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› ROADMAP FOR THE BGI MANUAL

Bridging the knowledge gap in the field of Blue Green Infrastructures

EXCEPT INTEGRATED SUSTAINABILITY

IFLA EUROPE INTERNATIONAL FEDERATION OF LANDSCAPE ARCHITECTS

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1. INTRODUCTION

Blue-Green Infrastructures (BGI) are strategically planned networks of natural and semi-natural areas with other environmental features. They are designed and managed to deliver a wide range of ecosystem services such as biodiversity enhancement, water purification, air quality, space for recreation and climate mitigation and adaptation[1]. BGI[2] is an increasingly popular topic in European and global policy debates: not only do BGIs represent important enhancements of ecosystem services and biodiversity in urban and rural environments, they are also an expression of sustainability-centered approaches to urban living and planning. The development of BGIs has the potential to unlock new opportunities for both environmental, societal and economic prosperity, while tackling a number of pressing global challenges.

1.1. PROBLEM DEFINITION AND AIM OF THE PROJECT

While a constant stream of BGI-related research is produced in universities across Europe, such valuable insights often struggle to reach practitioners. This knowledge is rarely translated into clear guidelines for design, construction, and maintenance. Communication issues often rooted in disciplinary silos hinder the effective integration of such results into both decision-making and implementation. An improved connection between academia and practice would carry the added value of maximizing BGI regulation and implementation, while ensuring the highest possible impact of European research on the topic.

1.1.1. Setting the goal: bridging the knowledge gap between science and practice

The International Federation of Landscape Architects Europe (IFLA Europe, Belgium), the Joint Nature Conservation Committee (JNCC, United Kingdom), BiodivERsA (BDA, France), Natural Resources Wales (NRW, Wales) and Except Integrated Sustainability (Except, the Netherlands) collaborated on a roadmap towards the development of a BGI Manual - a tool that combines insights from different fields, to provide stakeholders with valuable data and actionable instructions to develop BGIs.

The Manual targets a number of selected groups, aiming at improving a) their understanding of BGI-related scientific knowledge and b) the application of this knowledge into practice. Specifically, the target groups are: policymakers and decision makers in regional and local area development, project managers responsible for delivery of specific strategic infrastructure, designers working on projects at all scales, construction managers, and operatives, maintenance managers, and staff.

1.1.2. Roadmap to the Manual: The Process

The process of developing the BGI Manual consists of 5 parts

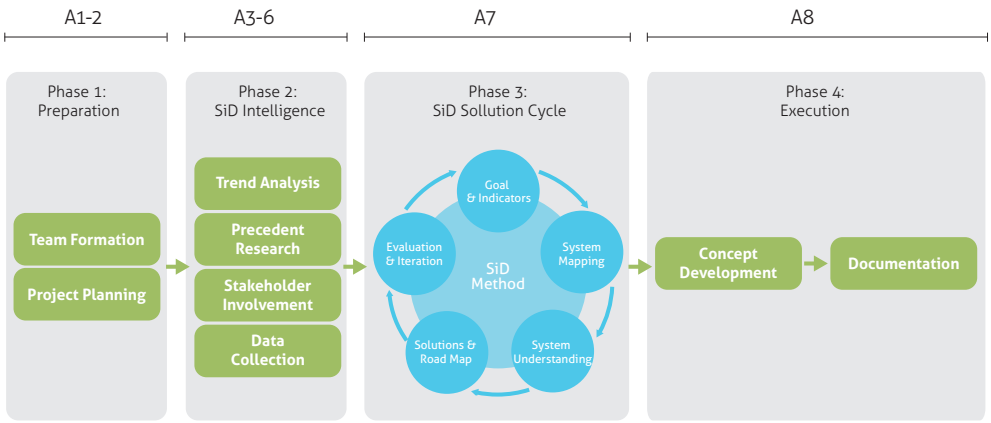
Part A: Start-up - Initialization of the project.
Part B: Scale-up - Development of the manual.
Part C: Refinement and finalization.
Part D: Localization - Localized versions of the manual.
Part E: Continuous update - Feeding the manual with a continuous stream of new research.

1. Definition of Green Infrastructure by European Commission DG Environment (http://ec.europa.eu/environment/nature/ecosystems/index_en.htm)
2. Blue-Green Infrastructure (BGI) and Nature Based Solutions (NBS, www.connectingnature.eu) and other terms are being used interchangeable in literature and practice. In this research, the term BGI is the terms used to encompass all of these terms as they relate to using a nature based/nature centred approach.

1.2. PART A - INITIALIZATION

The core of **Part A** is to provide the project partners with shared knowledge on how closer connections between science and practice can be achieved. This part results in a proposal for the scope, content and structure of the end product (the BGI Manual), including a clear indication on costs, timeline, resources, and personnel involved.

This research is rooted in Except's *Symbiosis in Development (SiD)* framework. The SiD framework is specialised in developing multi-faceted sustainability innovations using system thinking, network theory, and life-cycle understanding. The initialization part - along with its sub-parts (A1 to A8) - follows the SiD process, from Preparation to Execution - depicted in Figure 1 below:



› Figure 1 - Visualization of the Symbiosis in Development (SiD) process.

A1: Preparation meetings and planning (SiD phase 1).
A2: Team setup (SiD phase 1).
A3: Trend analysis (SiD phase 2).
A4: Stakeholder research (SiD phase 2).
A5: Precedent research (SiD phase 2).
A6: Data Assembly (SiD phase 2).
A7: Co-creation session (SiD phase 3).
A8: Finalization (SiD phase 4).

After finalizing A1 and A2, research was carried out to complete sections A3 to A6 - the Intelligence phase. Findings from the research are presented in this report.

1.3. INTELLIGENCE PHASE

While conducting the intelligence phase, a research framework was designed to integrate the four analyses predicted by SiD - trends, stakeholders, precedents, and data assembly. The interpretation of the interactions between the four researches is based on the Integrated Approach for mapping dependencies and analysis of complex systems established by Amosov et. al. (2018).

The framework provides a structure that captures the boundaries, scope and deliverables of the BGI project within a series of research questions, linked to each component of the Intelligence phase of SiD:

Trend Analysis: What are the environmental, social, and economic trends that can influence BGI research and development, and the related knowledge transfer, now and in the future?

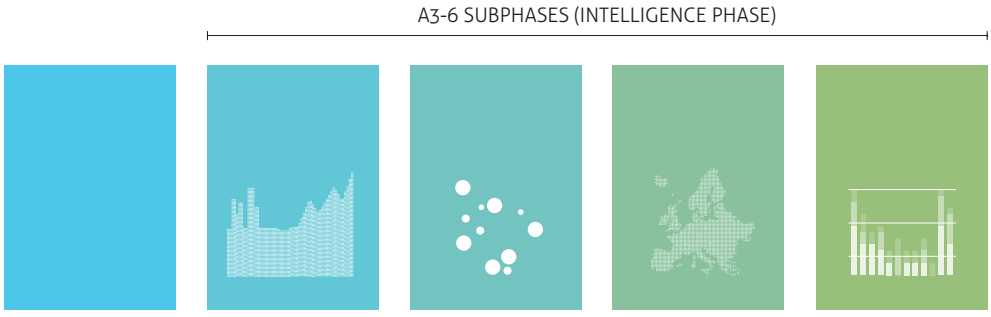
Stakeholders: Who are the key stakeholders involved in developing BGI, and what barriers and opportunities for knowledge sharing do they perceive?

Precedents: Which BGI experiences, solutions, and methods can be addressed to retrieve lessons and caveats for future implementation?

Data Assembly: What data exists in the BGI field, and how can these be structured?

1.4. REPORT STRUCTURE

This report displays the results and conclusions of subphases A3, A4, A5 and A6. In **Chapter 2,** global sustainability trends and subtrends are defined, and their relation to BGI and this project addressed. **Chapter 3** displays the results of the stakeholder analysis. **Chapter 4** contains precedent cases on BGI methods and solutions, as well as examples of knowledge sharing practices in other fields, as source of inspiration. **Chapter 5** gives an overview of the BGI data available, and provides suggestions on how this can be structured.

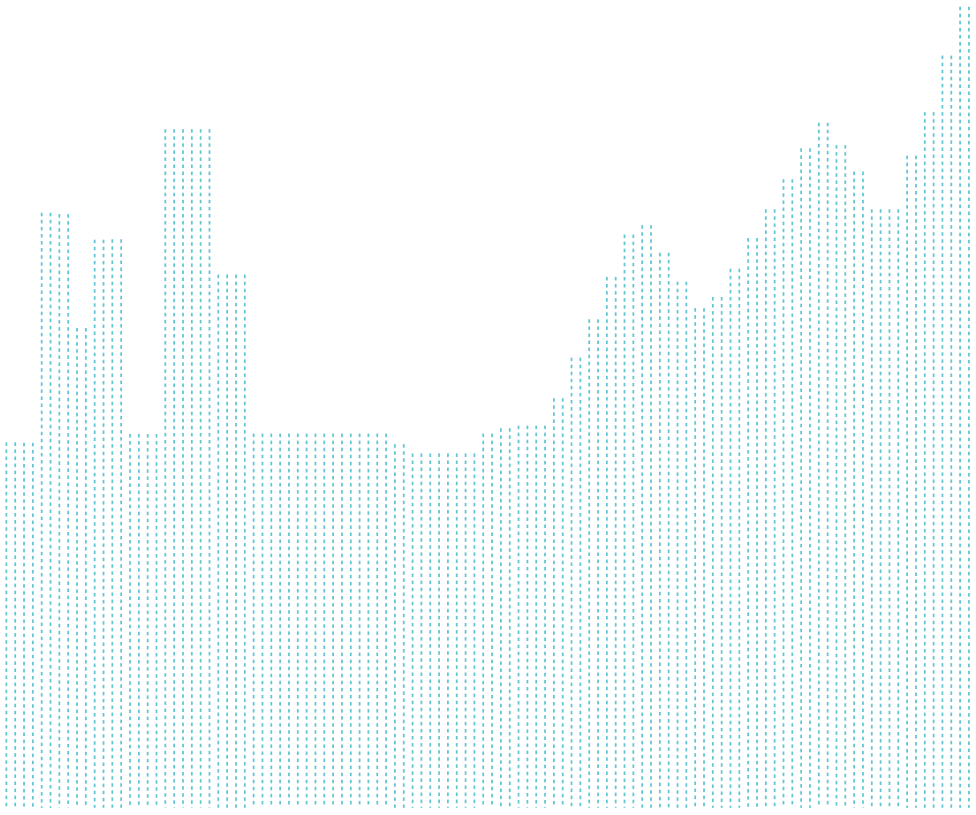


2. TREND ANALYSIS

2. TREND ANALYSIS

2.1. INTRODUCTION

By analyzing trends, we can scan and pinpoint long-term social and environmental dynamics that will likely influence BGI design and implementation, now and into the future. The identified trends serve to inform resilience planning of BGI solutions, and, as such, assist in ensuring projects are integrated with BGI concepts. This integration is a key component of resilience planning, and of the application of flexible approaches to design, construction and maintenance of the built and natural environments. The identified trends are included in planning for Phase B, and will serve as input for the co-creation session.



2.2. RESEARCH DESIGN

The trends were clustered into Environmental, Social and Economic categories (Figure 1). The definition of the most significant trends within these categories tapped into the knowledge gathered over Except's 20 years of experience in trend analyzes and reporting, together with key insights provided by JNCC, IFLA, BiodivERsA, and NRW.

Additionally, insights from the following seven international, highly authoritative reports and research papers were retrieved:

Planetary boundaries

Research framework undertaken by the Stockholm Resilience Centre and the Australian National University. By displaying the state of nine critical resources for the continued survival of mankind on Earth, the framework looks at where humanity stands and where it is likely to be heading. Out of the 9 trends, 4 are found particularly relevant to BGIs - i.e. loss of biosphere integrity, climate change, freshwater consumption and the global hydrological cycle, land system change.

Transforming our World, The 2030 Agenda for Sustainable development

This Agenda was developed by United Nations (UN). It sets 17 Sustainable Development Goals to achieve global development rooted in sustainability and equity. Goals related to biodiversity, cities and infrastructures are deemed of particular interest to BGI.

Driving Systems Change in Turbulent Times, the future of sustainability

Trend report developed by Forum for the Future. Forum for the Future is an international organization that promotes collaboration between different actors to address global challenges. This report focuses on seven trends expected to influence the future of humanity.

New Urban Agenda Habitat III

Habitat III was developed and adopted by the UN in 2016, during a conference on Housing and Sustainable Urban Development. The Agenda considers the disciplines of spatial planning and the management of cities as the means to achieve sustainable development. It sets the standards of sustainable city development in five topics: national urban policies, urban legislation and regulations, urban planning and design, local economy and municipal finance, and local implementation. The report underlines the positive relationships between good urbanization and job creation, livelihood opportunities, and improved quality of life - which should be included in every urban renewal policy and strategy.

Global trends paradox of Progress

Since 1997, every 4 years this report is updated by the National Intelligence Council of USA. The report is an unclassified strategic assessment of how key trends and uncertainties might shape the world over the next 20 years. Its purpose is to support senior US leaders to think and plan for the long term. The report discusses 7 trends expected to have an impact on humanity's future. It presents future challenges related to climate change such as extreme natural events, air quality, and the related risks for human health and livelihoods. The report concludes that *"States that have a large land mass, high levels of biodiversity, and good quality air, food, soil, and water will be more resilient to natural disasters*[1]*".*

1. United, Nations. (2016). New Urban Agenda. HABITAT III, United Nations Conference on Housing and Sustainable Urban Development

The European environment - state and outlook 2015

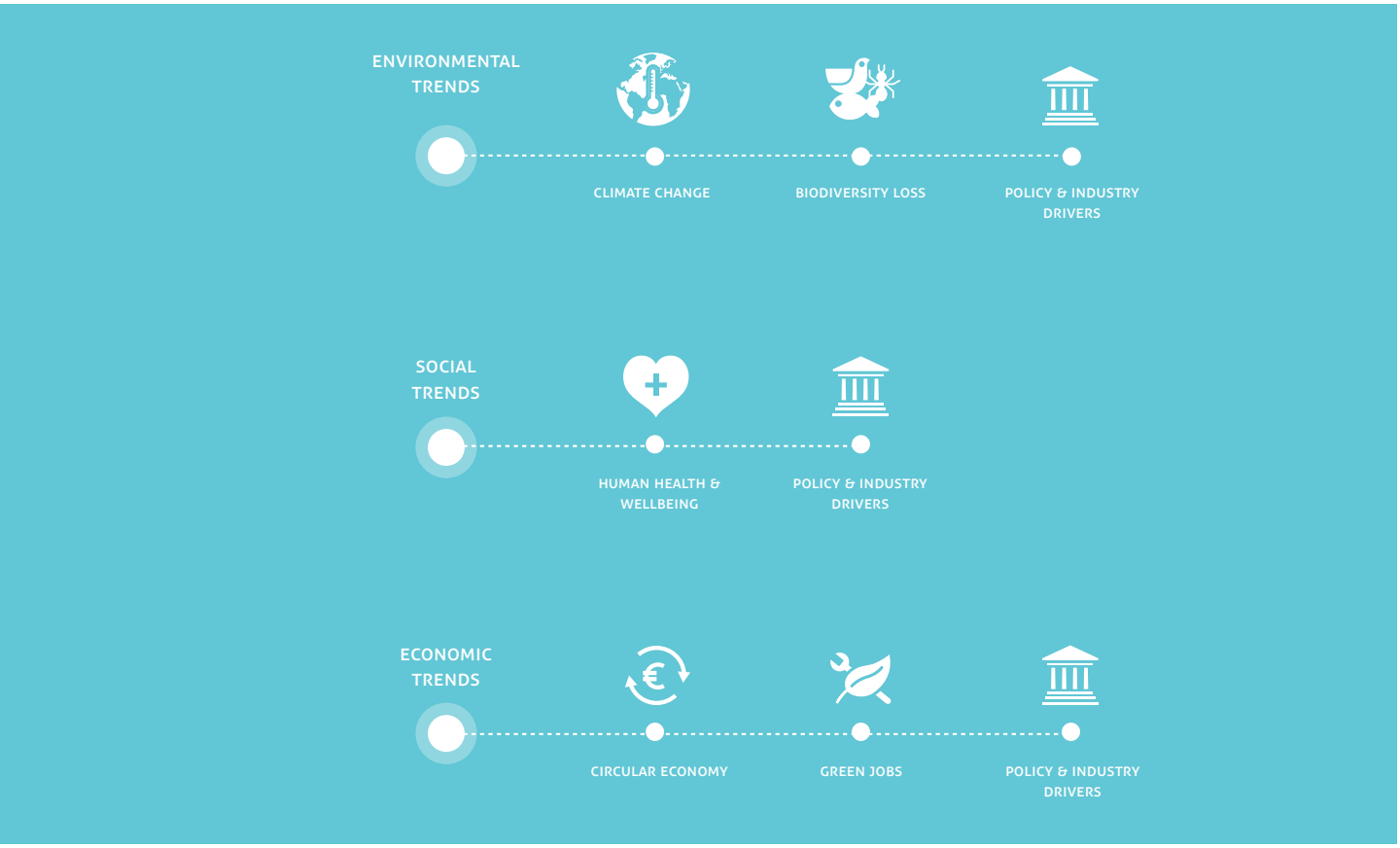
This synthesis report was produced by the European Environment Agency to assess European environmental trends. The report presents the background to environmental policies aiming to meet certain goals and the potential risks of not meeting these goals. Green infrastructures (GIs) are mentioned as a spatial planning concept that can offer a wide spectrum of ecosystem services, address habitat fragmentation and risks from climate change. Therefore this trend report is considered to have high relevance for the development of BGIs.

The Global Risks Report 2018

This report was produced by academic advisers on behalf of the World Economic Forum. It presents the likelihood of potential risks for the next 10 years. The risks are clustered in 5 categories - economic, environmental, geopolitical, societal, and technological. Out of a list of potential risks 4 stand out from the Environmental category: extreme weather events; natural disasters; failure to address climate change mitigation and adaptation; and ecosystem collapse.

Tapping into the knowledge developed from the reports above and their associated references, this analysis describes globally accepted trends and proposes suggestions on their potential use and development into the future in relation to BGI knowledge.

2.3. ENVIRONMENTAL TRENDS

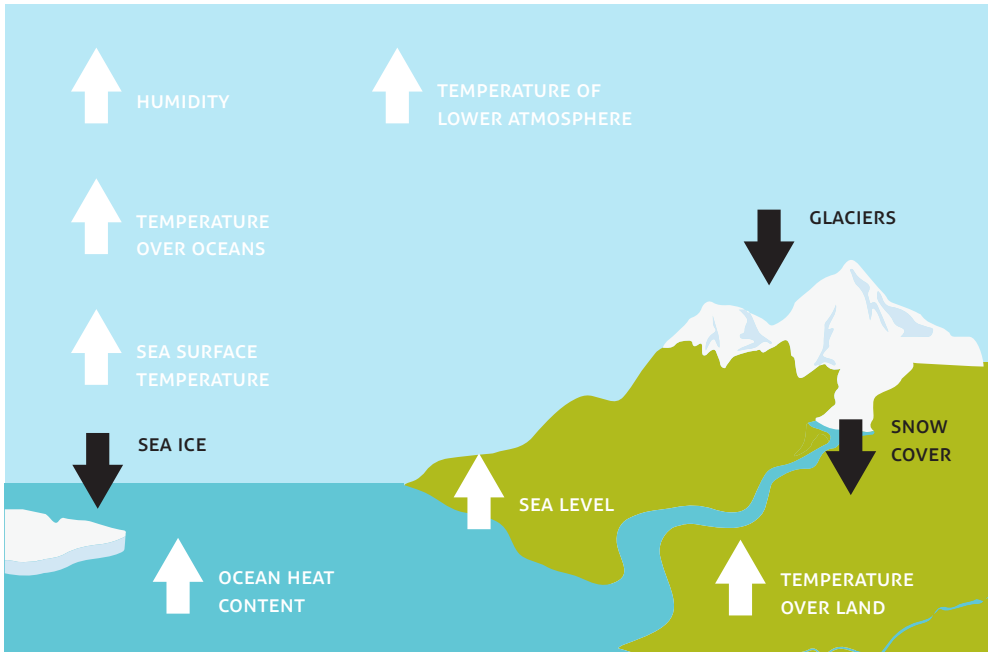


› Figure 1 - Trends and sub-trends

2.3.1. Climate change and its effects

Climate change will have varying impacts on different parts of the planet. Warming has triggered many other changes to the Earth's climate and severe weather events will be related to locally unique changes in temperature and environment. Climate change will have varying impacts on different areas of the planet as increasing levels of greenhouse gases trapped in the atmosphere - leading to a number of effects, depicted in Figure 2 below. Besides, these dynamics also affect the capacity of the earth to maintain a stable climate. This will lead to increases in frequency and intensity of extreme natural events such as floods and forest fires with devastating long-term impacts on our environment. Increasing levels of greenhouse gas in the atmosphere affect the capacity of the earth to maintain a stable climate leading to corollary effects of warming (Figure 2). Increasingly frequent and intense extreme natural events such as floods and forest fires are having a devastating, long term impact not only on human settlements, but also on the wider landscape.

Innovations in climate adaptation and mitigation have received increasing attention during the



› Figure 2 - Ten indicators providing a snapshot of global warming.

latter quarter of the twentieth century. These developments enjoy significant support in global, regional, and national policy documents relating to projects and programs of the UN - e.g. Global Compact Cities or Habitat III. These programs are mainly focused on reducing carbon emissions (mitigation by absorption), with climate adaptation measures being developed in order to address the extreme natural events caused by global warming. Temperature rise is likely to reach 1.5°C between 2030 and 2052 if it continues at the current rate.

Flooding and water management

Changing patterns of precipitation, along with extreme droughts and flooding events (Image 1), require a rethinking of the way in which urban and rural areas are designed, constructed and managed. Within the climate adaptation realm, water management figures as a key field of practice. Increased flooding is an observable trend especially in urban centres which are dominated by impervious surfaces (Image 2). The impervious surfaces associated with urban development prevent water infiltration to local aquifers, reducing the amount of available freshwater. Furthermore, they produce large amounts of water runoff in short periods of time during extreme storm water events.

› Image 1 - Abnormal drought during the heatwave in Europe 2015, on the Upper Rhine.

Employing unbound substrates and techniques, or exposing the permeability of the soil in combination with holistic hydrological management and spatial planning, are possible remedies to allow attenuation and less pressure on stormwater infrastructure. The city of Lund in Sweden is an example where BGIs are used as a means to tackle flood events.

Other examples of integration of BGIs into urban and rural developments to tackle water management issues are identified with different types of drainage systems - e.g. rain gardens, permeable pavements, swales, retention ponds, wetlands, as well as the management and the planning of forests and vegetation, and the storage and management of stormwater runoff. Freshwater supply and recharge of aquifers is an inherent capacity of BGIs and one of the main ecosystem services they support (Image 3).

› Image 2 - Carlisle Civic Centre in the floodwater, December 2015. Ground floor was severely damaged.

› Image 3 - A Bioswale, installations like this help the flow of stormwater which reduces the risk of flooding to homes and also recharges local aquifers.

Urban heat island (UHI) effect

The dark, grey surface colors and the compactness of cities contributes to the retention of heat from the sun. This causes the urban heat island effect (Figure 3) which in turn has implications for human health in our cities. In 2003, it was estimated that 1.4-2.2 human deaths were related to the heat island effect in the Netherlands.

