is not over-complicated by the introduction of onerous bureaucratic management processes that present unnecessary burdens. A framework for asset management of BGI would allow a proportionate approach to be taken dependent on the type of BGI measure under consideration and the magnitude of potential risks associated with its implementation.

Guidance on asset management for grey infrastructure is relatively mature and embedded in good practice. There is an opportunity to apply these mature standards, frameworks and guidance to BGI. However, there is as yet no established procedure for defining the functionality of BGI, which is a key part of traditional asset management.

Grey infrastructure is often designed to be multi-functional (for example an airport is primarily a transport hub but provides a host of other functions). Blue-green infrastructure is more often designed to be both

multifunctional and resilient, which provides additional benefits beyond its core functionality and can also add value. The additional benefits of BGI are often context dependent and can include one or a number of benefits such as those included for value estimation in CIRIA's B£ST tool:

- Managing air quality
- Improving amenity
- Supporting asset performance
- Improving biodiversity and ecology
- Regulating building temperature
- Enabling carbon sequestration
- Supporting education
- Enabling development
- Managing flooding
- Improving health and wellbeing
- Managing noise pollution
- Supporting recreation
- Contributing to traffic calming
- Managing water quality
- Managing water quantity (groundwater, flows and volumes)
- Reducing crime
- Supporting economic growth
- Supporting tourism

For example, a series of rain gardens may be designed to slow the flow of surface water running off from the road whilst acting as a traffic calming measure and improving the aesthetics of the local area. This is likely to have additional benefits such as carbon sequestration, air and water quality improvement, increasing biodiversity, or bringing health benefits through encouraging walking or cycling through the area.

Many organisations that have traditionally used grey infrastructure are increasingly utilising BGI to manage flood risks and improve the local environment. An AM approach could help to ensure that these 'assets' are maintained and managed for continued effectiveness in reducing flood risk, improving water quality and/or delivering the multiple benefits they were designed to do. The approach developed should align with the way in which Risk Management Authorities record and manage assets (in relation to maintenance schedules, adoption etc.) and with other relevant assets systems such as those related to transportation.

With this increasing focus on implementation of BGI measures, it is timely that CIRIA brings together the disparate organisations and disciplines involved in delivering and managing grey and BGI interventions with experts in asset management to understand and develop new principles and value measures for managing BGI within existing AM Frameworks. This will define where existing asset management approaches are most relevant, identify challenges and provide recommendations to how these may be overcome.

Drawing on previously published guidance (from CIRIA and elsewhere), this project will consider how BGI can be included in strategic asset management plans (SAMPs). These demonstrate how well an organisation can quantify the performance, cost, value and benefits of its asset portfolio, and how accurately it can predict the rate of change of these over a defined time, as well as its ability to manage the change. The challenge for BGI measures is in evaluating the benefits as well as the rate and type of change over time. This project will evaluate how the principles of SAMP can be directly applied to BGI and where further research and guidance is required.

A practical framework will be developed that complements existing asset management principles. It will also identify gaps and suggest recommendations where the application of principles needs to be developed specifically for BGI asset management. The guidance will focus on key principles, in a similar way to that of CIRIA's publication: '*Whole-life infrastructure asset management: good practice guide for civil infrastructure*' (C677; 2009).

Aims and objectives

The aim of this project is to produce high level guidance and principles for the asset management of BGI. The guidance will provide a common and proportionate approach to collection and analysis of data on performance, value, costs and risk of failure of BGI measures.

Detailed objectives are to:

1. Exchange knowledge by bringing together different disciplines from disparate organisations with experience of delivering and managing BGI interventions with experts in asset management.