With climate change among the primary exacerbating factors of the urban heat island effect, designers and planners are urged to address the related issues to mitigate its effects. The response of urban planning to climate change-related risks includes the requisite to ensure design approaches to neighborhoods and streetscapes incorporate trees, urban parks, and green roofs for increased shading and cooling. These approaches are undertaken both in northern and southern Europe.

Research from the city of Munich proves that BGIs have not only the capacity to reduce UHI, but certain planning of green public spaces as well as the selection and position of trees can result in even greater cooling effect.

> ***"The real case simulations show that the terrain, prevailing wind direction and wind conditions, neighboring areas and the size of the applied measures, influence the cooling effect."***[2]

› Figure 3 - The paved surfaces create a dome, which traps the heat origin from sun radiation and human activities. The cooler air at higher levels of the atmosphere traps heat within the cities.

2. Žuvela-Aloise, M., Koch, R., Buchholz, S., & Früh, B. (2016). Modelling the potential of green and blue infrastructure to reduce urban heat load in the city of Vienna. Climatic change, 135(3-4), 425-438, p. 436

Forest fires

The lack of integrated spatial planning and forest management, combined with the rise in temperatures and increasingly hot and arid summers, results in extreme forest fires. The effects of forest fires on the integrity of soils and watercourses result in changes in flow rates and sediment deposition, low levels of carbon sequestration, and more severe flood events. In the summer of 2018, almost a hundred people lost their lives in Greece, in one of the deadliest forest fires of the 21st century (Image 4).

Relevance for BGI: BGIs represent a means to mitigate and adapt to climate change. BGI can reduce the heat load in an area, mitigate flood events, and be used to develop a holistic approach for the spatial planning of green spaces at different scales. As networks of green and blue protected areas, BGIs provide solutions to manage natural and semi-natural areas, and reduce the occurrence of forest fires.

› Image 4 - Forest fire next to a residential area. Countries in southern Europe are commonly affected by climate change, forest fires are a repetitive event during the summer months.

2.3.2. Biodiversity loss

Biodiversity reflects the number, quantity and diversity of genes, species and ecosystems inhabiting our planet. Albeit a multifactorial phenomenon, biodiversity loss is significantly affected by climate change, urbanization, land use change, and human activities leading to habitat destruction. Across all of the selected trend reports, habitat loss and the consequent reduction in biodiversity lie among the most critically surpassed variables. Scientists proclaim that after the extinction of dinosaurs, the 6th mass extinction of species is unfolding currently, with species reported extinct at a rate 1000 times faster due to human impacts.

Habitat destruction

Land use change, deforestation, pollution, urbanization, and high rate resource extraction cause habitat destruction. Climate change alters ecosystems, with multiple effects: it is expected that climate change alone will threaten almost one quarter of all species of flora and fauna on land with extinction by 2050. Ecosystem services provided by biodiversity in 'healthy' environments include nutrient cycling, carbon sequestration, pollination, and pest regulation. Loss of biodiversity presents economic as well as environmental risks, as these services are key for improving agricultural productivity. Besides, biodiversity loss has effects for human health - it threatens food security, health, energy security, clean water, medicine (bioprospecting), social relations, and the sourcing of basic materials.

Biodiversity loss is not only caused by a reduction in the number of natural or naturalized sites, but also through increasing distance between, and the relative sizes of habitats. It is possible, through appropriate planning, design and implementation, for development to achieve 'no net loss' or 'net gain' for biodiversity. In many cases the concept of 'biophilic' design is being adopted to improve on the provision of a biodiverse urban and rural environment.

Habitat fragmentation

The development of human infrastructures such as roads, railways, energy transmission lines, and water networks are spread over natural areas and cut through habitats (Image 5). In addition, overexploitation of resources and ecosystems reduces the quality of the remaining habitats, while threatening the survival of existing species. A clear example is the increase in rates of animal mortality on highways. During 2012, 24,852 European hares, 36,865 Roe deer, and 1,414 European badgers were killed on roads in Austria. In a similar story, almost two trillion insects are killed by cars on Dutch roads every year.

This fragmentation results in species having to traverse further in search of food and mates, which in certain areas could increase the frequency of human-wildlife conflicts.

Fragmentation of habitats shrinks the gene pool of flora and fauna with low dispersal ranges, by reducing the interbreeding of populations within a given species. This causes fauna and flora to be less resistant to diseases, and less adaptable to environmental changes. As climate change creates non suitable microclimates, it will become increasingly important for species to move to new areas. A report by the EEA further describes the effects of habitat fragmentation.

› Image 5 - The European route E45 is a traffic network that links Sicily with Norway. In this image a reindeer wanders between forest and road, increasing the risk of car accidents. This image was taken in Sweden between the communities of Sorsele and Slangas, both crossed by the E45 route.

Invasive alien species

Climate change and international trade routes increase the loss of native biodiversity in favor of invasive alien species. The adaptability of invasive species enables them to thrive and reproduce in areas to which they are not native, further compounding pressure on local biodiversity. Invasive alien species represent a major threat to native plants and animals in Europe, causing billions of euros of damage to the European economy every year. Invasive alien species compete with local biodiversity for space and resources and alter local environments, as well as affecting the provision of ecosystem services. Invasive plants are dangerous as they modify species composition of the land, reduce the ability of local species to survive, colonize the space, and so reduce species diversity and habitat richness. Invasive alien species also alter the nutrient and hydrological cycles and the microclimate of an area as well as introducing disease and pests to which the native species have no defence.

Relevance for BGI: BGIs such as wildlife overpasses on highways and beehives on green roofs, are technical, design and policy interventions that carry biodiversity at their core. The potential for biodiversity enhancement increases where BGIs provide a network of multi-scale green spaces to increase functional and structural connectivity between areas and counteract habitat fragmentation.

Furthermore, BGIs, if appropriately designed and managed, have great potential to mitigate the impact from invasive species and enhance native biodiversity.

2.3.3. Policy and industry drivers for environmental trends

International treaties, including COP21 in Paris, have been put in place to realize ambitions towards climate change mitigation and adaptation. Nevertheless, they seem to be proving insufficient in implementing the significant measures required to meet the minimum targets. Effective actions to mitigate climate change are commonly implemented through locally-driven, bottom-up approaches and undertaken by regional and local governments who face climate change-related challenges. Such actions have proved preventive, as noted at the Global Climate Summit in San Francisco 2018. Notable cities engaged in adaptation and mitigation efforts are, among others, Melbourne, Vancouver, Portland, Copenhagen, Oslo, Bristol and Nijmegen - the last four recently nominated as European Green Capitals.

Reporting standards such as the *Global Reporting Initiative (GRI)* and the Intergovernmental *Scince-Policy Platform on Biodiversity and Ecosystem Services (IPBES)*, have been working on creating an equal playing field in the area by developing guidelines, and policy briefs and biodiversity assessments (IPBES). This ultimately broadens the scope of Corporate Social Responsibility (CSR) reporting towards integrated, inclusive perspectives. The drive for increased transparency and reporting can be seen as a bottom-up mechanism to drive further movement in governance policies, strategies, and operations.

Funds are increasingly available within organizations to tackle climate change. To enhance the effectiveness of these measures, organizations such as transparency International have developed frameworks and guidelines to ensure the proper use of funds. Transparency International EU is a movement aimed at finding ways to make decision-making in the EU as transparent as possible, so that politicians, civil servants and loyists can be held accountable for their actions. Article 13 of the Paris Agreement 2015 commits countries, "*to provide regular progress reports on national pledges to address climate change*"[3].

In this context, it is expected that EU governments will make reporting and documentation for a project accessible to interested parties, as a means of gaining the trust of citizens. This way, transparency counteracts corruption and creates safe environments for investors - especially where climate change issues are concerned.

Relevance for BGI: As all these aspects are expected to influence the development of BGIs, the data gathered during the realization of a BGI project should be recorded and be accessible. Such a practice ensures the proper development of BGI projects, and holds actors accountable for the appropriate use of resources. A high level of public interest in the development and management process of BGIs is expected, as they embody integrated approaches to social security and quality of life. Environmental stewardship gains relevance in businesses agenda as several businesses increasingly rely upon ecosystems services, including the biodiversity underpinning them.

3. http://jncc.defra.gov.uk/pdf/PN5_Biodiversity_Risk_FINAL.pdf

2.4. SOCIAL TRENDS

2.4.1. Human health and wellbeing

By 2030 60% of the world's population is expected to live in cities. Growing population, urbanization and unequal distribution of resources are resulting in nature disappearing from people's daily lives. Loss of open space, traffic congestion, noise, poor air quality, and lack of exposure to natural areas has impacts on human health and wellbeing - especially amongst children. A renewed awareness on the outcomes of these negative trends is leading to growing investment in countermeasures in progressive countries.

Relevance for BGI: BGIs can support ecosystem services that are directly linked to human health and wellbeing - i.e. air quality regulation, water quantity regulation, heat stress mitigation, noise reduction, promotion of physical activity, stress reduction, and social interaction (Image 6).

BGIs encourage nature into cities, and can make green spaces more accessible to people, resulting in improved human health and wellbeing.

› Image 6 - A group of people enjoying a nature walk in Epsom, England.

2.4.2. Policy and industry drivers for social trends

The requirements for transparency with regard to the monitoring and reporting on sustainability issues within organizations is growing in importance. Many research, policy and infrastructure delivery programs now require reporting on environmental impacts. This is partly due to society's growing awareness of the negative impact that many industries have on the planet through disruptive practices. Most organizations are now either compelled to, or will voluntarily, implement sustainability related policies, guidelines and standards, and take accountability for practices employed along their whole value chains.

Relevance for BGI: BGI projects carry the potential added value of fulfilling the requirements of a wide range of stakeholders. The successful implementation of BGI countering the risks posed by the effects of climate change in a coherent manner, will warrant a joint effort by both citizens and government. The 'footprint' of many large infrastructure projects and industries can then be addressed through implementing BGIs. Together with local action in environmental projects, citizen science must ensure the continuous development of BGI. This bottom-up approach to mitigate the effects of climate change unites governments, citizens, activists, practitioners and academics under a common goal, enabling a timely recognition of BGIs as necessary for sustainable urban and rural development.

2.5. ECONOMIC TRENDS

2.5.1. Circular Economy

As a direct response to resource depletion, the circular economy is now a fully established trend in global conversation as a paradigm to connect resource flows across value and production chains, and increase resource efficiency while lowering environmental impact. It represents the integration of a variety of trends, including the recycling trend in the 1960's to 90's, and the short-lived commercial Cradle to Cradle trend in the early 2000's. Circular Economy (CE) is gaining traction around the world as the new paradigm for processes and operations aimed at 'closing the loop'. CE will result in more cooperation across supply chains and more systematic insight into the operations and material flows of organizations, as well as society as a whole.

Relevance for BGI: BGIs such as biofiltration or as a wastewater hybrid system - addressed later in this report, represent expressions of CE in the water management field: green roofs harvest and reuse water, whereas bioswales and reed-bed phytoremediation systems purify polluted water. By these means, BGIs reduce the ecological cost of treating wastewater.

2.5.2. Green jobs

The environmental challenges of our times such as climate change, loss of biodiversity and the implications of a fossil fuels-based economy are expected to lead to a global boom of green jobs. These are considered the new professions, arising to take on these new challenges, as well as producing goods or services that benefit the environment, or preserve natural resources *"The findings of our report underline that jobs rely heavily on a healthy environment and the services that it provides. The green economy can enable millions more people to overcome poverty, and deliver improved livelihoods for this and future generations".* [4]

The provision and management of BGI assets requires a skilled, local workforce. In much the same way as local authorities provide services, the integration of BGI within the economy of urban management, farming, and agriculture can lead to opportunities for communities, suppliers, manufacturers, and decision makers on different scales.

Relevance for BGI: Green jobs in BGIs are expected to create a significantly positive impact on the global economy, as they generate capital by supporting ecosystem services, without compromising the capacity of the planetary boundaries.

4. Wentworth, Adam. (2018). Global green economy could create 24 million jobs by 2030. From http://www.climateaction.org/news/global-green-economy-could-create-24-million-jobs-by-2030

2.5.3. Policy and industry drivers for economic trends

It is expected that all BGIs would require certain certified stages that need to be accomplished in order to achieve the expected outcome. A chain of custody is a succession of responsibilities for processes as a product moves through each step of the supply chain - the given product has certain specified characteristics and is subjected to certain regulations. This trend will influence the structure and organization of BGI projects in the future. Already in the USA certain certifications such as Green roads and SITES exist, that verify the quality of provided services and the outcome of BGIs i.e. green infrastructures next to road networks, parks and green spaces in cities. In the UK and Ireland, CIRIA published a report on the use of BGI and this has now entered a second research phase.

Relevance for BGI: The climate change adaptation potentials of BGIs serve to further enhance the protection of investments for real estate owners and insurance companies from natural disasters - with implications on the value of properties. In addition, business perceptions are positively affected by the shared values of BGIs: if adequately conveyed to practitioners, these long term potentials trigger growing investments and related jobs provided by different businesses.

2.6. LESSONS LEARNED

Knowledge on these trends is usually generated through different media, by a wide range of stakeholders: academics usually gather data, develop software, and assess and evaluate case studies. Stakeholders on the policy level address BGIs in policy implementation documents and guidelines, reports, brochures, and developmental rules. Practitioners working in building these infrastructures produce instead spatial development plans, urban planning guidelines, and technical reports and specifications. A number of online platforms, are being developed as means of communication between different stakeholders. These and other knowledge sharing tools and practices are addressed in more detail later in this report.

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2.4. Social trends

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Reports & scientific articles

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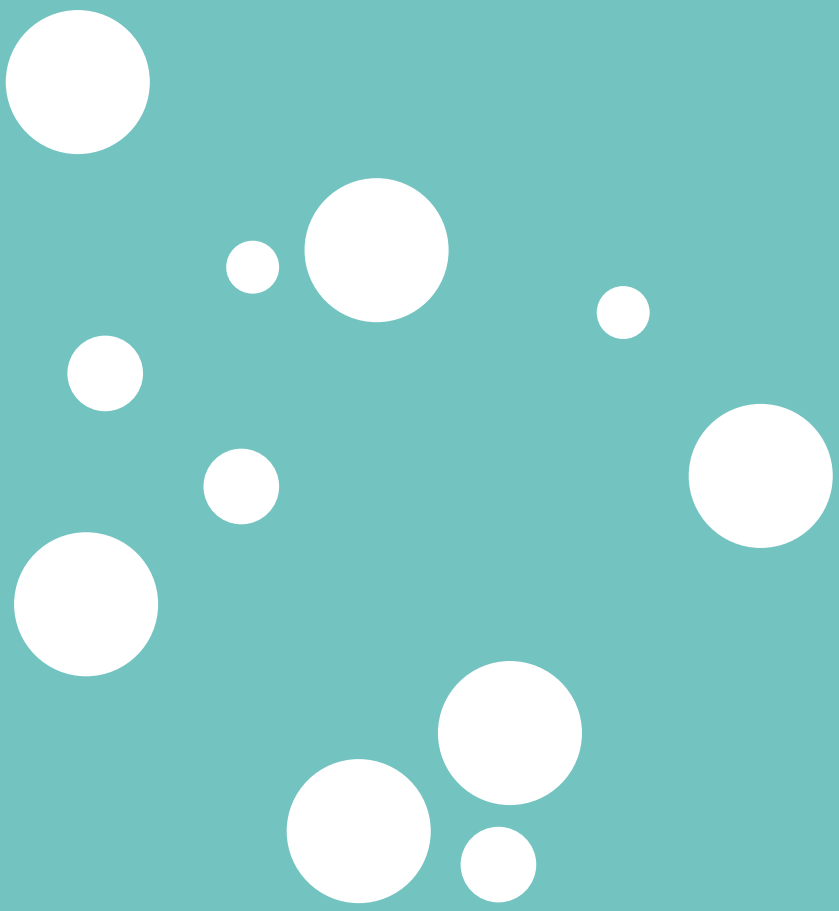
All websites were checked for validity at May 27, 2019.

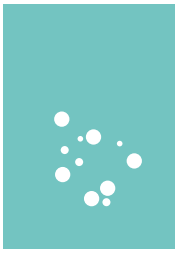
3. STAKEHOLDER ANALYSIS



3. STAKEHOLDER ANALYSIS

Chapter 1:
Introduction

Chapter 2:
Trend Analysis


Chapter 3:
Stakeholder Analysis

Chapter 4:
Precedents

Chapter 5:
Data Assembly

3.1. INTRODUCTION

The project involves stakeholders in the process as soon as possible - this step ensures the final product meets the needs of key users and addresses their perspectives.

Sub-phase A3 of the BGI project enables an understanding of the current knowledge-to-practice flow around BGI through an overview of stakeholders and their activities, and the pinpointing of their mutual relationships. This phase also addresses the main barriers hampering effective bridging of theory to practice as perceived by these stakeholders, together with their suggestions on how to overcome them.

Moreover, understanding data and resources related to each sector supports the mapping of key impediments in the translation of scientific insights into practice, with the priorities and needs of participating stakeholders in mind. In addition, the process assesses the possibility of these actors to participate as partners in later stages of this project.

3.2. RESEARCH DESIGN

This section displays the activities undertaken during the stakeholder analysis.

3.2.1. Shortlisting

Following suggestions from the Project Steering Group (PSG), a list of 64 potential stakeholders was assembled. In collaboration with the PSG, 11 stakeholders were shortlisted according to:

- The level of expected influence of the stakeholder on the project.
- Sector-based classification: to ensure an adequate representation of relevant actors - knowledge institutes, government entities, landscape architects, constructors.
- The possible contribution of a stakeholder to the project (e.g. user, knowledge supplier, investor).
- Closeness of the relationship between stakeholders and PSG members.

The longlist of stakeholders is shown in Annex I. The final shortlist of stakeholders is provided in *Figure 1*.

3.2.2. Online questionnaire

Between January 15th and February 15th 2019, a representative from each of the shortlisted stakeholder organizations filled in an online questionnaire. The structure of the questionnaire consisted of five distinct sections:

1. Expert Information
2. Stakeholder Information
3. BGI Methods and Tools
4. BGI Solutions, and
5. Future Product (BGI Manual).

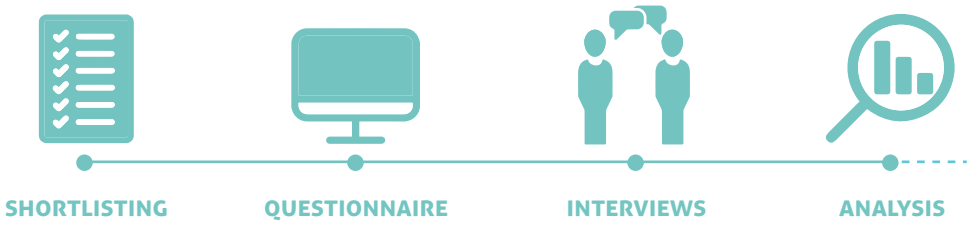
See Annex II for the complete online questionnaire.

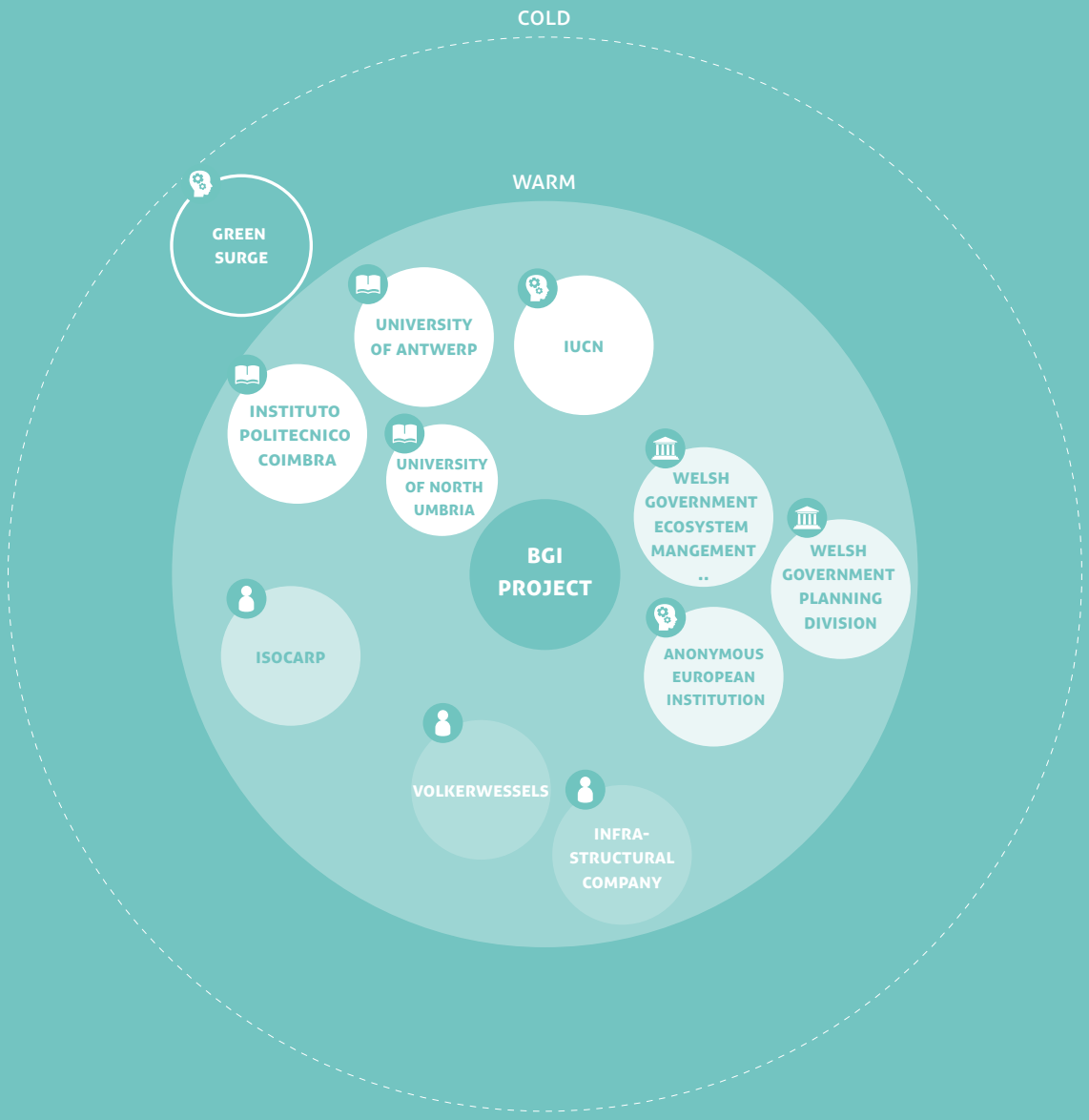
3.2.3. Interviews

Additionally, between the 21st of January and 18th of February 2019, interviews were conducted with each stakeholder by members of Except's research team and a representative of the PSG. Interviews enabled sector-specific insights to be gathered on the role and activity of each stakeholder. The content of the interviews was developed in a customized approach, based on specific inputs on each stakeholder's profile. Due to the limited availability of stakeholders, follow-up calls were held with 9 out of the 11 shortlisted stakeholders.

3.2.4. Network analysis

The information gathered through the online questionnaires and the follow-up calls was used for analyzing stakeholders individually as well as contextualized in sectorial overviews, representative of recurrent, sector-specific opportunities and bottlenecks in BGI knowledge transfer and realization.





SECTOR

- KNOWLEDGE INSTITUTES
- GOVERNMENT ENTITIES
- LANDSCAPE ARCHITECTS & PLANNERS
- CONSTRUCTION, INFRASTRUCTURE & ENGINEERS
- KNOWLEDGE SHARING PROJECT

CONTRIBUTION

- USER
- KNOWLEDGE SUPPLIER
- INVESTOR
- LEGISLATOR
- CONTENT PROCESSOR

› Figure 1 – Map of the shortlisted key stakeholders. The color indicates the sector. The icon indicates the (possible) contribution. The larger the circle, the higher the expected influence. Warm means that there was already a connection established between the PSG and the stakeholder before they were approached to participate.

This chapter provides a snapshot of the activities and dependencies in the BGI realm for each of these categories, i.e. what function stakeholders perform, and how their activities relate to (or depend on) other actors. Each of these sectorial descriptions concludes with an overview of "lessons learnt", including bottlenecks and possible future opportunities, as retrieved during the interviews. The section concludes with a reflection on how and when these cross-sector insights overlap, and how these stakeholders provide the first benchmark for the format and content of the BGI Manual.

3.3. STAKEHOLDER PROFILES

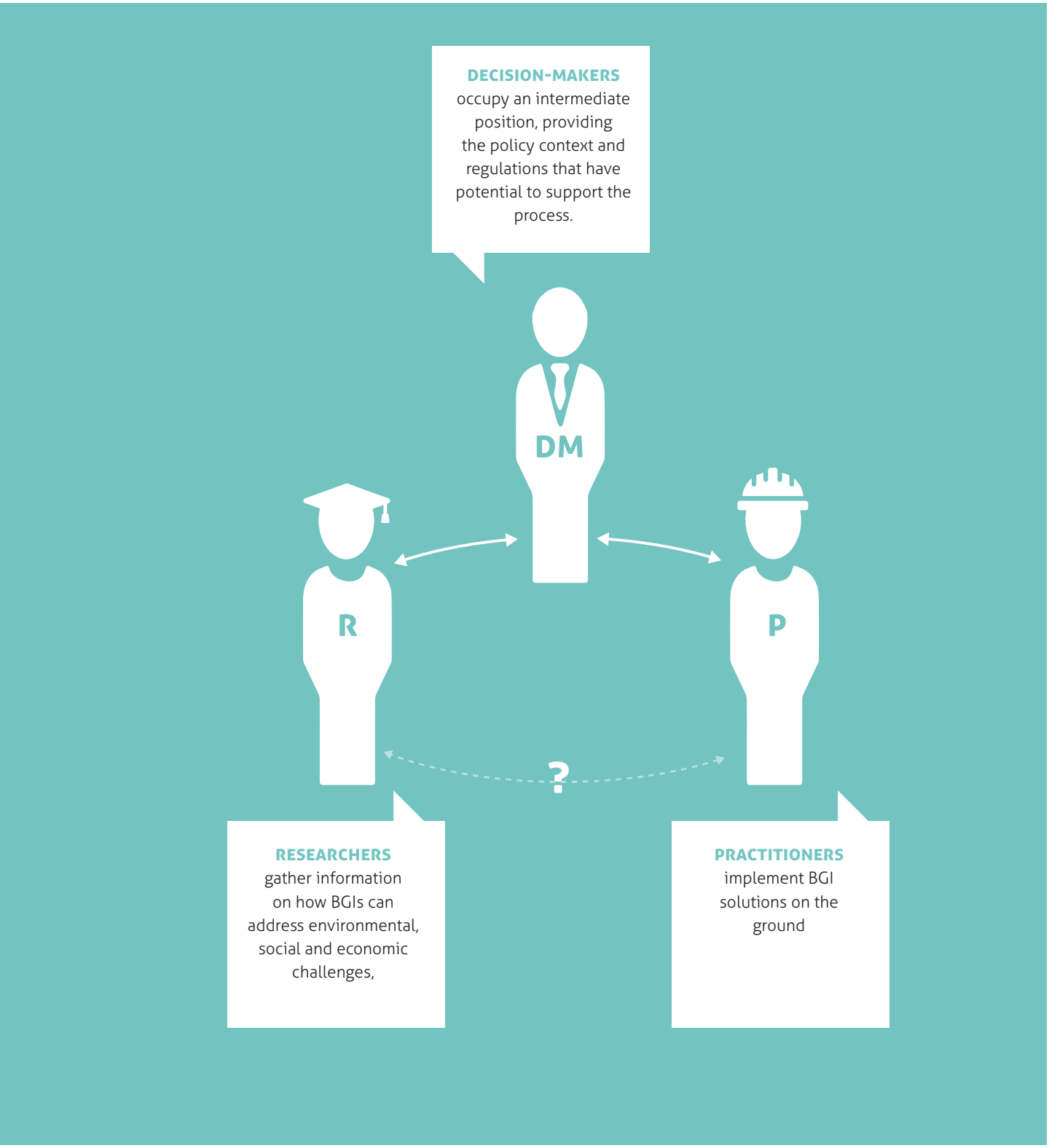
Across the questionnaire and individual interviews (summaries are in Annex III), 3 main categories of stakeholders were identified - **researchers** (R), **decision-makers** (DM) and **practitioners** (P). Across this spectrum, a number of parameters were studied, including their activities and dependencies, encountered bottlenecks, and precedents of knowledge transfer (see Annex IV). The aim of pinpointing common threads is to facilitate the co-creation of solutions in later stages of this project.

The categories, with the related stakeholders shortlisted and interviewed are provided in Table 1 below.

STAKEHOLDER CATEGORY	ENGAGED ORGANIZATIONS
Researchers (R)	**1** University of Northumbria / Natural Environment Research Council (NERC) Knowledge Exchange Fellow **2** University of Antwerp **3** Instituto Politécnico Coimbra **4** International Union for the Conservation of Nature (IUCN) **5** GREEN SURGE - Representatives from University of Munich
Decision-makers (DM)	**6** Welsh Government - Planning Division **7** Anonymous European institution **8** Welsh Government- Ecosystem Management and Implementation
Practitioners (P)	**9** International Society Of Cities And Regional Planners (ISOCARP) **10** Anonymous construction company **11** VolkerWessels

› **Table 1** - Overview of the stakeholder categories and the specific organizations engaged.

Figure 2 (next page) shows the chain of interactions (e.g. information exchange) between the categories addressed, and the issue of streamlining the knowledge sharing process between academia and practice. Researchers gather information on how BGIs can address environmental, social and economic challenges, whereas practitioners are the ones to implement such BGI solutions on the ground. DMs occupy an intermediate position, providing the policy context and regulations that have potential to support the process.



› Figure 2 - Chain of interactions between the BGI stakeholders: R - researchers, DM - decision-makers, and P - practitioners.

3.3.1. Researchers

Activities: Researchers mostly focus on the development of scientific knowledge around BGI by publishing academic articles and scientific reports, as well as guidelines and manuals (Northumbria, GREEN SURGE). Other research areas include design and assessment tools that affect the future implementation of BGI. In addition, stakeholders point out instances where academia are involved in actual implementation of BGI (Antwerp University, Politecnico of Coimbra). Digital data repositories ensure knowledge is circulated, and the necessary data is made available. These data include statistics, sensoring, geographic information system (GIS) data, case studies and methodologies. Similarly, knowledge sharing platforms such as GREEN SURGE focus on aggregating and disseminating knowledge with the aim of facilitating the implementation of BGI. They do this by gathering data, developing software, publishing practical handbooks, assessing and evaluating case studies, and facilitating co-creation sessions between stakeholders via workshops and events.

Dependencies: The key dependency as perceived by researchers is on public administrations and local authorities, e.g. municipalities, as they usually provide the space and resources for researching and developing BGI. As a NERC Knowledge Exchange Fellow, a researcher from Northumbria University further highlights the dependency between policy-making and academia as crucial in designing and writing better planning policies for BGI. However, translating knowledge on ecosystem services and biodiversity into different policy domains is not always easy. To overcome this, a researcher from Northumbria University identifies the 'hooks' that link ecosystem science to key policy or legislative duties.

Bottlenecks, unexpressed potentials and opportunities: The main lessons learnt across the interviews within the Researchers category can be summed up into:

Design research with practitioners in mind

As pointed out by a number of researchers interviewed, an appropriate way to better connect academia and practice in knowledge transfer is to get them to co-produce and co-design research. Shaping research questions in the early stages to be useable and benefit practitioners ensures that outputs are fit for purpose. A representative of IUCN advocates the need for interdisciplinary research approaches to BGI: as real-life issues can only be solved by cutting across different disciplines and approaches.

Collaboration between environmental and planning departments

The lack of communication between these two departments within municipalities and local authorities is acknowledged by stakeholders as one of the main barriers for implementing BGI. As a researcher from Northumbria University further elaborates, BGI is often perceived as a competency of the department of environment. These are often limited in both size and budget, according to IUCN. Furthermore, a researcher from Antwerp University argues the focus of urban planners lies disproportionately on grey infrastructure, and they often lack training on BGI implementation. Planning departments are important as this is where key decisions concerning BGI are made. GREEN SURGE sees a particular potential in this joint effort as cities represent the best repositories for key information regarding BGI.

Fine-tuning language

Stakeholders agreed that language and terminology that facilitates interaction across fields is pivotal. For example, a representative from GREEN SURGE highlights that scientific jargon can hamper the knowledge-implementation flow. However, at Antwerp University they further specify that due to the inherent different domains and specific technical aspects related to BGI, the lack of communication between different stakeholder groups represents a particularly relevant issue to address. The specificity, diversity, and in some instances mutual "siloing" of different languages on BGI - often more relevant to ecologists than to planners, is further acknowledged within IUCN and Northumbria University.

Setting Standards and Tools

The potential for the creation and fine-tuning of standards on BGI is acknowledged by different researchers across the interviews. Both Northumbria and GREEN SURGE attest to the need for standards that take quality as well as quantity into account. This lack of standards hampers the design of functional BGI that delivers multiple benefits. A set of standards and specifications for BGI solutions - such as the ones developed by IUCN or Natural England - is also claimed to be necessary by a researcher in University of Coimbra. The wide availability of tools makes it unnecessary to develop more. Rather, practitioners need clear signposting to the tools already available for use in different contexts. In GREEN SURGE the need for more convincing arguments in BGI guidelines is mentioned: they should not merely consist of 'recipe books', but rather provide an enhanced narrative on the shared ecological, social, and economic value that BGI brings.

Top down vs. bottom up

A point of interest raised by different researchers is the potential for combining top-down and bottom-up approaches when dealing with BGI knowledge sharing and implementation. At Antwerp University, for instance, the importance of incorporating citizen science in order to implement projects that influence citizens' daily life is highlighted, so as to help raise the social awareness of the value of BGI. This awareness is considered an effective way of nudging decision makers: one example highlighted how increased awareness of air pollution in different areas of Antwerp influenced citizen's housing demands, ultimately causing a shift in the real estate market. The promotion of bottom-up approaches that capitalize on the energy, interest, and initiatives of citizens is further highlighted by GREEN SURGE. However, at Antwerp University, they point out that these approaches alone cannot replace top-down initiatives which significantly streamline BGI implementation processes. As an example, policy makers in Antwerp made it mandatory that a) every flat roof must be turned into a green roof, and b) every new construction must feature a green roof. In this regard, a researcher from Northumbria University further highlights the importance of the discussion currently being held in the English policy agenda on mandating biodiversity net gain for development. Overall, a better connection between citizens' initiatives and strategic policy level is found to be a valuable trajectory to envision the future of BGI.

3.3.3. Decision-makers

Activities: The focus of these actors lies in developing policy strategies around BGI. They engage in drafting policy strategies and policy implementation guidance documents for specific sectors, both at the national level (as in the case of the Welsh Government Planning Division) and on the European level (Anonymous institution).

Dependencies: These actors greatly depend on scientific institutes to inform policy planning with related knowledge, i.e. the Welsh Government on Natural Resources Wales, and the EU on the Joint Research Centre. Regarding implementation, they depend on other government departments, local authorities and practitioners, and report back during policy monitoring. They also interact with civil society and NGOs that can advocate implementation and take responsibility for local initiatives.

Bottlenecks, unexpressed potentials and future opportunities: The main lessons learnt across the interviews within the Decision Makers category can be summed up into:

Dissonance in time-frames

As argued in the Welsh Government Planning Division, policy makers operate within predefined political cycles which hardly ever align with the progress and process of scientific research. This makes incorporating more recent research into policies difficult. It is further highlighted that policy officers often lack the time they need to read through the amount of available BGI-related research. While navigating through large volumes of research, governments advocate their need for strong guidance to choose appropriate methods according to their objectives and needs. According to the European institution, this can be a particularly relevant bottleneck due to the fact that policy is guided by science, and governments rely on institutions for scientific knowledge - e.g. Natural Resource Wales in the case of Welsh Government.

Gaps between levels of decision making

The anonymous institution highlights that no strategy tailored to the local level is currently implemented on the European level: each member state has its own administrative organization, employs different data collection methods and is not mandated to report back on BGI strategies. This lack of regulation and directives makes BGI hard to manage and track at EU policy level, as problems of data compatibility also occur. Furthermore, a number of local authorities are often unfamiliar with BGI approaches, which frequently leads to other demands on time and resources being prioritized. In Wales it is often the case that successful BGI projects are developed on higher value land, as developers are more willing and committed to signing funds for land-management related projects.

3.3.4. Practitioners

Activities: The main activities of landscape architects include the development of spatial development plans, urban planning guidelines and technical reports. The main concerns of this group lie in the design and application of effective urban development master plans. With regard to the construction sector, the main activities include the implementation and maintenance of infrastructure projects that can provide direct or indirect opportunities for BGI solutions. This sector also provides technical specifications for integrating BGI into infrastructural projects, impact assessments of construction and data repositories for technical reports.

Dependencies: Landscape architects depend on academia to provide the scientific foundations for BGI implementation in the urban context, as well as on government entities, who create the legislative framework that dictates the conditions for developing the masterplan. Their activities also rely on practitioners from urban administration departments, businesses, and citizens, who can each influence the planning process in different ways. Stakeholders from the construction sector rely on academic institutions to improve processes through scientific knowledge. Moreover, governments and clients from the commercial sector contract infrastructure projects. In addition, NGOs or local biodiversity groups are often responsible for managing and maintaining BGI projects in the long-term once a construction project has ended, e.g. projects which have committed to delivering biodiversity net gain.

Bottlenecks, unexpressed potentials and future opportunities: The main lessons learnt across the interviews within the Practitioners category can be summed up into:

Dissonance in priorities

An overarching consideration detected across the interviews with practitioners is that, while BGI is not always a priority for planners and developers, attitudes are slowly changing. Implementing a BGI network at the urban scale is particularly challenging, as it entails coordinated approaches by different sectors, each with its own responsibilities, priorities, and processes. However, practitioners note that more and more urban planners are considering BGI at the start of project design. An anonymous practitioner adds to this, arguing that big infrastructure projects and housing developments are increasingly interested in environmental enhancements as it often accelerates consent processes. A relevant step towards fine-tuning cross-sectoral priorities seems to be stronger and clearer communication: not only on the social, "intangible values" of BGIs, but also on their economic benefits. According to the experiences within the anonymous construction company, clients often ask for a natural capital account of a site to demonstrate this.

Fine-tuned terminology and guidance across sectors

According to several of the practitioners interviewed, innovative approaches to BGI should follow the existing processes of the industry, and be aligned with the way in which the construction sector carries out its activities. The terminology produced in research is often deemed confusing, and overall rarely relevant for practical implementation. A practitioner from an anonymous construction company further elaborates that BGI research "has little or no relation to on-the-ground reality, and it is not written in such a way that can be transferred to practice". Moreover, according to the interviewees, practitioners find the volume and plethora of policy strategies hard to grasp and stay up to date on. Infrastructure elements are highly challenging to retrofit after certain decisions have been made. Due to this reason, experts in this field believe that inclusive approaches, that involve them earlier in the process, enable more effective BGI implementation. Planners, on their part, need a combination of hard and soft policy approaches to BGI. On one hand, they need a clear, step-by-step implementation process - securing land, early involvement of stakeholders and public, maintenance, operation, and long-term financing. On the other hand, planners need such guidelines to be flexible and context dependent.

Top-down vs. Bottom-up

The lack of legal instruments to steer the commitment of the actors towards BGI makes the process even harder: a practitioner at ISOCARP mentions the need for stronger BGI-related legal requirements. Furthermore, they highlight the need to channel the initiatives of citizens that are aware of the benefits of BGIs through regulation. Other practitioners argue that a significant step in this direction is to hold discussions on mandatory biodiversity net gain for development projects in England. This will require considerations of biodiversity at an early stage of planning, and also bridge the gap between the construction sector and grassroots groups of biodiversity advocates.

3.3.5. Detecting patterns and common threads across sectors

This section will conclude the insights gathered through the singular clusters of stakeholders (R, DM, and P) to find shared threads and concerns. The list of commonalities is listed below:

Vocabulary and Communication

A number of interviewees pointed out problems related to miscommunication and lack of fine-tuning of terminology across the three sectors addressed. A representative from the Welsh Government Ecosystem Management and Implementation division (DM) refers to confusing terminology and language as one of the main issues of implementing related research into policy making. At Northumbria and Coimbra Universities (R) it is also argued that politicians' lack of technical/scientific background, as well as disciplinary silos, represents a significant bottleneck to effective communication. Research vocabulary is often more suited to ecologists rather than those in planning. An anonymous construction practitioner points out that research publications are rarely aligned with the real needs of practitioners. Moreover, the plethora of different definitions for BGI across different practice domains makes it challenging to find common ground to start the conversation in the first place.

Setting Standards

Each with her/his own perspective on the topic, the majority of stakeholders interviewed mentioned the need for a set of common standards for BGI across sectors. These standards and specifications can be focused on the facilitation of the construction process or to fine-tune the awareness of different societal actors on BGI. At GREEN SURGE (R) the importance of taking public concerns into consideration when developing standards is also highlighted, in order to be widely accepted and adopted. At the anonymous institution it is mentioned that standards for BGI technologies and products would be useful tools in order to provide a benchmark for expected outcomes.

Links to Policy

Researchers acknowledge the need for tools and methods that are linked more strongly with policy. IUCN (R) for instance, recommends stronger integration of the value of ecosystems in water, health and climate change policies from the local to the EU level to facilitate development. At Northumbria University (R) it is argued that environmental issues should be set higher in the policy agenda, through clearer relationship with economic indicators. This point is further stressed by a practitioner (P) who argues that demonstrating economic returns is critical as project managers work with a specific budget and they must justify how it is spent. Researchers at Antwerp University (R) acknowledge policy as a key driver for the implementation of BGI - e.g. the case of mandatory green roofs in Antwerp. In the Planning Division of the Welsh Government (DM), they highlight the importance of policy in developing BGIs, noting that wider recognition and further research on the contribution of BGIs can facilitate linkages with existing policies. A widespread interest in biodiversity seems to represent a common thread across sectors: an

anonymous practitioner highlights that great potential lies in the connection between BGIs and biodiversity enhancement, especially in countries that have strong policies on biodiversity stewardship or at EU-level, where, according to a number of decision-makers, biodiversity represents a core pillar of BGI strategy.

For researchers at GREEN SURGE, pilot projects are valid testing grounds for developing policies. These projects allow actors to argue for policies that take into account local conditions, whereas at the same time the effectiveness of any intervention has been tested. Overall, decision makers suggest that an approach where research can be designed according to policy objectives and national, or regional, priorities is key.

This stakeholder analysis represents the first building block in the roadmap towards a BGI Manual, as patterns and common threads detected across the three sectors serve as items to embed in the DNA of the future manual. Specifically, the common thread that this paragraph covers provides more specific pointers. A primary barrier for a streamlined knowledge-to-practice flow is language-related: the need is acknowledged for information that is conveyed in understandable language, that crosscuts sectors, and provides stakeholders with a shared vocabulary on BGI. Moreover, the manual is expected to retain an inherent capacity to renew existing terms, and to be populated by new ones in line with the development of knowledge on BGI. Secondly, the manual should provide sets of guidelines that are relevant across sectors, to standardize the potentials and expectations of BGI while providing a benchmark for good practices. Additionally, the manual is foreseen as a tool that connects knowledge to practice also through the policy level: this feature would have the added value of justifying and pinpointing the steps of policy agendas aimed at tackling, among other issues, climate change, biodiversity loss, and water management in both urban and rural contexts.

3.4. THE BGI KNOWLEDGE VALUE CHAIN

Tapping into the analysis performed during the interviews, this paragraph outlines the value chain of interactions between the key stakeholders that populate the knowledge-to-practice flow.

The section first explains the process of deriving the value chain from the stakeholder analysis previously described, and presents one possible depiction for the complete chain of interactions. Secondly, it summarizes potential ways for the functioning of the value chain to be optimized, in such a way as to alleviate the bottlenecks while fine-tuning the activities of each stakeholder, and to streamline the flow from knowledge to practice.

3.4.1. Visualizing the knowledge-to-practice flow

By individuating both common threads and specificities on the individual and sectoral level, twelve basic functions performed by stakeholders in the exchange of BGI-related valuable knowledge (i.e. the value chain) are found. Together, these steps form a chain of actions performed by the stakeholders, separately or collaboratively, at different stage of a BGI project development.

It is particularly valuable to mention that these activities are performed along an inherently nonlinear process: each of these can be envisioned as a cycle of its own, interacting by means of a number of direct or indirect feedback loops.