2. Collaboratively understand and present how the functionality of BGI has been framed and defined and assess how these existing frameworks and definitions can underpin effective asset management

3. Create a generic library of BGI intervention types and data to collect about each type of measure

4. Apply and where necessary adapt existing asset management frameworks to facilitate the proportionate application of established asset management principles to BGI measures. This will be done through:

    - Collating case studies of good practice asset management of BGI
    - Summarising the gaps in existing asset management principles where work is needed to define principles specifically applicable to BGI, e.g. evidence on adaptability, robustness and deterioration of BGI and consequent resilience to a range of environmental risks
    - Recommending next steps to define missing BGI-specific asset management principles

Outcomes

This project will provide:

- A proportionate framework for the delivery and management of BGI that efficiently manages asset performance, adaptation, risks, costs and maximises value and which enables the integration of strategic management of BGI with established asset management frameworks
- A structure for assessing enhanced social value, ecosystem services, and/or various capitals (natural, social, physical, economic etc.) delivered by BGI
- Improved approaches to consider complexity around multi-functionality, multiple benefits and multi-stakeholder requirements through the lifecycle adaptive management of BGI

Target audience

The guidance will be relevant primarily for inland BGI, and the proposed target audience includes engineers, designers, asset planners, asset managers and their organisations, e.g. Environment Agency, Defra, water companies, local government, client organisations (Highways England, Network Rail etc.) and The Rivers Trusts.

Approach and outputs

The table below describes expected approaches to delivering outputs and details will be determined as the project and funding progresses. This will be further developed by the selected and appointed research contractor.

Stage 1: Engagement and principles document	Outputs
A desk top study of established asset management processes, both generic and those in use by relevant stakeholders, to identify the principles of strategic asset management planning with applicability to BGI.	• An overview of principles of strategic asset management planning in use within relevant organisations. • An assessment of asset management principles and their application to BGI implementation, including initial identification of asset management principles which would be applied differently to BGI

Consultation with stakeholders including asset owners managers, utilities, transport operators, Lead Local Flood Authorities, Environment Agency, water and sewerage companies, engineers, designers, client organisations and the Rivers Trusts will take place through structured workshops (online initially and face to face when possible), online survey and telecons. This will identify appropriate asset management frameworks, appropriate classification of BGI and key principles.	• Suggested definitions of the functionality of BGI • An assessment of how existing frameworks and definitions can underpin asset management for BGI and their practical application • Further assessment of the appropriateness of asset management principles which would be applied to BGI (gaps, or necessary modification)
Case studies of BGI delivery will be gathered focussing on maintenance and management. Criteria will be developed to select those most appropriate and useful for this project. These will include a variety of BGI types, different functionality and approaches to monitor performance.	• A long list of draft case studies, illustrating a range of BGI measures • A draft set of functionality criteria drawn from existing AM and BGI processes with explanatory text/justification • A draft set of proposed functionality criteria specific to BGI measures • Draft skeleton framework for collection of different categories of data types including e.g.: location, type of measure, scale, functionality data needs, maintenance needs, outage strategy, fault and incident response, decommissioning requirements • A summary of what is useful and achievable to deliver within Stage 2

Stage 2: Development of outputs	Outputs
Up to 15 case studies of BGI measures including a range of SuDS and NFM.	• A library of BGI intervention types and data to collect about each type of measure • A summary of the gaps in existing asset management principles where work is needed to define principles specifically applicable to BGI, e.g. evidence on robustness, adaptation, maturity and deterioration of BGI and consequent resilience to a range of environmental risks
Produce recommendations report	• A concise report identifying o recommendations that have emerged from the scoping stage, o final case studies, o draft functionality criteria, o draft AM framework for BGI o data collection framework o recommended next steps to define those asset management principles to be applied differently to BGI

Stage 3: Dissemination
This will execute the communications and implementation strategy to deliver engaging outputs. Linkages with appropriate institutions and organisations will be utilised to disseminate information to the desired target audience. Dissemination will include webinars and joint online events. A summary presentation will also be developed.

Outputs

The guidance will be an exploration of how AM can be adapted and applied to blue-green infrastructure. As a succinct document (less than 150 pages) it is likely to be the first in a series of documents which include updated knowledge and information as the subject matures.

Project information

The project will be managed by CIRIA with specialist technical input from xxx.

The project costs are £168k, with a breakdown of the stages below.

Stage 1: Engagement and principles document: £64k

Stage 2: Development of outputs: £95k

Stage 3: Dissemination: £9k

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