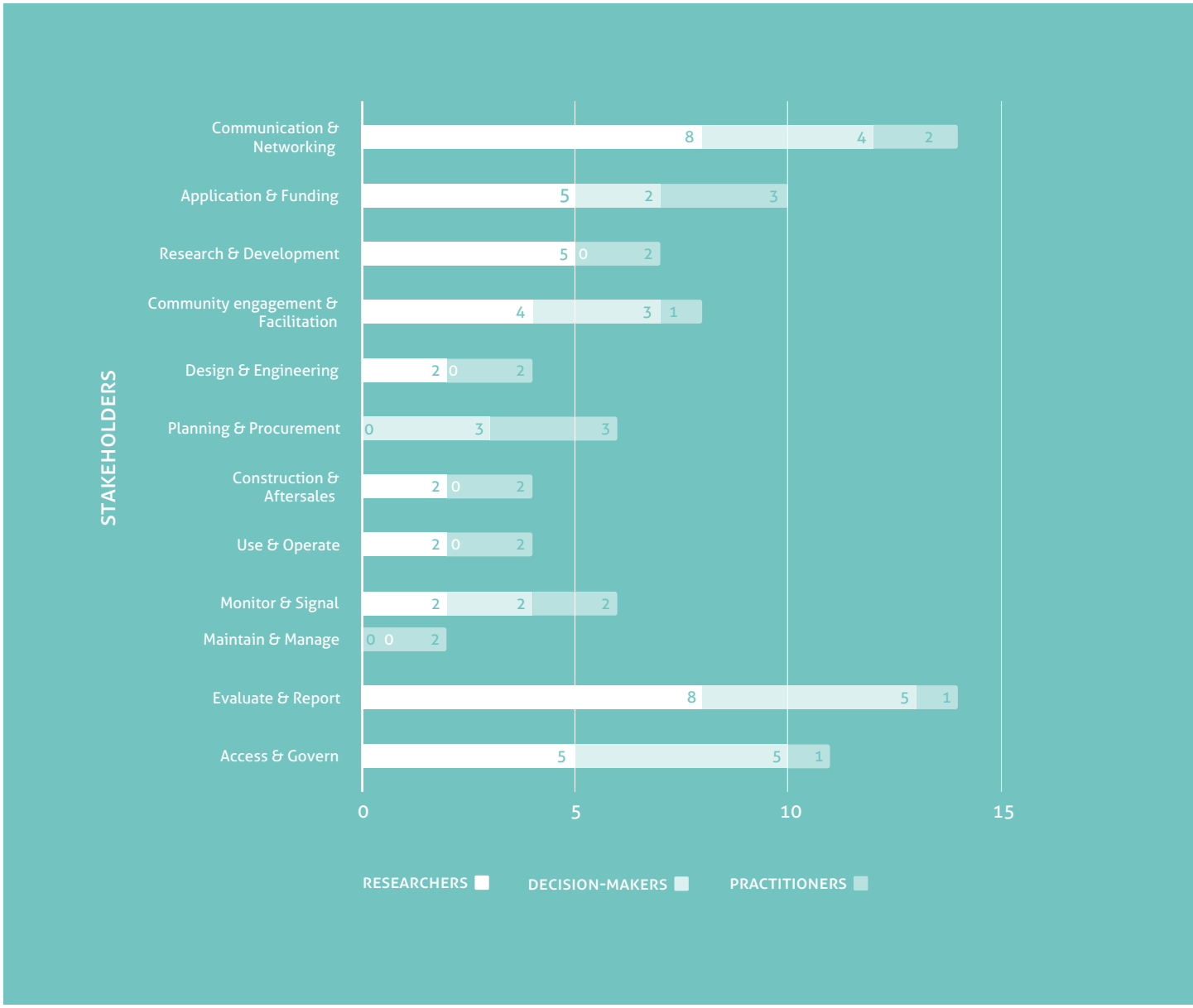
The twelve functions captured are listed and explained in Table 2.

FUNCTION	RELATED ACTIVITIES
1 Communication & Networking	› Sharing of information through different means (e.g. meetings, publications, webpages) for the preparation, execution and management of BGI. › Increasing awareness among stakeholders. › Creation of a common language.
2 Application & Funding	› Actions that need to be taken in a proposal for funding BGI. › Application formats that ensure accountability for BGI development.
3 Research & Development	› Activities for the collection, recording and analysis of data for the development of BGI. Experience comes through development and leads to innovation.
4 Community Engagement & Facilitation	› Preparation, execution, and management of BGI with the involvement of multiple stakeholders and disciplines. The multidisciplinary background of participants create BGI solutions with higher social acceptance, lower research and development costs, and integrated local needs.

› **Table 2 -** List of activities performed across the BGI value chain.

FUNCTION	RELATED ACTIVITIES
5 Design & Engineering	› Technical activities and design knowledge are requested for the safe and proper development of BGI. Mathematical formulas, blueprints, and environmental standards such as pollution, climate, and plant species are observed in this phase.
6 Planning & Procurement	› Activities for the development of BGI within urban, natural or semi-natural areas. › Plans, policies, incentives and regulations are different for each area, and consequently influence the development of BGI.
7 Construction & After-sales	› Activities for the construction of BGI as well as responsibility and accountability for management.
8 Use & Operate	› Activities and knowledge for the operation and performance of BGI.
9 Monitor & Signal	› Sample collection and technical means such as sensors used to monitor and manage the performance of BGI, and their potential environmental impacts. The provision of dynamic data allows better risk management and adaptation of BGI in the environment.
10 Maintain & Manage	› Activities and regulations for the maintenance and management of BGIs after the implementation phase. Its focus on the management of BGI assets and their relationship with users. In this way better economic, environmental and technical performance is achieved through BGI solutions.
11 Evaluate & Report	› Knowledge dissemination for BGI by scientific research, government regulations, consultancy and business reports.
12 Access & Govern	› Preparation, execution and management of all the generated data (e.g. statistics, policies), resources (e.g. construction manuals), competencies, and education of stakeholders.

The bar chart below (Figure 3) shows how many times each stakeholder (R, DM, P) explicitly stated participation in each of the twelve activities within the value-chain. Exceptions are represented by the Management and Maintenance activity - performed only by practitioners, and the activities relating to constructing and implementing BGI, which exclude decision-makers. With different scopes and competencies, stakeholders cover the majority of the twelve activities simultaneously.



› Figure 3 - Frequency of times each stakeholder stated that he/she performed an activitybelonging to that stage of the value chain (Table 2)

3.4.2. Optimizing the value chain

The stakeholders believe that the potential for streamlining the knowledge sharing process requires consistent collaboration amongst a wide range of sectors with different competencies. Across the interviews, a number of recurrent actors and sectors filling the gaps within the BGI discussion were explicitly indicated by all the three stakeholder categories addressed in this research. These sectors are:

- **Agriculture:** Land can be used to create connectivity between urban, peri-urban and/or rural BGI solutions. For example, agricultural land could be employed as a green corridor that enhances biodiversity and ecosystem services.

- **Forestry:** Forested land can be introduced into the planning of BGI to increase biodiversity and establish connectivity between urban, peri-urban and/or rural BGI solutions.

- **Water Management:** Actors in the hydrology field have the potential to provide added value by sharing strategic plans for water infrastructure development, support requirements for integration of blue and green features, and co-funded projects.

Additional "intermediary" stakeholders missing from this value chain were highlighted during the research:

- **Citizen communities:** These actors can provide their contribution via a 'citizen science approach'. These activities strengthen the public acceptance of BGI solutions, and empower the local community by ensuring their participation and leadership in development, maintenance, and management of BGIs.

- **Startups:** The shared value these organizations provide lies in the development and testing of BGI business cases, and related products and services. They can support the gathering of funds as well as human resources, while establishing cross-sectoral relationships via partnerships that ultimately scale-up BGI solutions.

- **Municipalities:** According to the majority of stakeholders interviewed, local authorities have the strongest decision-making power regarding planning and design of BGI - especially in planning decisions, budget allocation and approval of BGI projects.

- **Financial entities:** Financial frameworks and banking mechanisms, angel investors, investment companies, insurance companies, and real estate firms can support the planning and management of long-term infrastructure developments.

- **Engineers:** Problem-solving skills and design solutions represent the main contribution of these practitioners, as well as analysis (e.g. cost-benefit, performance) and the rapid prototyping and testing of possible missing components of BGI solutions.

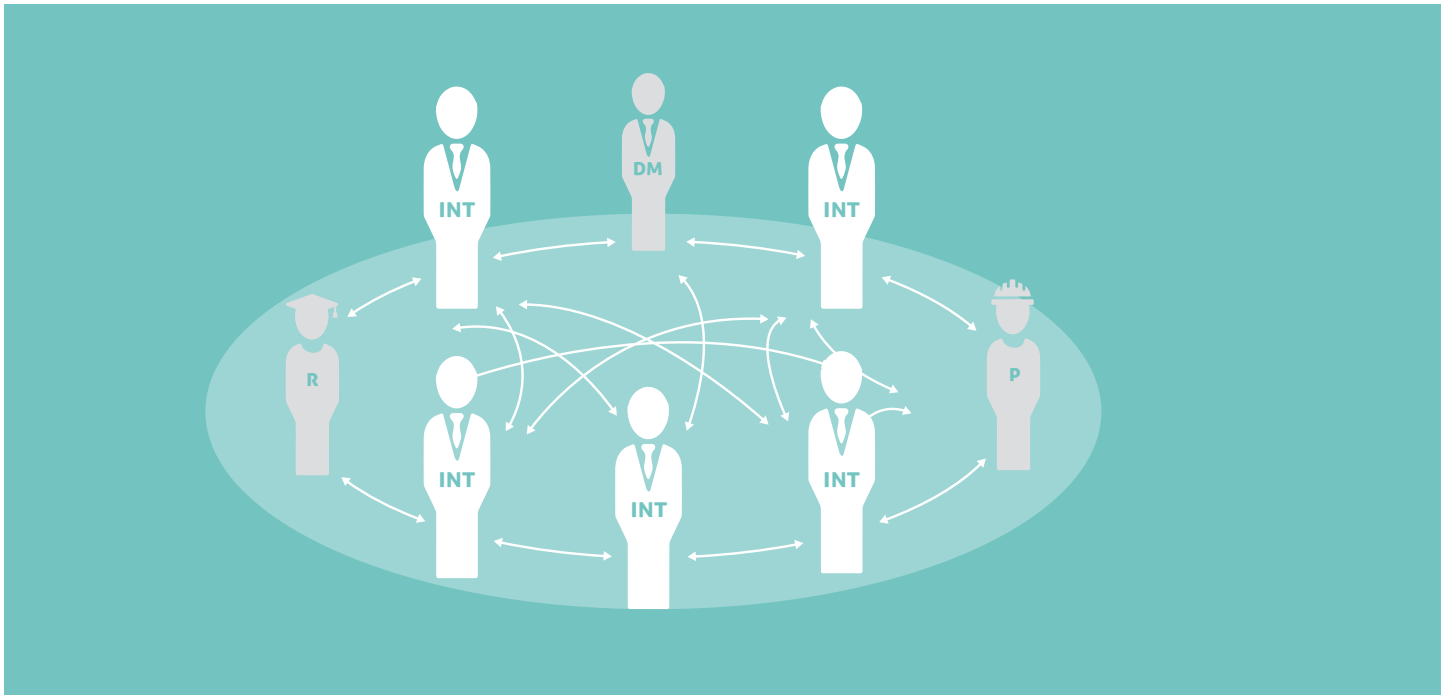
- **NGOs:** These organizations are crucial for translating research into user-friendly materials, as well as raising awareness, engaging and educating other stakeholders. NGOs can also support applications for funding.

3.4.3. Conclusive reflections on the Value Chain

According to the information retrieved along the research, the main issue to address is the lack of a fully connected value chain, in terms of communication and fine-tuning across different stakeholder groups and levels of governance (e.g. local to EU level). The close relationship between the roles and activities of each group is evident from a value chain perspective. The output of one group provides input for the activities of another, creating continuous feedback cycles. For example, knowledge produced by researchers provides scientific guidance for policy planning. This can be achieved through the statutory scientific advisors of government on the national and European levels (e.g. NRW for Welsh Government and JRC for the EU), as well as other European & international research platforms (IPBES, MAES, IUCN). Public administrations and local authorities use these policies to shape their own local or regional development plans, which set out conditions that practitioners must adhere to when implementing BGI. Practitioners in turn may themselves draw on research to design or construct cost-effective and multifunctional BGI solutions.

The data produced and activities performed by each group together adds value to the transition of knowledge to practitioners. However, as this research reveals, the presence of gaps within the BGI value chain - e.g. in the form of conflicting interest and/or communication-related issues - can create long delays, high costs and ultimately poor social, economic, and environmental performance.

Intermediary stakeholders have the potential to translate the data produced by each group to specific target-groups by means of both digital platforms, e.g. databases of design guidelines, and physical interactions, or co-creation, e.g. living labs. This knowledge brokering can also help to reduce time delays, while speeding up BGI implementation. Figure 4 below provides a snapshot of the value chain, integrated with intermediaries who streamline the knowledge-to-practice flow in digital or physical form.



› Figure 4 - Conceptual overview of a complete value chain around BGI.

3.5. THE BGI MANUAL

After detailing their perception of barriers and opportunities for knowledge transfer, the stakeholders pinpointed a number of features that a BGI Manual should feature - clustered and explained below:

- **Technical guidance:** Guidelines and instructions for all the necessary elements used in BGI projects, e.g. materials, sources and design principles.
- **Guide for implementation:** Strategic code book, prescribing a step by step guide for the development of BGIs, from policies and regulations to the construction level.
- **Standards & Specifications:** Requirements that need to be understood and taken into account before, during, and after the development of BGIs, i.e. a checklist to ensure the quality of the final product.
- **Inventory of methods:** Itemized catalogue that collects different BGI methods, and their potential to include issues such as water management, biodiversity, and green public spaces, among others.
- **Sign-posting:** Capacity of the final product to clearly and straightforwardly connect specific BGI-related issues with other useful information sources, and ready-to-use tools.
- **Examples of best practices:** List of successful case studies and BGI methods that can act as benchmarks for addressing environmental challenges effectively.
- **:** Posters, powerpoints, photographs, schemes, figures, and videos that clearly display key information on BGI.
- **Links with policy:** Strong, explicit connections to the policy sector. This inclusion prevents BGI solutions being viewed as localized, isolated interventions, framing them as solutions that embody a strong link between local and global policy goals.
- **Benefit demonstration:** The inherent capacity of the final product to manifest the overall contribution of BGIs for society, economy and environment. By explicitly figuring this shared value, the final product would increase its attractiveness for potential investors and governmental authorities.
- **Business case options:** It express the desire of the interviewees that the final product/ service be market-oriented and not isolated within governmental budgets and goals.
- **Multi-stakeholder relevance:** Capacity to address social and environmental problems by bringing together knowledge and expertise from different fields.
- **Modelling:** Software programmes and other monitoring and analysis techniques such as GIS and simulations that model scenarios to test the validity of decision making for BGIs.
- **Communication fora:** Hubs of communication between different professional fields involved in the creation of BGIs. Exchange of knowledge, expertise, and skills between the involved actors are crucial for the successful implementation of BGI projects.

- **Training workshops:** Places where stakeholders can practice their knowledge, get trained, and expand their understanding of BGI while cooperating with partners.

- **User contribution:** Interactivity and capacity of content updates, based on users contribution.

3.5.1. Crossing Requirements for BGI Manual

In this section we address the level of interest in each of the above features expressed by Researchers, Decision-Makers, and Practitioners. Figure 5 provides a graphic depiction of the main features of interest, divided by stakeholder category. Each category is coupled with the number of stakeholders that mention it specifically as a requirement.

By comparing the three figures, common (or diverging) features across sectors become visible.

Practitioners and Researchers both advocated the need for standards and specifications for BGI, i.e. checklists to be kept track of during and after the development of BGIs to ensure the quality of the final product. A further requisite these two stakeholder categories share is the need for an inventory of methods, including the issues each specific one can address, e.g. biodiversity loss or water management.

A feature deemed pivotal for all the stakeholders interviewed is the clear links to policy, i.e. a strong connection with policy goals and procedures to provide legitimacy and link local solutions to global issues.

Furthermore, Decision-makers and Practitioners share the need for a clear demonstration of benefits within the BGI Manual, i.e. an explicit definition of the social, economic, and environmental contribution of BGI, meant to increase attractiveness.

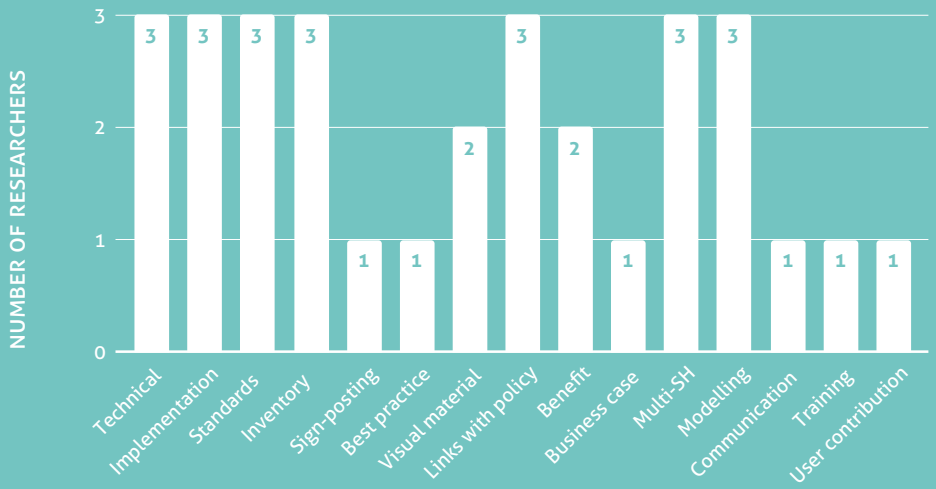
The need to emphasize the multi-stakeholder relevance of the Manual is shared by Decision-makers and Researchers, aiming at a tool that brings together insights across fields of expertise. These two categories also share the need for visual material within the manual.

However, the BGI Manual could partly address features that are highly important to only one stakeholder category: insights on how to co-create BGI-related knowledge with other actors in communications fora are particularly valuable to decision-makers, e.g. in the form of living labs. Researchers, on their part, identify modelling programs and software in the manual as key items for effective communication of their findings to other stakeholders.

The decision on whether the Manual should consist of a digital platform, a physical product, or a combination of the two, is left for the co-creation session this research is a preparatory step for.

The requirements visualized in Figure 5 (next page) are crossed and displayed in Table 3 on the next page, to identify common threads across the three stakeholder categories.

› Figure 5 (next page) - Main features for a BGI Manual, stated by Researchers, Decision-Makers, and Researchers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Modelling
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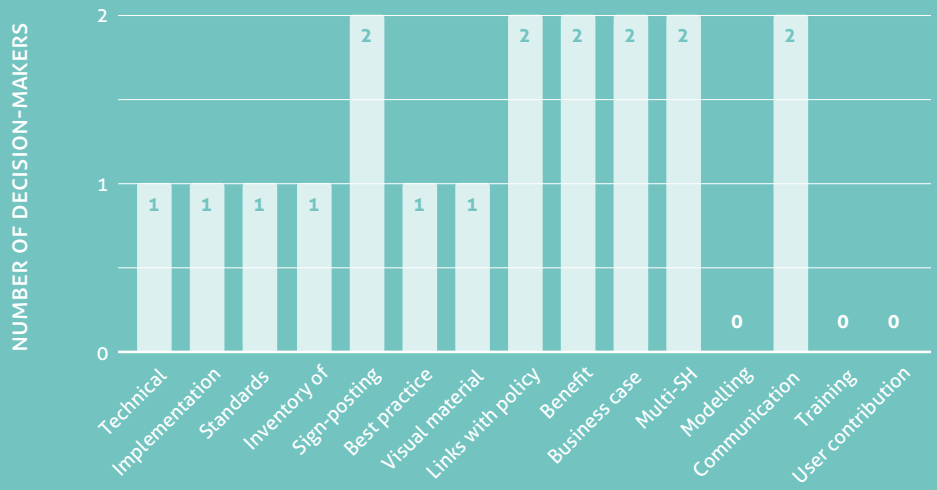
Training
User contribution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Training
User contribution


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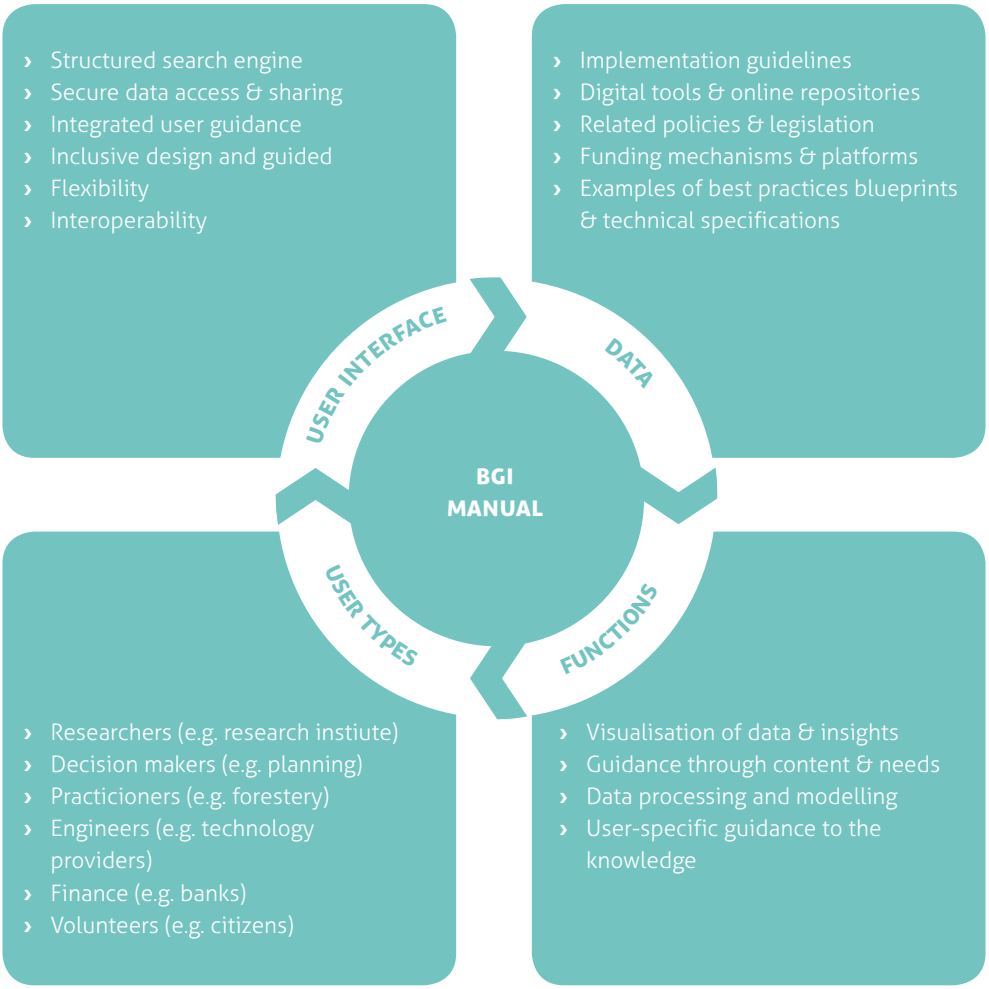
Best practice
Visual material
Links with policy
Benefit
Business case
Multi-SH
Modelling
Communication
Training
User contribution

FEATURES	RESEARCHERS	DECISION-MAKERS	PRACTITIONERS
Technical guidance	3	1	1
Guide for implementation	3	1	1
Standars & Specifications	3	1	2
Inventory of methods	3	1	1
Sign-posting	1	2	1
Examples of best practices	1	1	2
	2	1	0
Links with policy	3	2	2
Benefit demonstration	2	2	2
Business case options	1	2	0
Multi-stakeholder relevance	3	2	1
Modelling	3	0	0
Communication fora	1	2	1
Training workshops	1	0	0
User contribution	1	0	0

› Table 3 - Common threads across the three stakeholder categories

Figure 6 (next page) provides a visual depiction of all the information collected along the interviews. Particularly, key insights regarding a) barriers and opportunities for the knowledge-to-practice flow to be improved and b) requirements from each stakeholder group for the future BGI Manual are merged. The grouping comes as a result of the micro-to-macro analysis described in this report: from single stakeholders to sectors, and from singular sectors to a systemic value chain. Once cross-checked and compared, the insights are grouped along the categories of content, functions, user interface, and user type. This process ensures that future discussions on the BGI Manual hold these insights as pivotal, to craft a product that is rooted in the perspectives and needs of the value chain.

Bringing these topics together in an interactive way in the Manual ensures that BGIs are mainstreamed in their multifunctional contribution to sustainable development, and the processes to realize them is streamlined.



› Figure 6 - List of requirements for future BGI Manual.

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All websites were checked for validity at May 23, 2019.

4. PRECEDENT RESEARCH

4. PRECEDENT RESEARCH

4.1. INTRODUCTION

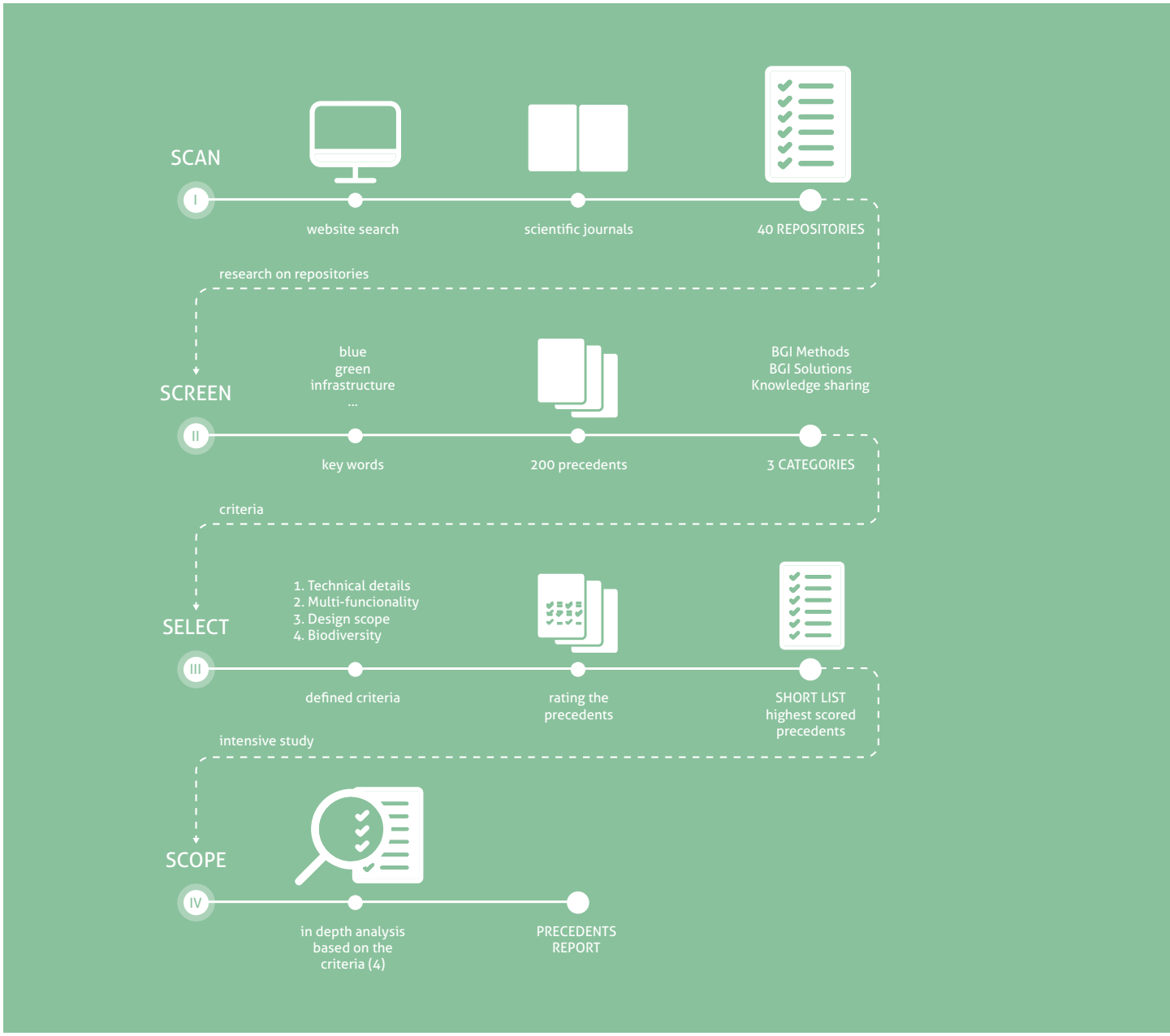
The primary reason for the precedent research stage is to prevent reinventing the wheel. Precedents are relevant for the purpose of learning from other products, projects, and research. The precedent research enables accessing and recording available knowledge and addressing knowledge gaps. It pinpoints key sources for existing data, design methods, and construction and maintenance practices. Examining methods identifies factors likely to determine the success or failure in implementing scientific knowledge on BGI in practice. The research ensures that the key insights are integrated into a comprehensive guide rooted in practice in later stages.

Precedents in the BGI field can be gathered from a critical review of current literature, and categorized into Methods and Solutions. After outlining the current state of knowledge around BGIs, the research targets the heart of the problem by providing a review of knowledge transfer tools and methods from other scientific and professional fields. These precedents serve as inspiration to bridge the knowledge-to-practice gap in the BGI field.

4.2. RESEARCH DESIGN

The research design consists of four steps. Through this process, data sources and precedents are identified and analyzed in detail. The phases that structured the desk research and the funneling of information are depicted step by step in Figure 1 below:

The initial web search on BGI repositories gathered a high number of precedents (200). The long list is then grouped into different categories, and analyzed. The proposed methods and solutions represent the outcome of four steps, listed below.



› Figure 1 - The process of structuring information and data for BGI precedents

I. Scanning for sources

More than 40 relevant repositories (data sources) are identified by searching the web and following inputs of the PSG. Among other sources, databases (e.g. BiodivERsA), scientific journals (e.g. Elsevier), search engines (e.g. Sciencedirect) and government pages (e.g. www.europa.eu) are screened for available data on BGI.

II. Screening of sources

By typing a variety of key-words (see Annex V), the data sources are queried. Along this step, 3 categories of precedents are identified - methods, solutions, and precedents of knowledge sharing in different fields. The outcome is a long list of 200 BGI-related methods and solutions, and 11 cases of knowledge transfer from research to practice in other fields. Serving as a database, the long-list provides a set of precedents, their online references, as well as short individual descriptions.

1 **BGI Methods**: Tackle issues related to climate change, water management and biodiversity loss in urban and rural areas. During the analysis, Methods were clustered in the 3 subcategories *online platforms*, *guidelines* and *digital tools*.

- **Online Platforms:** Sources of information for BGI methods, identifiable with data repositories such as scientific journals, search engines and web pages. These platforms give access to relevant literature, methods and case studies regarding BGI. In addition, they serve as means of communication between different stakeholders.

- **Guidelines:** These methods refer to technical and scientific documentation employed by BGI practitioners. Guidelines include strategic documents, government reports, developmental rules, brochures, and scientific articles.

- **Digital Tools:** Applications, softwares, and calculation sheets for designing BGIs, used in projects by practitioners. The tools are digital methods for searching, designing, and performing calculations on BGIs.

2 **BGI Solutions:** Implementations of one or more BGI Methods, defined in a spatial context. BGI Solutions can be considered representative examples of BGI Methods. Specifically, solutions represent physical manifestations of infrastructures, case studies that include green and/or blue functions such as green roofs, green walls, biofiltration systems, management of riparian areas, or wild-corridors. The solutions are categorized according to their spatial scale in 4 categories, from nano to macro. Such grouping is deemed valuable, as it provides insights on key issues such as a) the number and knowledge background of the stakeholders that need to be involved, b) the resource expenditure that needs to be employed for design and implementation, c) the environmental, social, and economic shared values of a project.

- **Nano:** The smallest spatial category of BGI Solutions, executed on small sites. The area for this category spans from 0 to 0.1 ha.

- **Micro:** The area for this category spans from 0.1 to 1 ha.

- **Meso:** The area for this category spans from 1 to 10 ha.

- **Macro:** The largest spatial category of BGI Solutions, executed on large sites. The area for this category is >10 ha.

3 **Examples of knowledge sharing from different fields**: selection of knowledge transfer practices from other scientific and professional fields. These platforms carry a strong potential to streamline the knowledge-to-practice flow in their own domains, e.g. in terms of facilitation/involvement of stakeholders in interactive co-creation, knowledge exchange, and networking.

III. Shortlisting the precedents

In this step, BGI Methods and Solutions within the long-list are evaluated according to four criteria, justified by patterns identified during the previous step. The criteria (Technical details, Multi-functionality, Design scope, Biodiversity) are then rated on a scale from 1 (low) to 3 (high), based on their relevance to BGIs. The criteria serve to score all the listed precedents: higher scores are assigned to those precedents that presented higher levels of detail within each criterion. The highest scoring precedents in all four criteria are shortlisted for more in-depth study. The criteria serve as benchmarks for the following in-depth analysis of each precedent. More information on the rating of the criteria (listed below) is presented in Annex VI.

› **Technical details:** This criterion evaluates the level of technical details included in a precedent. Technical details include design, construction and operation data for BGIs. Examples of precedents with a high level of technical details include blueprints, construction standards, operating principles, and procedures. This criterion is chosen to pinpoint precedents that highlight technical requirements and conditions for accurate implementation of BGIs.

› **Multi-functionality: Considered by the EU a key inherent capacity of BGIs,** this criterion evaluates the social, economic and environmental benefits offered by Methods and Solutions. Examples of precedents with a high level of social benefits include, among others, multiple uses of space, and the related opportunities for local communities stemming from recreation and tourism. Examples of precedents carrying a high level of environmental benefits feature data related to sustainable water management, improved air quality, and biodiversity conservation. This criterion is selected to highlight the multiple benefits resulting from the implementation of BGIs, whilst filtering out mono-functional precedents. Unveiling these benefits expands the potential linkages of BGIs with the policy, financial, and stakeholder sectors.

› **Design scope:** This criterion covers the depth of information in relation to scale of spatial planning for BGIs. The design scope criterion highlights the necessity to clearly address the different scales of BGI implementation, as different scales lead to different needs, and ultimately different benefits. In relation to the spatial scale of BGIs, different involvement of stakeholders, policies, and scientific backgrounds were observed. Examples of precedents with high-ranking design scope include data related to the size of a BGI, as well as the geographical and environmental conditions of the context it is embedded in. The design scope criterion filters out one dimensional approaches, that overlook the nearby landscape during the design, construction, and management phase. Employing the design scope criterion enables the identification of spatial planning data, explaining explain the interconnectivity of a BGI space with the nearby environment. Examples of this interconnectivity can be the relation between water collection from a green roof and the recharge of a local aquifer, or the interconnectivity of an urban park with a nearby forest - and the positive effects on biodiversity stemming from this connection.

› **Biodiversity:** This criterion evaluates the depth of information of a precedent in relation to biodiversity. Biodiversity is a core aspect within the knowledge domain of BGIs. Examples of high-ranking precedents feature data such as plant taxonomy, climate conditions, and animal habits, employed as key pointers to design and manage BGIs - e.g. insect gardens, wildlife corridors, or Natura 2000. Precedents that score high on this criterion provide strong arguments for the benefits of BGI on biodiversity (be these main goals, or only positive side-effects of the infrastructure).

IV. Scoping the shortlist

In this phase, the precedents with the highest rankings are shortlisted and examined in depth, employing the criteria as filter. The criteria were separated into a set of relevant performance indicators, and applied to each short-listed precedent. Finally, the performance indicators were employed for descriptions of the most relevant precedents, i.e. methods and sub-categories, and solutions (further information for the performance indicators can be found in Annex VII).

4.3. ASSESSMENT OF RELEVANT PRECEDENTS

The precedents are clustered in 3 main categories. The precedents featured in this report are among the highest scoring during the ranking process of the criteria, and they were deemed as particularly representative in order to pinpoint key issues and features the Manual should include.

CATEGORY	SUB-CATEGORY	PRECEDENTS
BGI Methods	**Online Platforms**	**1** EU Commission Environment **2** Oppla **3** Naturvation **4** Green Infrastructure Partnership
	Guidelines	**1** Barcelona Green Infrastructure and Biodiversity Plan 2020 **2** Green Bridges, Wildlife Tunnels and Fauna Culverts **3** CIRIA Report **4** Urban Green Infrastructure Planning: A Guide for Practitioners
	Digital tools	**1** LIDRA Model **2** Natural Capital Planning Tool **3** Green Infrastructure Wizard **4** InVEST
BGI Solutions	**Nano**	**1** Biofiltration (hybrid) system
	Micro	**2** Green Roofs
	Meso	**3** River Renaturalization
	Macro	**4** Forest Restoration
Knowledge-to-practice	-	**1** Open Source Ecology **2** Urban Living Lab **3** Water and Sanitation Program **4** Tranzo

› **Table 1 -** Categories of selected precedents

4.4. BGI METHODS

4.4.1. BGI Online Platforms

European Commission Environment

The Environment section of the European Commission website was created by Directorate-General for the Environment. It contains core information about the actions undertaken by the EU to protect natural resources such as air, water, and biodiversity on its territory. These actions mostly translate into policies, funding, legal compliance, and awareness material. Web-links to relevant material such as reports, guidelines, multimedia, and other web pages such as Life+, Horizon 2020, and Natura 2000 provide further details. Within the website, green infrastructures represent a core pillar in the biodiversity- related policy strategy.

The website provides data related to technical standards, means to improve information exchange, and opportunities for innovation. The expected Trans-European Network for Green Infrastructure (TEN-G) would set the standards for the design, construction and management of green infrastructures in Europe. The multifunctionality of green infrastructures is extensively analyzed within the EU website in the areas of climate adaptation, water management, energy, rural abandonment, transportation networks, health, and finance. Multi-scale spatial planning and land use management are employed by the EU to underst estimate the beneficial effects of the implementation of BGIs. In addition, different planning regulations within European countries and the integration of Natura 2000 protected areas to new spatial plans are highlighted as future challenges to biodiversity.

This precedent was selected as it clearly showcases future visions and strategies of a supranational government body for the development of BGIs. It is key for future stakeholders and interest parties to increase their awareness of the policy context in which BGIs will be developed.

Oppla

Oppla is the EU Repository of Nature-based Solutions: a knowledge marketplace where the concepts of natural capital, ecosystem services and nature-based solutions are brought together. BGIs are mentioned among these concepts, and overall widely covered on this platform.

Membership of Oppla is free to all and the platform supports a community of more than 2000 users from science, policy and practice. The concept and business model underpinning Oppla is the result of two EU-funded projects, OPERAs and OpenNESS, drawing upon the knowledge of over 60 universities, agencies and enterprises.

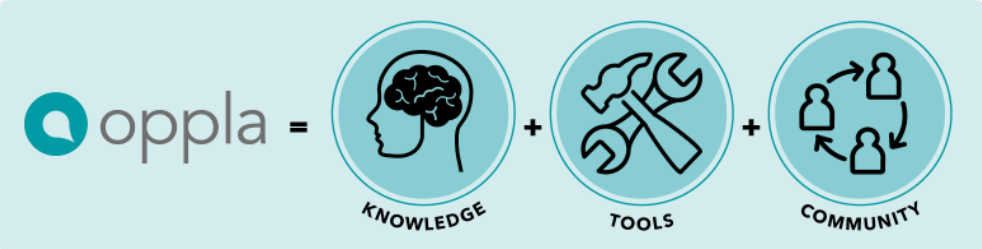
To capitalize on the full potentials of the platform, a free membership registration is required, giving access to three main services:

- **Ask Oppla:** a crowd-sourced enquiry service, where members of the community help to answer each other's questions.
- **Oppla Marketplace**: a knowledge "supermarket" where members can obtain guidance, software, data and other useful resources, as well as promote the outputs from their own projects.
- **Oppla community:** a service for promoting network and cooperation between registered members from around the world.

Technical information related to BGI can be found on this platform, presented in the context of case studies.

The Oppla Marketplace service also offers access to digital tools and guidelines for better and easier design, construction and management of BGIs. The multidisciplinary background of the subscribers ensures that Oppla captures all the social, economic and environmental shared values BGIs provide.

Additionally, precedents and case studies featuring within the platform - e.g. Stuttgart, Bristol, and Antwerp, demonstrate the benefits of multifunctionality and the design scope (land connectivity) resulting from BGI. Biodiversity is a central aspect of the Oppla platform, either in the form of open discussions as a preparation step before upcoming conferences, or in the form of reports that bring together technical details, multifunctionality and design scope in the context of Biodiversity protection and enhancement. Oppla was included in the shortlist as it represents one of the most innovative and promising means of knowledge exchange between practitioners and academics encountered.



› Image 1 - The Oppla platform, a EU-provided knowledge marketplace on NBSs and ecosystem services

NATURVATION

This web platform currently involves 15 institutions across Europe, and was created by Durham University with funds from the EU in the context of the Horizon 2020 Research Programme. The aim of the platform is to bring together ecology- and urban planning- related knowledge, to present and implement innovative ideas that address urban challenges such as water management, overheating, health, and wellbeing. Over 1000 case studies can be found on the digital map within the website, nearly all of them relating to Nature- Based Solutions (NBS) - a concept closely related to BGI. A search engine allows the grouping of case studies according to the key challenges they address, the urban setting, and the project budget.

In 2019, The Naturvation project will launch an open online course for sharing existing knowledge with interested parties - e.g. on new government arrangements, business models, and citizen engagement. A wide range of technical detail can be found within the case studies featured on the Naturvation platform, where projects such as green roofs, lake restoration, and habitat protection are analyzed in brief. Relevant links provide users with more in- depth details. For example, projects such as Tree Strategy of Malmo or Green Space Audit of Doncaster focus on the multiple benefits BGIs provide.

The Design scope of Naturvation is mostly focused on urban environments - implying the narrowing down of the implementation scale of BGIs to the neighborhood, district and city scale. The clear focus of Naturvation on the urban scale, and the vast number of case studies from cities all over the world contribute to the shortlisting of this platform. Biodiversity features throughout Naturvation as a key aspect for NBSs. Particularly, this platform focuses on the pressures urban environments and existing grey infrastructures (such as highways) exert on biodiversity. In another example, plant selection is introduced as a key step for appropriate green roofs design.

Green Infrastructure Partnership / TCPA Online Platform

The UK Town and Country Planning Association (TCPA) is a charity founded in 1899 with the aim of transforming the way society planned and built towns. Advocating for social justice, beauty in design, health and wellbeing, and economic efficiency, the TCPA played a key role in addressing the needs of urban and peri-urban developments in post-war periods. After founding The Garden City Movement in the 1890s (under its previous name of the Garden City Association), the TCPA has led a number of highly successful pan-European projects.

TCPA started the platform 'Green Infrastructure Partnership (GIP)', focusing on solving global problems like poverty and climate change via integration of GI, energy, and housing solutions at various scales. GIP is a network of over 200 green infrastructure professionals, that supports the creation, maintenance and promotion of green infrastructure. This is done by providing governments, developers and the private sector with high quality strategy and policy support. GIP offers online and offline services in capacity building, research, and training to a variety of organizations, ranging from small community groups to large public sector agencies. GIP also gives access to a free database of documents, case-studies, videos, tools, and other information about GI and its benefits - the 'Green Infrastructure Resource Library' (GIRL).

The Library offers links to the data categorized across 33 material types, ranging from 'natural capital regeneration' to 'community engagement'. These materials provide high-grade technical details in the form of standards, overviews of GI design blueprints, guidelines for design and planning, statistics and references to the original data sources and experts. The scope spans across a variety of GI solutions that can be applied at a household, city, or nation scale - e.g. green roofs and walls, green spaces, ecological corridors, woodlands, water environments, and food/agriculture. Biodiversity is covered in the dedicated section 'Biodiversity & GI', but is also intrinsically included in most of the material. Each item in the Library expresses a holistic approach to the design of multifunctional GI environments.

4.4.2. BGI Guidelines

Barcelona green infrastructure and biodiversity plan 2020

This integrated environmental management plan was outlined by the municipality of Barcelona in 2012, to capitalize on the contribution of green spaces to the future climate challenges of the city. Alongside the development of this plan, landscape elements such as the hilly terrain, proximity to the sea, the presence of rivers flowing in the city, and the green corridors that link Barcelona's green spaces with the surrounding natural areas were taken into consideration.

This guideline was shortlisted as it extensively presents steps that need to be taken to merge environmental, social and economic benefits into greater outcomes. According to the plan, the preservation of natural heritage needs to go hand in hand with scientifically informed technical criteria. This relationship is illustrated, for instance, in the tailored selection of plant species, utilized as a key pointer for the development of green infrastructures. Across the report, features and functions of green infrastructures are recorded and grouped according to their beneficial effects for the city and the types of space where they exist.

The multiple functions and purposes that can be derived from these infrastructures span the economic, environmental and social realms. Preservation of biodiversity as the natural heritage of the city represents a core pillar of the plan: the local flora and fauna are described in depth and employed as a benchmark to monitor the success in (B)GIs implementation.

The design scope foresees higher connectivity between green infrastructures, aiming at a greater provision of ecosystem services for the city. Elements such as natural open spaces, river areas, forests, parks, gardens, squares, vegetable gardens, tree lined streets, street greenery, ponds, green roofs, and walls are not envisioned as isolated green patches within the city, but considered as part of an interconnected green-blue grid. This network develops strong interrelationships between its hubs, consequently affecting the water management, air quality, and biodiversity within the city.

› Image 2 - Green corridors in the Barcelona landscape

Green bridges, wildlife tunnels, and fauna culverts: the biodiversity approach

This method was developed by the German Federal Agency for Nature Conservation, and it includes guidelines and blueprints for the design and construction of wildlife crossings. The construction of these GI elements is directly recommended by the EU. This report includes clear technical details in the form of principles for the realization of green infrastructures that serve biodiversity conservation goals. Specifics such as width, height, visibility, and plant selection are some of the technical details this method extensively elaborates upon.

Wildlife crossings serve the purpose of increasing connectivity between wildlife habitats, facilitate safe mobility of animals, and mitigate the impacts of grey infrastructure (such as highways) on wildlife population.

Wildlife crossings feature high multifunctionality: not only do they reduce animal mortality, but they also increase the safety of the existing highways for humans, as they reduce the number of collisions between animals and vehicles. As a side effect, expenses related to vehicle repairs and first aids are reduced.

The design scope of this method envisions migration corridors, stepping-stone biotopes to fill in spatial discontinuities, among others. Spatial planning scale is a means to design green infrastructures that enable the cross-passing of different species: the scale of construction influences the number and the size of species expected to transit. Wildlife crossings are tailored to different species through different designs, e.g. bridges, underpasses, tunnels, ladders, and corridors. This method was selected as the most prominent for extensively analyzing all the existing green infrastructure designs for biodiversity conservation.

CIRIA Report

The report 'Delivering biodiversity benefits through green infrastructure' was produced by the Construction Industry Research and Information Association (CIRIA) in 2011. CIRIA is a member-based research and information organization publishing reports and technical papers covering building and civil engineering, as well as transport and utilities infrastructure. Although the guidance is set in a UK and Irish Government policy context, the content is targeted at all construction professionals to encourage cross-disciplinary working to enhance biodiversity and ecosystem services through BGI, and minimise negative environmental effects.

Biodiversity is a central component of this guidance: Part A of the guidance provides information for constructors who want to know more about biodiversity, ecosystem services, and the multiple benefits of green infrastructure. Part B focuses instead on the opportunities to enhance biodiversity through the lens of a client, designer, contractor, or asset manager at all stages of a project. The main drivers for developing this guidance are presenting the economic case for biodiversity and ecosystem services, legal requirements to protect biodiversity, increasing awareness of biodiversity, ecosystem services, and the multifunctional benefits of GI at policy level. Part C of the guidance covers the practical implementation of BGI into construction projects. It does so by signposting key toolkits for BGI, while presenting both a decision support checklist and a table for integrating biodiversity into the key stages of BGI design. Relevant technical terms are described throughout the document, particularly those where conventional use differs between engineers and ecologists.

Overall, the guidance applies to projects of all sizes, from a major highway to the regeneration of a small brownfield site. As previously mentioned, when sites are linked together a fully multifunctional GI network is achieved.

› Image 3 - Green roofs and walls belong to small-scale - yet highly impactful - type of Green Infrastructures

Urban Green Infrastructure Planning: A guide for Practitioners

'Urban Green Infrastructure Planning: A Guide for Practitioners' is based on the findings of the GREEN SURGE project: a collaboration between 24 partners in 11 countries, funded by the European Commission's Seventh Framework Programme from 2013-2017. This guide provides support for local green space planning, based on the findings of GREEN SURGE research. It includes 25 overviews of case studies from 13 different European cities, to provide lessons for practitioners across Europe. This guidance presents technical details on how to embed urban BGI in the planning process, based on four core urban challenges and four core principles of BGI. The guidance contains information on assessing BGI networks, developing plans, and engaging stakeholders. It also includes a detailed checklist to evaluate current planning approaches as well as a 'toolbox' containing a range of criteria and indicators to evaluate biodiversity. Protecting biodiversity is acknowledged as one of four core urban challenges that BGI can address.

The guidance also provides users with key recommendations for protecting biodiversity. The need to design interventions for biodiversity enhancement that are based on local conditions and considering the variety of urban biodiversity figures among these advices. The guidance also recommends that the full spectrum of benefits - ecological, social and economic - should be considered when planning urban BGI, and that consideration should be given in relation to who needs the benefits and who can access them, in order to create social cohesion. Finally, a conceptual framework is provided, which can be adapted to local contexts. The guidance promotes that BGI should be multi-scale, multi-object, and both inter- and trans- disciplinary.

› Image 4 - Urban parks offer recreation and mitigate the UHI effect in Munich, Germany

4.4.3. BGI Digital tools

LIDRA Model: Low Impact Development Rapid Assessment

Low Impact Development Rapid Assessment (LIDRA) is a US-based online tool for rapidly assessing the cost-effectiveness and uncertainties of various Low Impact Development (LID) strategies for GIs. LIDRA calculates the potential reduction of annual runoff in urbanized areas by GIs. In addition, it estimates the life cycle cost of GIs that are needed for this reduction. The model enables comparisons between combinations of LID scenarios implemented over periods of up to 30 years, to facilitate the realisation of GI.

LIDRA was developed by a team of environmental engineers, economists, hydrologists, urban designers, and contributors from Drexel University, eDesign Dynamics LLC, the US Forest Service, and the New York State Department of Environmental Conservation. Ensuring multidisciplinarity and practicality, the tool provides a range of technical details, such as ground surface runoff from roofs, driveways, streets (from a house to a city-level), land use categories, implementation rate, life cycle costing, social and climate uncertainties, GI size, and cost. LIDRA showcases multiple functions of GIs, including social, economic and environmental performance. Biodiversity is mainly represented at an urban scale, in interaction with soil types, water management, and flood control.

Urban watersheds of any size can be investigated via LIDRA. The HP009 watershed next to the NYC wastewater treatment plant, for instance, was designed by combining data resolutions at both household and metropolis level into a GI solution.

Natural Capital Planning Tool

The Natural Capital Planning Tool (NCPT) is a free site assessment tool, specifically developed for planning purposes. The NCPT enables the indicative, yet systematic, assessment of the likely impact of proposed plans and developments on Natural Capital and ecosystem services. It also provides data in terms of recreational opportunities, air quality, and climate regulation.

The tool consists of an Excel file, also accessible by non-specialists. The NCPT is specifically aimed at supporting developers and planners to create sustainable places for both people and wildlife, while delivering adequate housing and infrastructure.

Developed as a cooperative effort between universities and local authorities, the project was designed to give planners, developers and other relevant actors a fit-for-purpose and easy to use tool that assesses the impacts a proposed plan or development design has on natural capital and ecosystem services (ES). The tool is downloadable with supporting documents, and the software is used to analyze and assist in calculating and monitoring trends in the ES within areas under planning and development. The tool is part of the Government's planning strategy to increase awareness on green infrastructures across England, and their potential environmental contributions. The software requires funding to maintain and update, and is operated privately. All habitats are included in the software - enabling calculations of the net loss or gain of ES. Specifically, the planning tool is useful to calculate changes in ES from development, or as a means of calculating changes based on the results of monitoring. Data input requires any plans to feature information on the areas of development and the expected outcomes. The Excel sheet requires analysis and assessment skills in order to produce construction level development plans.

Green Infrastructure Wizard (GIWiz)

Created by the US Environmental Protection Agency, GI Wiz offers access to a repository of GI tools and resources, designed to support sustainable water management and community planning decisions. Tailored to address complex data through intuitive design, GIWiz helps users analyze problems, understand management options, calculate design parameters, analyze costs and benefits, evaluate tradeoffs, engage stakeholders, and develop education and outreach campaigns. Quick links and an interactive questionnaire allow the user to easily track relevant data on BGIs.

Technical details are included in example case studies. A number of topics such as aesthetics, cost savings, public health, and hydrological improvements attest the multi-functionality of BGIs. The design scope of this tool mainly focuses on urban environments and water management. Exemplary cases of BGIs, perceived as a means to tackle extreme water events originating from climate change, can be found on a city or neighborhood level. Biodiversity data are mostly used for adequately selecting plant species during planning phases.

GIWiz promotes knowledge transfer between academics and professionals in public and private sector by different means. Among other media, it stimulates communications through the Green Infrastructure Webcast Series 72, or in the form of reports such as Lessons from Greening America's Capitals Project -Five Helpful Hints for Communities Wanting to be Greener.

InVEST: Integrated Valuation of Environmental Services and Tradeoffs

Integrated Valuation of Environmental Services and Tradeoffs (InVEST) is a group of tools used to map and value ecosystem goods and services provided by terrestrial, freshwater, and marine ecosystems. It can be used either with ArcGIS, or as a stand-alone software package.

InVest is the result of a partnership between Stanford University, the Chinese Academy of Sciences, the University of Minnesota, the Stockholm Resilience Centre, The Nature Conservancy, and the World Wildlife Fund for Nature. It was developed by a multidisciplinary team of academics, practitioners and software engineers.

These digital tools are linked to a library, a rich source of accessible and informative peer reviewed and published material. This tool was selected for its potential contribution to estimate the multiple benefits of BGIs, and capitalise them. These digital tools are being tested already by infrastructure companies, to ensure their usefulness and usability, as well as provide feedback for further research and development.

4.5. BGI SOLUTIONS

4.5.1. Nano-scale

Biofiltration (hybrid) system

Lodz, Poland

Biofiltration (hybrid) systems represent a combination of engineering and biological measures for stormwater retention and purification, mainly in residential environments. The solution is built in the city of Lodz, on the watershed divide of the Vistula and Oder Rivers in Poland.

For several years, the city has experienced extreme river flows and high stormwater runoff, with a high level of pollutants generated from the urban environment. Originally, river regulation was performed using widely vegetated cascades - used by residents for recreation. Occasional extreme surface and river flow, combined with pollution, presented significant threats to urban health and security.

Biofiltration (hybrid) systems are part of a larger project financed by The European Commission's LIFE Programme, the "Ecohydrologic rehabilitation of recreational reservoirs as a model approach of urban reservoirs". The total cost of the project was €1,244,319 from which the EU contribution was €489,157, the rest being secured from national and local funds. The main parties involved were the academic sector (University Lodzki, Department of Applied Ecology) and the public sector (City Office of Lodz). The implementation of the project lasted from 2010 to 2015. The main reason behind the project was the fulfillment of elements of the Water Framework Directive, which paid special attention to urban water ecosystems due to their relevance in terms of quality of life.

From a technical point of view, biofiltration (hybrid) systems represent both integrated engineered systems (underground separators) and biological/ecohydrological systems. The system retains the "first flash effect" (higher concentration of pollutants in the early stage of rainfall runoff) and holds large amounts of water. In the second phase, local native aquatic vegetation treats and cleans polluted water through biological processes. These types of solutions are characterized by their low cost (€ 70,000 needed for one element). Joining a number of these elements in complex networks creates a cleaner and more stable environment, which contributes in turn to biodiversity conservation. Besides, the solution leads to a rehabilitation of urban reservoirs, which serve as recreational sites for inhabitants. The specificicity of this approach is that the integration of small scale elements, in a combination of engineered and biological measures, creates a larger influence on the context they are embedded in.

› Image 5 - Ponds and reservoirs built to reduce storm-water sewage flow peaks in Lodz, Poland

4.5.2. Micro-scale

Green roofs

Hamburg, Germany

To counteract climate change and other urban environmental challenges, the city of Hamburg developed a 2014-2019 city strategy to undertake a challenging task – create 100 ha of new green areas in the form of green roofs. These items are meant to improve water management, reduce extreme temperature effects, enhance citizens' quality of life, and increase urban biodiversity. The project cost was around €3,000,000, and it was covered by The Hamburg Ministry for Environment and Energy. Housing groups, companies, constructors, landscape architects, and urban planners represented the major parties involved. The project aims at addressing a number of SDGs (among others, good health and well-being for people, sustainable cities and communities, climate action and life on land).

The intervention is based on a number of considerations on natural and near-surface areas:

- They provide ecosystem services.
- They support the resilience of spaces against climate change.
- They provide social and economic benefits for citizens.

The project provides information about standard structures that each green roof must have: a protective layer to make roofs waterproof, a drainage layer that steers excess water to the roof drains, a filter layer that prevents finer soil and substrate elements from being washed away, and a layer of vegetation that serves as a basis for plant growth. Technical specifics for this solution are relevant, as the solution taps into a broader and more complex urban water management system strategy. Depending on the use, the technical parameters, and the method of construction, green roofs divide into three types: intensive (usually made of perennials, grasses, shrubs and, in minor cases, trees which are permanently maintained through intensive care), simple-intensive greening (similar, but with the application of plant material that is less demanding with regard to the layer structure) and extensive (similar to natural vegetation and usually self-maintaining). The cost of construction and maintaining these types is very different. In this context, their application is various – intensive roofs are mostly used for commercial buildings, where owners demand high aesthetic value. Extensive roofs are mostly employed in residential areas.

The city-scale intervention in Hamburg partly addresses the targets of the EU Biodiversity Strategy. Extensive green roofs are unique urban elements, that provide habitat for native flora and fauna, as well as overall improvement of ecosystem functionality. Green roofs represent recreational surfaces for residents or employees, in the form of sports fields and parks, or as gardens collaboratively managed by the local community. This solutions generally conceives urban space on multiple scales. This strategy gives clear directions for urban landscape planning, by incorporating green roofs into legally binding instruments. Examples of these tools are the Hamburg Building law, or the Wastewater law. Green roofs, as design measures, are elaborated through the necessary technical documents and analysis of costs (e.g. investment and later cost reductions). These specifics represent key insights for stakeholders such as building owners.

› Image 6 - Skyline of Hamburg, Germany, from a green roof

› Image 7 - Green roofs, Hamburg, Germany

4.5.3. Meso-scale

River renaturalization

Darlington, England

During the intensive urbanisation wave at the end of the 19th century, the watershed of the River Skerne, England, was extremely modified. The river bed was channeled, widened and deepened. The level of the floodplain was raised using old industrial waste, and gas and sewer infrastructure was built alongside the river. As a result of these interventions, the flow was modified, and both the fauna habitat and diversity of vegetation were negatively impacted.

In July 1995, the restoration of a 2km part of the Skerne River in a nearby residential area within the city of Darlington was initiated by the local authorities. The project is particularly relevant as it figures among the first examples of a successful river restoration project, and presents the beginning of several analogue activities in urban and suburban landscapes in England. The project was partially funded by the LIFE programme – the total budget was more than €1.7 million, and EU contribution was around €750,000.

During the project realization, several measures were taken: the river channel was re-shaped in a more natural way, with curved meanders. The level of the floodplain was lowered, in order to recreate shallow wetlands and increase the space for water retention. The creation of wetland habitats enabled a natural flooding regime to return. New footpaths and recreational facilities were created in the floodplains, to make the river approachable and pleasant to the local community - whose involvement was essential for the project's success. The project employed a local representative, familiar with the community and pivotal in answering queries from the technical working group and project board. Over the following years, intensive monitoring was performed, to keep track of the project's indicators for success. Among others, many native flora and fauna species were recorded at a site, water quality increased, and flood control increased in effectiveness.

The relevance of this solutions lies in the participation of multiple actors: the European Commission (LIFE funding), the River Restoration Project (now River Restoration Centre), the Darlington Borough Council, Environment Agency, Northumbrian Water, English Nature (now Natural England), the Countryside Commission, Heritage Lottery Fund. Soon after the realization of the project, The River Restoration Centre was established as an expert information and advice centre for all aspects of best-practice river restoration and catchment management. Today, the Centre is a unique organization and platform for knowledge transfer and case studies about river restoration methods and techniques in the UK. Several of the project's nano and micro solutions were later included in the published Manual of river restoration techniques.

› Image 8 - An aerial view of the restored Skerne river in Darlington, England

4.5.4. Macro-scale

Forest restoration and conservation

Kaszó, Somogy, Hungary

The project area is located in south-western Hungary, in the surroundings of the village of Kaszó, in the county of Somogy. This area is a natural landscape, which has importance at a European level as part of the Szentai Forest pSCI of the Natura 2000 network. The protected area was threatened by a decrease in groundwater, earlier demolition of natural water-retaining landforms, and built-in drainage systems as a flood prevention measure. The project was implemented from 2013 to 2018, with a budget of €1,327,189. The largest part of the budget was secured from The LIFE Programme - the EU's funding instrument for contribution to the implementation and development of EU environmental and climate policy and action. The project was created by the consortium of KASZÓ Forestry Stock Company and Forest Research Institute. The main task was to restore alluvial forests with black alder and European ash in the wider area of Lake Balaton nature reserve. The purpose was to mitigate climate change by improving the hydrology of the area and the water supply to forests, wetlands, and meadows.

The main objectives of the project are to manage Natura 2000 sites by rehabilitating degraded natural habitats. The project aims at improve the water supply to the forests, smaller swamps and grasslands as well as to retain rainwater and stabilise ecological formation. Forest restoration and conservation was a long process, divided into several steps. The majority of concrete conservation actions were aimed at improving surface and land ambient for both surface and underground water preservation: building dams and channels, removing alluvium soil, strengthening valley barriers, creating two new lakes, building waterways into the perpendicular stream bed. Performing all these activities required time and operational synchronization, so as not to jeopardize the existing ecological status of aquatic habitats. The project contributed to the preservation of native species and the restoration of overall ecosystem function. All technical measures to create a water-oriented landscape were consistent with retaining and enhancing biodiversity. During the realization of the project, a complex system to monitor results was established, and the interventions were monitored through research. The main findings were presented at an international conference organized by the project team, to disseminate the project results as lessons learned. Multiple guided excursions were organized as well, to involve local communities in the significance of this realization. In order to show visitors the gains of sustainable forestry, an educational trail was created. This recreational facility connected naturally unique sites in the forest, and its use is limited to pedestrians. Although this solution is built upon a series of smaller scale operational measures, due to the resilience and overall improvements it provides to this whole ecosystem it was clustered into the macro scale category.

› Image 9 - Aerial view of ecosystem restoration in Kaszò, Ungary

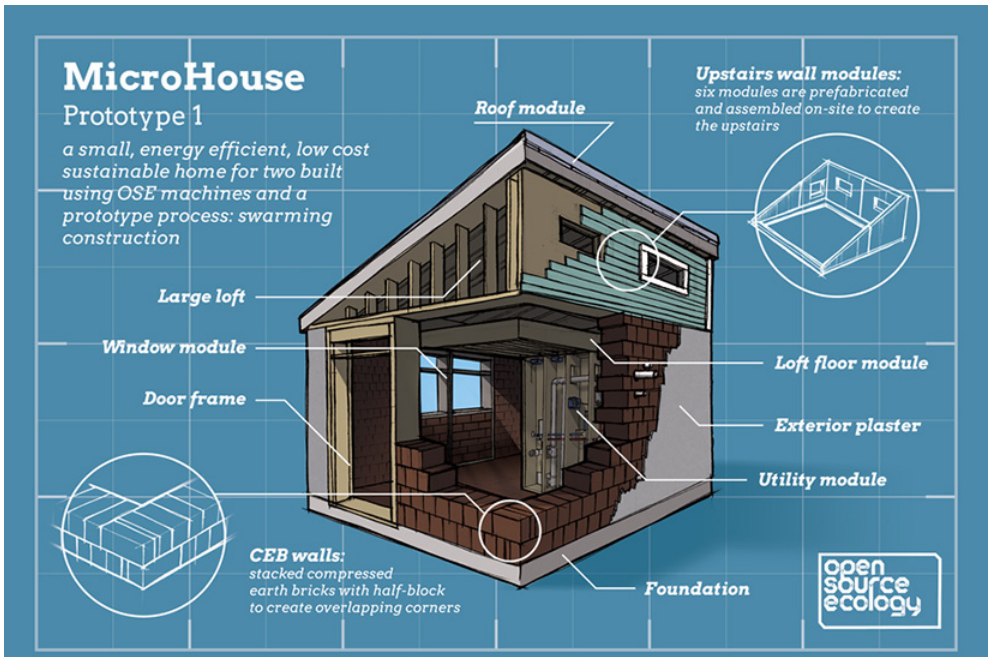
› Image 10 - Ecosystem restoration in Kaszò, Ungary

4.6. KNOWLEDGE SHARING PLATFORMS FROM OTHER FIELDS

Open Source Ecology (OSE) platform

Open Source Ecology is a scalable platform for documenting and developing blueprints for both physical DIY artifacts and related open enterprises. As an open source platform, its content can be used free of charge. OSE operates by promoting knowledge sharing between the users in an interactive online environment, which allows users to share their designs for the realization of different projects.

Similarly, BGI Solutions and Methods such as green roofs, walls and rain gardens, could be developed building upon the knowledge of other users.



› Image 11 - the MicroHouse is a modular building system core designed for add-ons, and is found on the platform among other case studies

Urban Living Lab Guidelines

This set of guidelines was developed by Amsterdam Institute for Advanced Metropolitan Solutions (AMS) together with TU Delft (TUD) and Wageningen UR (WUR) in 2017. The guidelines advocate for the existence of living labs as valuable testing grounds, from research to implementation level. These guidelines bring together users, knowledge institutes, and public and private actors for collectively realizing projects. The interaction between the stakeholders in a testing ground helps ideas to mature. The Living-Lab approach is led and promoted by AMS, which is a partnership of WUR, TUD and Massachusetts Institute of Technology (MIT) supported by a 10-year funding from the EU, as well as private and public funding from the Netherlands and internationally.

In the context of BGI, guidelines such as these can facilitate the involvement of stakeholders from different sectors and, consequently, the mainstreaming of BGI solutions. In addition, living labs similar to pilot projects can be nursery grounds for the the maturation of BGI projects, as they offer space for testing new ideas.

Water and Sanitation Program (WSP)

WSP is a marketing tool focuseing on the development of sanitation systems and services in developing countries. It brings together local authorities and communities for the realization of sanitary solutions. Following years of experience, knowledge is concentrated into a guide for the development of future projects.

The marketing approach to scale-up infrastructure and the user-centered experience of guiding and facilitating learning and practical experiences can be of inspiration for BGI-related projects. This marketing-centered feature can be applied in the BGI Manual to raise awareness, transfer skills and knowledge around BGI online, and develop micro-meso-scale projects locally, with the needed capacity.

Tranzo

Tranzo is the scientific center for care and wellbeing of the Tilburg School of Social and Behavioral Sciences of Tilburg University. The mission of Tranzo is to build a bridge between science and practice in the area of care and wellbeing. The objective is to promote an evidence-based approach by working in co-creation with practitioners to develop and exchange knowledge. Within an Academic Collaborative Center, work is carried out to develop scientific knowledge and to initiate innovation in care and other services offered in the sector involved. The cooperation is based on a long-term research program, jointly established by the University and the care and wellbeing organizations. Science practitioners, professionals who work partly in the field and partly within the University, play a central role in the Academic Collaborative Centers: they bridge the gap between science and practice.

In the context of BGI, an example such as Tranzo can inspire the creation or replication of mechanisms capable of bridging the gap between academics and practitioners and facilitating knowledge sharing between practitioners.

4.7. LESSONS LEARNED

The precedent research displays an overview of the ways BGIs have recently come to populate public conversations and translated into a number of real-life projects, guidelines, digital tools and platforms. The implementation of BGI Methods and Solutions strongly relies on information, e.g. frameworks for designing, realizing and monitoring BGIs. Addressing these precedents provides hints, lessons, and caveats for future attempts at improving knowledge transfer in the BGI field.

The inclusion of case studies seems to represent a key common feature across BGI methods, as they represent particularly effective means for knowledge transfer. Case studies, especially in the form of brochures and infographics, represent valuable bodies of information on different data and criteria - from scales to multifunctionality, technical details, and biodiversity benefits. The value of a number of online platforms and digital tools lies in their transdisciplinary approach, as they bring together professionals from different backgrounds to exchange information (see Oppla, GIP, and NCPT). Other methods foresee online courses on BGI and NBS, to make sure knowledge is delivered to practitioners interactively (Naturvation).

More often than not, navigating the digital tools with ease requires a high level of technical expertise - making it more challenging for certain stakeholders to capitalize on their full value. Several online platforms addressed featured user-experience related issues, in the form of difficult searching and navigation. However, platforms such as the GIP feature a more user-friendly interface: combining categories of green infrastructures from the perspective of co-creation and planning, it highlights multifunctionality of BGIs on a social, economic, environmental and technical level.

As an overarching remark, economic indicators were not included in the selection criteria of precedents. During the research, data on methods or solutions that contained explicit mention of economic data (e.g. in terms of components and labor), calculations, and related models were only sporadically found. Featuring specific indications, the LIDRA tool represented an exception in this regard. Due to these reasons, economic data did not represent a sufficiently reliable criteria for scoring the precedents.

A common feature of the showcased solutions is the emphasis on their multifunctionality. For instance, a renewed awareness is needed on the potentials of BGI in terms of flood prevention and water management, as well as a major contributor to a whole range of ecosystem services related to biodiversity. In addition, the multi-stakeholder involvement and inclusive approaches leading to the implementation of many of the solutions is identified as pivotal across the cases.

The promotion and collaboration between bottom-up and top-down approaches, along with interaction and co-creation between users, knowledge institutes, and public and private actors represent key features of knowledge sharing platforms from different fields (Urban Living Lab Guidelines, Water Sanitation Program). Keeping these factors into account is deemed particularly relevant when working towards the BGI Manual.

As displayed in the Precedent research, BGI solutions vary greatly in size - from nano (a green roof) to macro (a forest). Acknowledging the presence of multiple scales supports the potential for BGIs to be highly flexible. Interconnected networks of BGI solutions represent effective ways to capitalise on each solutions's multi-functionality and spatial scale, increasing performance over time in terms of shared values for biodiversity, and social and economic benefits.

Too large a scope lies among the possible downsides of this complexity: the wider the scope of BGI solutions, the greater the number of actors needed to collaborate - ultimately leading to delays and possible barriers in knowledge sharing.

The BGI Manual should incorporate and reflect these insights, offering a selection of tools, data, and guidelines that can be used by practitioners from different sectors and scales simultaneously. The need is acknowledged for data on BGI to be structured in a format that is compatible with data-modes and digital tools available online, to create multi-functional and multi-scoped BGI solutions. Combination of a high level of detail and a large design scope enables better communication of knowledge to practitioners. While tools can provide life-cycle cost assessments, platforms provide a wider perspective, for other actors to join and collaboratively realize projects.

The outcome of this Precedent Research is a preliminary database - elaborated upon in the next section - to provide the foundations for the co-creation session, the next phase of the BGI project.

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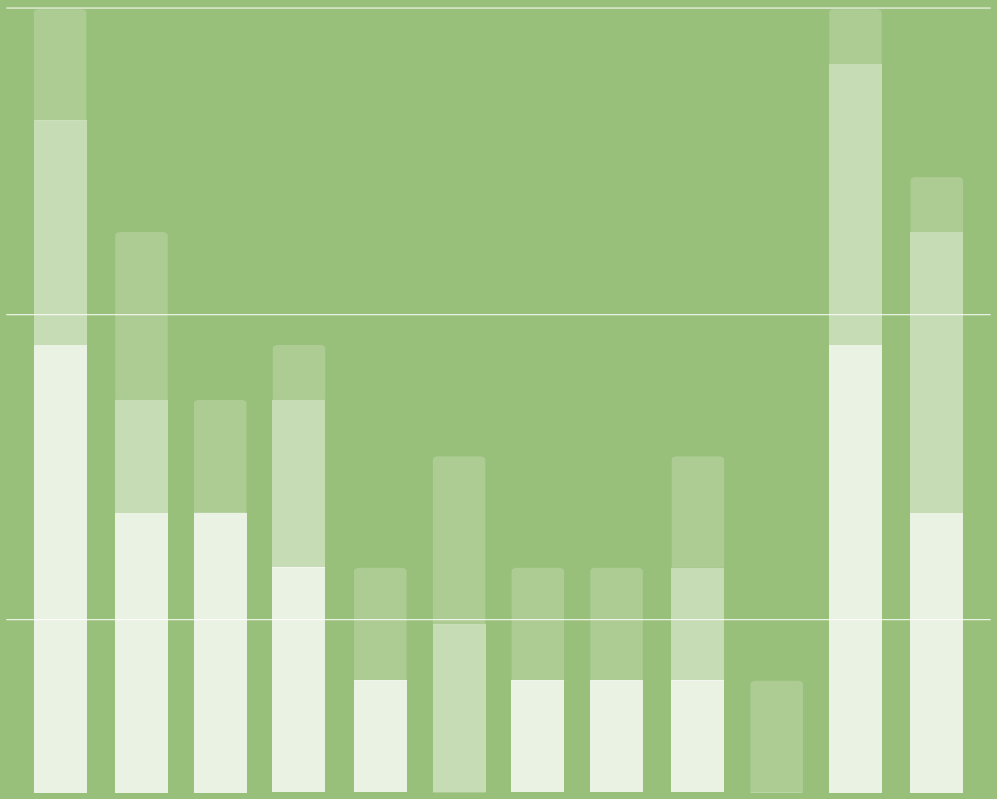
All websites were checked for validity at May 27, 2019.

5. DATA COLLECTION & ASSEMBLY

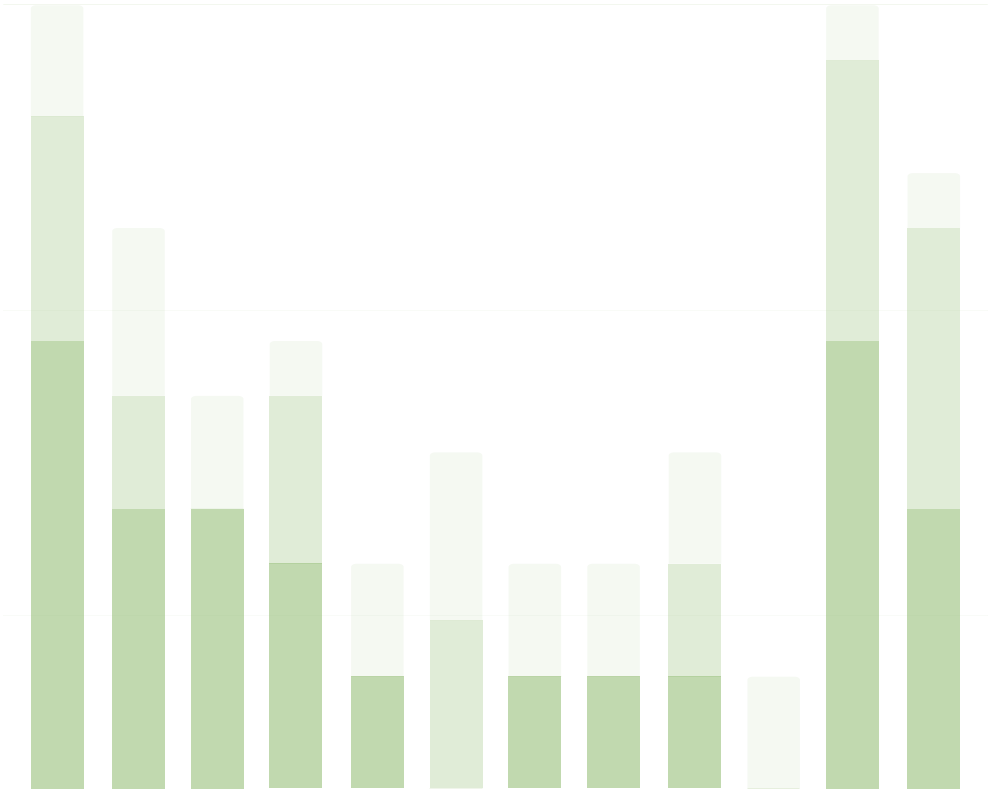


5. DATA COLLECTION & ASSEMBLY

5.1. INTRODUCTION

The goal of the Data Collection and Assembly is to analyze the existing data available within the BGI domain, and investigate ways to effectively map them in communication tools such as the Manual. The goal is pursued by structuring an overview of data retrieved in previous sections. By structuring a research database rooted in insights previously retrieved, the data assembly pinpoints key data for BGI realization to improve their mapping and communication through the Manual.

The developed library is not shared with the public in this phase, but serves as input for co-creating the Manual. All the relevant information gathered is collected and combined into two separate databases[1], and structured for further use and development in Part B.



1. Access to the complete database may be given after consultation of authors of the report. Please send an email to info@except.nl with your request.

5.2. OPPORTUNITIES FOR DATA USE AND VALIDATION

5.2.1. Research database

The research database (DB) is generated via the Stakeholder Analysis and the Precedent Research, and stores key information from Part A. The information were retrieved during the stakeholders and the precedents of data transfer, following the methods of long- and short-listing, described in sections 3 and 4. These data are outlined in Table 1 below. The stakeholder analysis DB contains a long-list and a short-list of stakeholders, as well as a matrix of activities, bottlenecks, dependencies and requirements for the BGI Manual. The Precedent Research DB contains an integrated framework, a long-list and a short-list of precedents, with detailed descriptions of the "best practices" with regard to technical details, multifunctionality, design scope, and biodiversity criteria (see table 2).

DATABASE	CONTENT	DATABASE
Stakeholders	Long list	Inventory of 64 stakeholders
	Short list	Selection of 11 stakeholders
	Stakeholder matrix	Evaluation of 11 stakeholders
Precedents	The Framework	Map of 64 research questions
	Long list	Selection of 300 precedents
	Short list	Evaluation of 57 precedents

› **Table 1** - Overview of the data categories in the 2 developed databases.

In Part A, only the short lists contain high-resolution perspectives on best practices. In Part B, the long lists can be provided to researchers and practitioners for re-evaluation. In this phase, new criteria of success suggested by users can impact the scores of the long-listed precedents. Practitioners can also access relevant tools, guidelines, stakeholders, and BGI solutions for their own projects. A construction company could, for instance, find tools for economic evaluation of biodiversity, and plan a multi-stakeholder collaboration accordingly.

In the current phase of the project, the DBs are used to synthesise data retrieved in the previous researches, and to facilitate the discussions within the co-creation session to follow.

5.2.2. Data Structure

The data structure is developed according to inputs from the Stakeholder Analysis and the Precedent Research. As data collection progressed, the categories were refined into a final data structure. The database was further validated via iterations between interviews, desk-research, and results analysis. The structure provides an overview of the BGI Project research boundaries, and is captured in Table 2 below:

RESEARCH FIELD	DATA CATEGORY	DATA COLLECTED
Stakeholders	Researchers	Roles, Activities, Dependencies, Bottlenecks, Requirements for BGI Manual.
	Decision-makers	
	Practitioners	
Methods	BGI Online Platforms	Design Scope, Multi-functionality, Technical Details, Biodiversity indicators.
	BGI Digital Tools	
	BGI Guidelines	
	Knowledge sharing platforms from other fields	
BGI solutions	Nano scale	Functions, Performance, Size, Costs, Benefits.
	Micro scale	
	Meso scale	
	Macro scale	

› **Table 2** - Data structure and the indicators in the DBs: the overall scope and the depth of the insights generated during this phase, providing foundations for further categorization and standardization systems - e.g. ISO.

5.2.3. Data Types

The data types were identified during the interviews *(Chapter 3)*, and through the screening of long-listed BGI and non-BGI precedents *(Chapter 4)*. The insight collected and analyzed in the process were aggregated into a conceptual overview of the data-types (with associated indicators), and are outlined in Table 3 below:

RESEARCH FIELD	DATA CATEGORY	DATA COLLECTED
Climatological	Time series of measurements of sufficient length, consistency and continuity to determine climate trends.	› Millimetres of rain water per area unit. › Temperature.
Hydrological	Data on state, conditions and dynamics of surface water.	› Catchment area (ha). › Coordinates. › Size, flow (m3/s).
Geological and Spatial	Data about real physical categories of spatial attributes.	› Status of protection. › Land use types. › Erosion (t/ha). › Productivity index.
Infrastructure	Data on basic build facilities and installations which are necessary for operation of various land-use categories.	› Hight, size, area. › Requirements. › Length, › Capacity (l/area), time.
Economic	Dynamics of human activities; space & structures for human activities.	› Age, habits, needs. › Quality, cost. › Salaries and wages.
Biodiversity	Ecosystems and species, ES.	› Soil remediation (plants) › Types: plants, species › Number. of specimens, plant typology, animal habits.
Health & Wellbeing	Social data such as age, education, health.	› User experience › Social acceptance › People employed.

› **Table 3** - Simplified overview of the data types (see Annex IX).

The table presents the indicators applied, or mentioned as relevant, in BGI projects by researchers, decision-makers, and practitioners. By reviewing the collected data, it stands out that various stakeholders use a variety of datasets to implement and communicate their projects. Depending on the project scope, the selection of data-types does not feature great variance, while indicators do. Problems occur when working across data-types: for instance, stakeholders pointed out issues related to the translation of biodiversity indicators into economic assessments.

These typologies enable a clear overview on key data employed in the BGI field, and are particularly relevant when working towards a Manual to store them, enabling user-friendly means of knowledge transfers. The typologies can be offered to practitioners, decision-makers and researchers attending the co-creation session to address the data, methods, and performance indicators stemming from these types

5.2.4. Data Transfer

As highlighted in Chapter 3, the involvement of stakeholder in co-creation of projects lies among the most effective ways to connect research to practice. The Research DB can provide a first building block for this bridge, as it displays the BGI knowledge needed or used by the three stakeholder groups. Table 4 below summarizes which data and insights are exchanged between researchers, decision-makers, and practitioners, along with the data required by each.

STAKEHOLDER	DATA COLLECTED	DATA REQUIRED
Researchers (R)	Statistics, designs of BGIs; Blueprints of BGI Solutions (technical).	Long-term / strategic planning from decision-makers; Economic (cost and benefit) valuation of BGI Solutions' outputs.
Decision-makers(DM)	Policies, incentives, strategic plans;.	Technical data and indicators for various elements of BGI.
Practitioners (P)	Technical data and engineering metrix.	BGI designs / blueprints; policies.

› **Table 4 -** Data exchange between key stakeholder groups

Focusing part of the co-creation session on these databases will enable the alignment of future users of the BGI Manual, and evaluate their desired user experience regarding the transfer of relevant data, and access to stakeholders and tools.

As also mentioned by the researchers in the Stakeholder Analysis, the timing in which the right stakeholder receives data in the right format is key to the success of a BGI project. Data exchange and collaboration needs to be supported by a simplified visual representation of the data and knowledge on BGI, together with insights produced using different methods.

In Part B the DBs can be upgraded into a user-friendly tool users are able to enrich with BGI-related insights. Shared online, the database could crowdsource and reduce costs for BGI research, while providing practitioners with missing tools, access to stakeholders, guides, and funding. A practitioner could learn which stakeholders are the most helpful, and select methods that will lead to implementation of economically, socially, technically and environmentally sound BGIs. For example, a construction company could use the selection of precedents to learn about the importance of connectivity, the benefits of an integrated approach to BGI, and the financial opportunities that result. They could also use the DB to establish and operate processes of co-creation and communication with the relevant stakeholders. Alternatively, a decision-maker could use the DB to learn about major trends and best practices, facilitating the introduction of new legislation that promotes connectivity and integration of functions. The DB could partially alleviate bottlenecks in data transfer as outlined in the BGI knowledge value chain *(Chapter 3)* e.g. at step 3 'R&D', step 4 'community engagement & facilitation', step 9 'monitor and signal', and

step 11 'evaluate and report'. Due to its standardized approach for classification and communication of relevant data, the Green Infrastructure Partnership's Resource Library *(Chapter 4)* could serve to research and develop GI solutions and to manage the entire process, from start to finish. Nevertheless, the BGI domain as a whole requires further standardization of user interfaces between data required and data generated.

5.3. LIMITATIONS AND FUTURE OF THE DATABASE

The current research DB contains a number of limitations:

Interoperability: searching / learning practitioners' experience is still ineffective, due to dissonance in vocabulary. In other words, users might roam the DB with keywords that do not match.

Standardization: stemming from the terminological dichotomy, current DBs offer various standards from around EU that are not specifically signposted by the origin or cross-compatible.

Size: provided data structure allows better grasp of BGI complexity: (1) a process of steps, and (2) a system of physical solutions. However, in order for the practitioner to effectively utilize the provided DBs, they have to get acquainted with insights generated during BGI projects.

Depth: the DB provides links to the data related to BGI, but not the data itself. One has to study the references in-depth to find the data.

The DB can be improved by undertaking different actions:
Further research on the vocabulary of various stakeholders, to enhance interoperability and standardized content.

- Create signposting of methods and standards for better search.
- Program the DB in the R-language for better search and signposting.
- A framework that could relate and/or integrate the indicators across multiple-scale BGI cases and projects would be helpful for further BGI R&D.

When further elaborated upon, the current DB has the potential to establish a set of system boundaries to allow a number of functions.

Search and **Add** precedents of data generation and transfer.
Search and **Add** precedents of exemplary BGI solutions.
Learn about structure and performance of BGI solutions.
Learn about the stakeholders and the value chain.
Define and **Design** BGI project boundaries and methodologies.

› Image 1 (next page) - 'Bosco Verticale', Milan, Italy

6. ACKNOWLEDGEMENTS

This research is part of the pre-proposal Part A of the BGI Manual Project. This project is a joined effort of the International Federation of Landscape Architects Europe (IFLA), Joint Nature Conservation Committee (JNCC), BiodivERsA (BDA), Natural Resources Wales (NRW) and Except Integrated Sustainability (Except). The research was conducted by the research team of Except, in close collaboration with the project partners. We thank them for their support and their valuable, extensive feedback on methodology, questionnaire and (interpretation of) results.

Furthermore, we thank all 11 stakeholders for taking the time and effort to collaborate in this research, by filling in the questionnaire and/or participating in the follow up interviews.

IFLA EUROPE
INTERNATIONAL FEDERATION OF LANDSCAPE ARCHITECTS

JNCC

biodiversa

Cyfoeth Naturiol Cymru
Natural Resources Wales

EXCEPT
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7. LIST OF ABREVIATIONS

AMS	Advanced Metropolitan Solutions
BGI	Blue and Green Infrastructure
CE	Circular Economy
CIRIA	Construction Industry Research and Information Association
COD	Chemical Oxygen Demand
COP21	2015 United Nations Climate Change Conference
CSR	Corporate Social Responsibility
DIY	Do It Yourself
EEA	European Environment Agency
ESS	Ecosystem Services
EU	European Union
GI	Green Infrastructure
GIP	Green Infrastructure Partnership
GIRL	Green Infrastructure Resource Library
GIS	Geographic Information System
GIWiz	Green Infrastructure Wizard
ICOMOS	International Council on Monuments and Sites
InVEST	Integrated Valuation of Environmental Services and Tradeoffs
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
ISOCARP	International Society Of Cities And Regional Planners
IUCN	The International Union for Conservation of Nature
JRC	Joint Research Centre
LCA	Life Cycle Analysis
LID	Low Impact Development
LIDRA	Low Impact Development Rapid Assessment
LIFE	L'Instrument Financier pour l'Environnement
MAES	Mapping and Assessment of Ecosystems and their Services
MEA	Millennium Ecosystem Assessment
MIT	Massachusetts Institute of Technology
NBS	Nature Based Solutions
NCPT	Natural Capital Planning Tool
NERC	Natural Environment Research Council
NGO	Non-governmental Organization
NRW	Natural Resources Wales
NYC	New York City
OSE	Open Source Ecology
PSG	Project Steering Group
R&D	Research and Development
SiD	Symbiosis in Development
TCPA	Town and Country Planning Association
TEN-G	Trans-European Network for Green Infrastructure
TUD	TU Delft
UHI	Urban Heat Island
UK	United Kingdom
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America
WG	Welsh Government
WUR	Wageningen UR

8. LIST OF DEFINITIONS

BGI
Strategically planned networks of natural and semi-natural areas, designed and managed to deliver a wide range of ecosystem services.

BGI Project
Project initiated in 2016, started in 2018 to study bottlenecks and relations of stakeholders in BGI.

BGI Precedents
Relevant case studies and projects existing in the BGI field .

BGI Solution
A physical expression of BGI in a determined location - e.g. green roofs, restored forests, re-naturalized rivers, etc.

BGI Methods
A virtual guidance (including digital data repositories, digital tools and practical manuals).

BGI Manual
Solution proposed to streamline the knowledge-to-practice flow in the BGI field
Citizen Science - Application of scientific methods in natural functioning research by nonprofessional individuals, or informal groups.

IPCC Report
A Special Report issued by the Intergovernmental Panel on Climate Change on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

Nature-based Solutions
"Actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[1]

Ecosystem Services
"The (environmental, social, and economic) benefits people derive from ecosystems"[2]

Natural capital
"Natural capital includes land, minerals and fossil fuels, solar energy, water, living organisms, and the services provided by the interactions of all these elements in ecological systems"[3]

1. https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions
2. https://www.millenniumassessment.org/documents/document.300.aspx.pdf
3. https://www.unep-wcmc.org/system/dataset_file_fields/files/000/000/232/original/NCR-LR_Mixed.pdf?1406906252

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5. Data Assembly

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10. ANNEXES

ANNEX I
STAKEHOLDER LONGLIST

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
					COLD LUKEWARM WARM	LOW MEDIUM HIGH	EUROPE NATIONAL LOCAL
1	**European Landscape Contractors Association**	The ELCA is the European Landscape Contractors Association. To promote cooperation as well as the exchange of information and experience in Europe the European Landscape Contractors Association (ELCA) was founded in 1963. Increasing the awareness of ELCA and the wider landscape industry across the EU and the rest of the world. Political communication towards decision makers: Maintaining and extending the contacts to relevant members of the European Parliament and to their offices, to civil servants of the European Commission and to representatives of other associations with similar interests. Permanent further development of the network in Brussels.	Knowledge supplier and User	Landscape Architects and Planners	Lukewarm	High	Europe
2	**Architects Council of Europe**	The Architects' Council of Europe (ACE) is the representative organization for the architectural profession at European level. Its membership consists of regulatory and professional representative bodies throughout Europe. Through them, the ACE represents the interests of over 560.000 architects	Knowledge supplier and User	Landscape Architects and Planners	Lukewarm	High	Europe
3	**Council of Europe**	The Council of Europe (CoE; French: Conseil de l'Europe, CdE) is an international organization whose stated aim is to uphold human rights, democracy and the rule of law in Europe.	Legislator / Funder	Government Entities	Warm	High	Europe
4	**European Institution (anonymized on request)**	Implementation of GI Strategies, policy conception, design and implementation.	Legislator / Funder	Government Entities	Warm	High	Europe
5	**European Association of Engineers**	"FEANI is a federation of professional engineers that unites national engineering associations from 34 European Higher Education Area (EHEA) countries."	Knowledge supplier and User	Construction, Infrastructure and Engineers	Lukewarm	High	Europe
6	**European Council of Town Planners**	The European Council of Spatial Planners (ECTP-CEU) is the umbrella organization for spatial planning institutes in Europe, providing its members with a common framework to promote the visibility, recognition of the important societal role and practice of planning and urban development in Europe and its teaching, continuing professional development and the definition of professional responsibilities. ECTP-CEU sets standards of education and conduct for the planning profession; engages in dialogue with local, national and European government, identifies, and rewards examples of good planning all over Europe.	Knowledge supplier and User	Landscape Architects and Planners	Warm	High	Europe

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
7	**Irrigation Association of Europe**	The EIA is a non-profit European organization which represents the interest of members from the Agriculture, Golf and Turf Industries. The mission of the EIA is to improve the products, practices and services used to manage water resources and to contribute to the global improvement of the environment.	Knowledge supplier and User	Agriculture	Warm	Medium	Europe
8	**Horticultural Growers Association of Europe**	An international organization dedicated to promoting horticultural producers and held the international garden / flora festivals or expositions.	Knowledge supplier and User	Agriculture	Warm	High	Europe
9	**Stone / Surfacing Suppliers of Europe**		Knowledge supplier and User	Construction, Infrastructure & Engineers	Warm	Medium	Europe
10	**UNISCAPE (Association of Universities for the European Landscape Convention)**	The aim of UNISCAPE is to support and reinforce scientific interdisciplinary co-operation among European universities regarding landscape issues, especially in the areas of research and teaching. UNISCAPE promotes the principles and the objectives of the European Landscape Convention. Concerning research activities, UNISCAPE promotes study and experimentation activities relating to landscapes, their evolution and transformations.	Knowledge supplier	Knowledge Institutes	Warm	Medium	Europe
11	**ECLAS (European Council of Landscape Architectural Schools)**	Exists to foster and develop scholarship in landscape architecture throughout Europe by strengthening contacts and enriching the dialogue between members of Europe's landscape academic community and by representing the interests of this community within the wider European social and institutional context.	Knowledge supplier	Knowledge Institutes	Warm	Medium	Europe
12	**European Commission Trans-European Transport Network**	The TEN-T policy supports the completion of 30 Priority Projects, representing high European added value, as well as projects of common interest and traffic management systems that will play a key role in facilitating the mobility of goods and passengers within the EU.	Legislator / Funder	Government Entities	Lukewarm	Medium	Europe
13	**European Federation of Green Roof Associations**	The thirteen associations promote and encourage the uptake of green roofs and green walls in their countries to help address issues related to climate change, ecosystem services, green infrastructure and lack of green space in the built environment.	Knowledge supplier and User	Construction, Infrastructure and Engineers	Warm	High	Europe

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
14	**Environmental Geography, Northumbria University**	"NERC Knowledge Exchange Fellow investigating 'Mainstreaming GI', particularly how to translate GI research into policy and practice. Is working with stake-holders and has held workshopsto identify user needs and barriers to mainstreaming GI. Has anunderstanding of GI projectson anEU Scale, not justUK. Was central to pulling together practical guidance on implementing the UK's National Ecosystem Assessment and has recently been advising the Welsh Government on GI"	Knowledge supplier	Knowledge Institutes	Warm	Medium	Europe
15	**Scottish Natural Heritage**	Responsible for leading the project team which is delivering the Green Infrastructure Strategic Inter-vention which uses European Regional Development Fund money to support a series of major projects to improve greenspace and other green infrastructure in urban Scotland. Responsible for ensuring that the Intervention complies with all EU and Scottish Government rules	Content Processors / User	Knowledge Institutes	Lukewarm	Medium - Low	National
16	**GREEN SURGE**	GREEN SURGE project will provide a sound evidence base for urban green infrastructure planning and implementation and produce a Manual for Urban Green Infrastructure Planning	Knowledge supplier	Knowledge Sharing Project	Cold	High	Europe
17	**Victoria BID GI audit**	TheVictoria Business Improvement District (BID)publishedThe Green Infrastructure Audit Best Practice Guide with support from the London Mayor and work conducted by Arup. Contains results from fifty interviews carried out with BIDs that have completed GI Audits, BID levy payers, property developers, landowners, tenants, local authorities and other organizations whose work involves green infrastructure.	Funder and User	Knowledge Sharing Project	Cold	Low	national
18	**Welsh Government Planning Division**	Policy development, steering policy on GI within the planning system in Wales. Publication of policy imple-mentation guidelines for local authorities and other stakeholders for GI implementation on the national level.	Content Processor	Government Entities	Warm	High	national
19	**Welsh Government Ecosystem Management and Implementation**	Funding of GI projects, planning national BGI policy, stakeholder engagement	Legislator	Government Entities	Warm	High	national
20	**Home Builders Federation Wales**	A trade association representing private sector homebuilders in Engl Wales. Its members deliver around 80% of new homes built each year.	User	Construction, Infrastructure and Engineers	Warm	High	national

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
21	**Welsh Government Enabling Natural Resources and Well-being in Wales**	ENRaW will predominantly support projects that make improvements in residential areas by delivering benefits for people, businesses and their communities.	Funder	Government Entities	Warm	High - medium	National
22	**Welsh Government Sustainable Management Scheme**	The Sustainable Management Scheme will provide financial support for a range of activities that will improve the management of our natural	Funder	Government Entities	Warm	Medium	National
23	**Planning Officers Society Wales**	We represent nearly 2000 individual planners working in 80% of the local authorities and public sector organizations around England. We can rightly style ourselves as "the credible voice of public sector planners in England". Our aim is to ensure that planning makes a major contribution to achieving sustainable development, from national to local level, in ways which are fair and equitable and achieve the social, economic and environmental aspirations of the community.	User	Landscape Architects and Planners	Warm	Medium	National
24	**University Helsinki**	Professor in urban ecology with a broad view on the research domain and experienced in implementing transdisciplinary projects relating to BGI	Knowledge supplier	Knowledge Institutes	Warm	Medium	Europe
25	**Arup consulting**	Landscape architecture, Nature Based Solutions, urban development, GBI	User	Landscape Architects and Planners	Warm	Medium	Europe
26	**Humbolt University Berlin**	Landscape ecologist proficient in urban governance and ecosystem services, and participatory approaches to urban development	Knowledge supplier	Knowledge Institutes	Warm	Medium	Europe
27	**Autonomous Univ. Barcelona**	Environmental economist with expertise in use of ecosystem services in urban planning and governance	Knowledge supplier	Knowledge Institutes	Warm	Medium	Europe
28	**University of Antwerp**	Professor in ecology leading the BioVeins project, which gathers ecological and interdisciplinary knowledge to identify the critical features of GBI, to guide the establishment, management and restoration of GBI, and to mitigate the effects of major urban global challenges, like habitat fragmentation, air pollution, and urban heat island	Knowledge supplier	Knowledge Institutes	Warm	High	Europe

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
29	**Instituto Politecnico Coimbra**	Professor in ecology and leading the UrbanGaia project supported by OSE, seeking to develop realistic indicators to evaluate, manage and develop performant GBIs in cities. UrbanGaia aims to develop strategies and techniques to improve the governance and management of the urban green and blue infrastructure (GBI), aiming to: [i] increase biodiversity; [ii] enhance the environmental services provided by urban ecosystems and their impacts for the quality of life; [iii] develop new strategies to improve urban ecosystems and GBI governance, including management, planning, policy and legislation levels of intervention.	Knowledge supplier	Knowledge Institutes	Warm	High	Europe
30	**Naturvation project/Durham University**	Professor in environmental governance and coordinator of the Naturvation project , which seeks to develop an understanding of what nature-based solutions can achieve in cities, examine how innovation can be fostered in this domain. See in particular the 1000 NBS case studies in 100 european cities.	Knowledge supplier and User	Knowledge Institutes	Lukewarm	Medium - High	Europe
31	**Green4Cities**	Green4Cities is an international Center of Excellence for Green Infrastructure in urban areas. We develop and realize concepts, ideas and solutions for your green vision in the area of technical research and development, network and installed projects. In this sense we create tailormade signposts to guide cities toward lifequality and resilience to climate change. Co-founder of Green4Cities, performs research, consulting, education in the area of urban green infrastructure technologies	User	Environmental organizations	Lukewarm	Medium	Europe
32	**Arcadis**	Lead Natural Capital and Biodiversity Expert, notably works on policy research studies for the European Commission, mainly related to the EU Biodiversity Strategy (e.g. Green Infrastructure, ecosystem restoration, EU protected areas network) involved in EU Business@Bidodiversity platform and	User	Environmental organizations	Lukewarm	Medium	Europe
33	**Wageningen University and Research**	Biodiversity research	Knowledge supplier	Knowledge Institutes	Lukewarm	Medium	Europe
34	**Rijkswaterstaat**	The organization manages and develops the main roads, main waterways and main water systems on behalf of the Ministry. The main task of the service is to work on the smooth and safe traffic flow ("dry water state"), the maintenance and improvement of the system of waterways ("wet waterstaat") and the protection against flooding.	User / Funder	Construction, Infrastructure and Engineers	Warm	High	National

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
35	**Ministerie Infrastructuur en Waterstaat**	The Ministry of Infrastructure and Water Management (IenW) focuses on quality of life and accessibility, with a smooth flow in a well-designed, clean and safe environment. The ministry works on powerful road, rail, water and air connections, protects against flooding and promotes the quality of air and water. A livable, accessible and safe Netherlands	Legislator	Government Entities	Lukewarm	Medium	National
36	**Royal BAM Group**	Construction firm with ten operating companies in five European home markets and in niche markets worldwide. BAM's operating companies are active in the business lines Construction and Property, Civil engineering, as well as in Public-private partnerships.	User	Construction, Infrastructure and Engineers	Lukewarm	High	Europe
37	**ProRail**	ProRail is responsible for the railway network in the Netherlands: construction, maintenance, management and safety. As an independent party we divide the space on the track, arrange all train traffic, build and manage stations and create new tracks. Finally, we maintain existing tracks, points, signals and level crossings.	User	Construction, Infrastructure and Engineers	Cold	Low	National
38	**Deltares**	Deltares is an independent institute for applied research in the field of water and subsurface. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Our main focus is on deltas, coastal regions and river basins.	Knowledge supplier and User	Knowledge Institutes	Lukewarm	Medium	Europe
39	**Dutch National Institute for Public Health and the Environment**	How can we keep ourselves and our environment healthy? That is the challenge facing government authorities at all levels, from the local to the interna-tional. The Dutch National Institute for Public Health and the Environment (RIVM) conducts research and provides advice to assist them in this task.	Knowledge supplier and User	Knowledge Institutes	High	Medium	National
40	**Royal Netherlands Meteorological Institute**	The Royal Netherlands Meteorological Institute (KNMI) is the Dutch national weather service. Primary tasks of KNMI are weather forecasting and monitoring of weather, climate, air quality and seismic activity. KNMI is also the national research and information centre for meteorology, climate, air quality, and seismology.	Knowledge supplier	Knowledge Institutes	Low	Cold	National
41	**VolkerWessels**	From innovative, sustainable housing concepts built in one day – to the construction of one of the world's largest sea locks. VolkerWessels has the expertise to transform an empty piece of land to a fully functional city. We are a Dutch group of companies with 16,000 employees and about 120 companies and offices in the Netherlands, the United Kingdom, Germany and Canada / United States.	User	Construction, Infrastructure and Engineers	Warm	High	Europe

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
42	**World Wildlife Fund**		Content Processor	Environmental organisations	Lukewarm	Low	Europe
43	**Netherlands Institute for Ecology**	The scientists at the Netherlands Institute of Ecology (NIOO-KNAW) perform basic and strategic ecological research on individual organisms, populations, ecological communities and ecosystems.	Knowledge supplier	Knowledge Institutes	Lukewarm	Medium	Europe
44	**European Environment Agency**	The European Environment Agency provides sound, independent information on the environment for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public. In close collaboration with the European Environmental Information and Observation Network (Eionet) and its 33 member countries, the EEA gathers data and produces assessments on a wide range of topics related to the environment.	Content Processor	Government Entities	Cold	Medium	Europe
45	**Biodiversity Information System for Europe**	BISE is a single entry point for data and information on biodiversity supporting the implementation of the EU strategy and the Aichi targets in Europe	Knowledge supplier	Knowledge Sharing Project	Cold	Medium	Europe
46	**PBL netherlands Environmental Assessment Agency**	PBL Netherlands Environmental Assessment Agency is the national institute for strategic policy analysis in the fields of the environment, nature and spatial planning. We contribute to improving the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all of our studies. We conduct solicited and unsolicited research that is independent and scientifically sound.	Content Processors	Knowledge Institutes	Cold	High	National
47	**IUCN - Commission on Ecosystem Management**	The International Union for Conservation of Nature (IUCN) is a membership Union uniquely composed of both government and civil society organizations. It provides public, private and non-governmental organizations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together.	Content Processors	Knowledge Institutes	Warm	High	Europe
48	**Staatsbosbeheer**	Staatsbosbeheer is commissioned by the Dutch government to strengthen the position of nature in the Netherlands. As a leading national public body and as land owner and manager of a sizeable amount of nature reserves we work to conserve and develop the Netherlands' characteristic green heritage. Together with society, we are committed to ensuring that current and future generations are able to experience the many essential values of nature, balanced with sustainable use of our protected areas.	User	Environmental organizations	Cold	Medium	National

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
49	**WISE**	Water Information System for Europe	Knowledge supplier	Knowledge Sharing Project	Cold	Low	Europe
50	**CLIMATE-ADAPT**	Support Europe in Adapting to climate change. Information system	Knowledge supplier	Knowledge Sharing Project	Cold	Low	Europe
51	**Eionet**	The network supports the collection and organization of data and the development and dissemination of information concerning Europe's environment.	Knowledge supplier	Knowledge Sharing Project	Cold	Medium	Europe
52	**European Habitats Forum**	"The European Habitats Forum (EHF) brings together leading European nature conservation organizations to provide advice on the development and implementation of EU biodiversity policy with a special focus on the EU Birds and Habitats Directives and the reform of sectoral policies critical to a successful implementation.	Content Processors	Environmental organisations	Cold	High	Europe
53	**CEEweb for Biodiversity**	CEEweb for Biodiversity is a network of non-governmental organizations in the Central and Eastern European region working for 20 years in 20 countries. Our mission is the conservation of biodiversity through the promotion of sustainable developmen	Content Processors	Environmental organisations	Cold	Medium	Europe
54	**BISE Clearing House Mechanism**	The network aims at promoting and facilitating technical cooperation, knowledge sharing and information exchange amongst national CHMs and BISE, in support of the implementation of the Convention on Biological Diversity (CBD) Strategic Plan for Biodiversity 2011-2020. It is supported by the European Environment Agency, the designated CHM Focal Point to CBD for the European Union.	Content Processors	Knowledge Sharing Project	Cold	Medium	Europe
55	**BiodivErsa**	"BiodivERsA - the network programming and funding research on biodiversity and ecosystem services across European countries and territories	Knowledge Supplier	Knowledge Sharing Project	Warm	High	Europe
56	**European Region of the International Federation of Landscape Architects**		User	Landscape Architects and Planners	Warm	High	Europe
57	**ISOCARP**	a non-governmental global association of experienced professional planners	User	Landscape Architects and Planners	Warm	High	International

#	COMPANY	DESCRIPTION	ROLE	TYPE	RELATIONSHIP	RELEVANCE	LOCATION
58	**Natural Resources Wales**	"Adviser: principal adviser to Welsh Government, and adviser to industry and the wider public and voluntary sector, and communicator about issues relating to the environment and its natural resources	Content Processors	Environmental organisations	Warm	High	National
59	**Connection Nature**						
60	**Nature needs half**				Cold		Global
61	**Groene Hart**				Cold		
62	**Joint Nature Conservation Committee**	JNCC is the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation. Our work helps maintain and enrich biological diversity and conserve geological features. It also helps sustain natural systems, which provide the core "services" we all depend on like food, fresh water and clean air. In this way they contribute to economic growth and social well-being and are integral to sustainable development Good policy-making, planning, development and risk management all depend on reliable, up-to-date information about biodiversity status and trends. Our role is to provide evidence, information and advice so decisions can be made that protect our natural resources and systems. JNCC itself is a forum that brings together the UK's four country conservation bodies. We advise Government and a wide range of bodies to help join up policy and to deliver a strong and cost-effective evidence base by helping to see that the best possible return is achieved from investment in research and surveillance in the UK and internationally.	Content Processors	Environmental organisations	Warm	High	National
63	**Ecosystem Services Partnership**				Warm		
64	**Infrastructure company (anonymized on request)**	An international infrastructure company who finances, develops, builds and maintains innovative and efficient infrastructure.	User	Construction, Infrastructure and Engineers	Warm	High	International

ANNEX II
ON-LINE SURVEY

ANNEX II - ON-LINE SURVEY

Welcome to the BGI Manual - Stakeholder Questionnaire.
Thank you for participating in this survey. Your feedback is higly appreciated!

This questionnaire is part of the BGI Manual project. Your answers will provide invaluable information that will be used to steer and direct the course of this project.

Please read the information of each question carefully before you answer. Where needed, we provide examples of potential answers to make it easier for you to understand what exactly are we looking for in each question. You will be able to modify your answers even after taking the survey so if you think of a better way to answer some questions, or you have recalled additional information, please feel free to edit your responses.

Completing the questionnaire will take between 30 – 60 minutes. The information collected will be used for the above mentioned purpose only and will be shared with the project partners (Except Integrated Sustainability, the International Federation of Landscape Architects (European Region), BiodivERsA, Natural Resources Wales and the Joint Nature Conservation Committee). We kindly ask you to complete the questionnaire latest Monday, January 21st, 4:00 PM CET.

Survey Monkey: https://www.surveymonkey.com/r/CJSS5JJ

A. EXPERT INFORMATION

Section 1: Personal information

1. What is your name?

2. What is your Role within your organization?
Examples: scientist, engineer, advisor, consultant, manager, coach

3. What is your personal role within BGI projects?
Examples: carry out research, design or plan projects, provide training & capacity building use, operate & distribute BGI solutions, construct, maintain & deconstruct BGI solutions?
Instruction: In 1-2 sentences describe how you can relate to BGI projects.

B. STAKEHOLDER INFORMATION

Section 1: Key activities

4. How does your organization contribute to BGI Projects?
Examples: This refers to specific functions of your organization in the value chain of translating knowledge on BGI into projects and solutions: design, planning and implementation; research, networking and capacity building; tech-support and after-sales services; (co-) funding and assisting, carry out the full project cycle (A to Z) or parts of it.
Instruction: Please write the top-3 functions related to BGI projects, and give a short description of each.

5. To what extent do your BGI projects consider biodiversity and ecosystem services?
Not considered -- Somehow considered -- Core consideration

6. To what extent does your organization rely on scientific knowledge on biodiversity and ecosystem services to implement BGI projects, either directly or indirectly?
Not at all -- Somehow reliant -- Greatly reliant

7. What do you produce as organization, related to BGI?
Examples: reports, technical documentation, scientific papers, frameworks & manuals, tools & digital products.

8. What data do you generate related to BGI projects?
Example: stats, tables, maps, metrics, matrices, sensors data
Instruction: Briefly describe what is the content of the outputs mentioned in your previous answer.

Section 2: Key Partners & Customers

9. Who are your most important partners in relation to BGI?
Example: academia, government, commercial sector, NGO or other
Instruction: Name the top-3 partners who are vital to your BGI related operations. Where available, please provide links for your mentioned partners.

10. Do you have a dependency on your mentioned partners related to data and digital products?
Example: provision of specific datasets, digital products & tools, manuals

→ **IF YES**
11. Please indicate for what data/digital products you depend on your mentioned partners (provide links where available).

12. Do you have a dependency on your mentioned partners related with physical products?
Example: manufacture and installation, clean technology systems, materials & resources

→ **IF YES**
13. Please indicate for what physical products you depend on your mentioned partners (provide links where available).

14. Do you have a dependency on your mentioned partners related with services and expertise?
Example: technical advice, consulting, funding

→ **IF YES**
15. Please indicate for what services you depend on your mentioned partners (provide links where available).

16. Who are your most important customers in relation to BGI now and in the future?
Example: academia, government, commercial sector, NGO or other?
Instruction: To whom do you address your efforts? Name the top-3 customers who are at the centre of your BGI processes and provide links where available.

Section 3: Communication channels

17. What communication channels do you use to reach out to your partners and/or customers about new concepts and/or products related to BGI projects?
Examples: social media (Facebook, Twitter, LinkedIn), online platforms, email communication, newsletters, journals, conferences and summits
Instructions: Name the top-3 channels that you use to communicate your BGI related activities and provide links where available.

C. BGI METHODS & TOOLS

18. Do you do research information on BGI?

19. Which methods do you use to research and analyse information regarding BGI?
Examples: standards and frameworks, online search, literature review, querying databases, gathering opinions of experts, interviews and surveys.
Instructions: Name your top 3-5 methods, scientific standard(s) or frameworks that you use for developing knowledge on BGI (provide links where available).

20. Do you plan or design BGI?

→ IF YES

21. Which methods do you use to design BGI?
Examples: standards of the ISO series, Sustainable Design of Buildings Standards, European Standards for Urban Development and Land Management
Instructions: Name your top-3-5 examples of methods that you use when designing BGI solutions and provide links where available.

22. Do you operate and maintain any physically implemented BGI?

→ IF YES

23. Which methods do you use for operation and maintenance of physically implemented BGI solutions?
Examples: User Manual for use of Biofilters, design guidelines for water security, ISO requirements on landscape maintenance in urban or peri-urban areas, regulations of local authorities
Instructions: Name your top-3-5 operation and maintenance methods for your BGI solutions and provide links where available.

24. Is there any internal or industry guidance on BGI that you currently use? If so, are you willing to share this with this project?
Instruction: Mention your internal BGI guidance and provide link if available

25. What kind of tools do you have in your repository (free or licensed) relevant to the design and implementation of BGI?
Examples: databases, project planning, modelling-simulation, GIS-based
Instructions: Indicate which tools do you need to perform your activities exclusively in regard to BGI. List your top-3-5 tools and provide links where possible.

D. BGI SOLUTIONS

26. Has your organisation developed or implemented a BGI solution?
Example: physical - biofilter, green roof, urban garden (food/ornamental), green urban/rural areas, bioswales, technosols, permeable pavement; digital - model, tool, manual, framework

→ **IF YES**

27. What is a BGI solution you have developed and implemented?
Example: physical - biofilter, green roof, urban garden (food/ornamental), green urban areas,bioswales, technosols, permeable pavement; digital - model, manual, framework
Instruction: Describe your BGI solution in one sentence (max 20 words). Provide a link where possible

28. What are the main functions of your BGI solution?
Example: treat gray water from houses, capture stormwater, provide locally produced crops, improve aesthetic quality, capture air pollutants and improve air quality, regulate heat waves in urban environments, ecological corridor, provide areas for recreation
Instruction: Describe (in 1-2 sentences) what is the main function of your BGI solution

29. What are the main components of your BGI solution?
Example: vegetation structure, soil components, gravel, water, materials, mechanical/ architectural parts
Instruction: Describe the main components of your BGI solution (separate with commas)

30. What is the scale of your BGI solution?
Examples: local-national-regional, urban or peri-urban, house-street-neighborhood-city, brownfield-landscape
Instructions: What is the scale of BGI Solution that you implemented / participated in?

31. Where it is implemented and used (location)?
Instructions: Indicate the geographic location where your BGI solution has been implemented/ used (separate with commas if necessary)

32. What scientific/technical concepts of biodiversity and/or ecological engineering does your BGI mobilise?

33. What are the social factors that make your BGI solution a success?
Examples: participatory approaches, addressed existing social issues, stakeholder involvement, community building and social participation
Instruction: Describe top-3

34. What are the economic factors that make your BGI solution a success?
Examples: return of economic benefits through reduced long term maintenance costs for infrastructure, reduced water treatment costs, reduced energy costs for cooling and heating, maintenance of economically important ecosystem services, utilised reused, cheap and/or locally sourced material, low production costs, high degree of upscale
Instruction: Describe top-3

35. What are the environmental factors that make your BGI solution a success?
Examples: improved water, soil & air quality, improved ecological functioning-connectivity and provision of ecosystem services, reduction in energy related emissions
Instruction: Describe top-3

36. What are the Key Performance Indicators (KPIs) that you use to assess the effectiveness of your BGI solution?
Examples: water-air-soil quality, energy consumption, species abundance & diversity, urban green cover percentage, quantity/quality of produced food, upscale level
Instruction: Name top 2

37. How do you track and monitor these KPIs?
Examples: ecosystem services models, chemical quality control, geospatial analysis, sensors, statistics.
Instruction: Name top-3 approaches.

38. What lessons did you learn from developing and implementing your BGI solution and how has this informed any next steps?

39. Do you have other examples of BGI solutions your organization has developed or implemented?

→ **IF YES**
Repeat question 27 - 39

→ **IF NO**
40. Do you have any precedents of a successful BGI solution that you would recommend?
(please share a link to further information)

E. FUTURE PRODUCT

41. What would you improve in your daily activities to be more productive and happy in relation to BGI?

42. What do you need to be able to contribute to BGI projects?

43. Which aspect of BGI is confusing or needs improvement?
Examples: nature of data, language used and terminology, technical implementation, technology and manufacture
Instruction: Describe based on your experience so far, what are the main bottlenecks in the implementation of BGI.

44. Which parts of your BGI project appear to be more problematic?
Examples: research, design, implementation, monitoring, upscaling, funding

45. Do you think there are challenges translating academic studies to BGI practitioners?

46. If yes, what do you think these challenges are and what actions do you believe would help in making this translation easier and thus the information more operational for you?

47. Do you think there are bottlenecks and limitations of current method(s) (research/ practice)? If yes, what do you think these are?

48. What content would you like to see from a future proposed BGI Manual (drawings, specifications, standards, links to information)?
Example: tabular lists, graphs, reports, publications, frameworks and guidelines, models & tools, infrastructure specifications, policy documents, spatial data
Instruction: List your top-5 desired output materials (insights)

49. What would be your ideal user interface for a future proposed BGI Manual?
Examples: online platform, application/software, downloadable database, manual, report, physical printed copy, CD / Disc format
Instruction: Describe in 30 words.

50. Would you be user, contributor, investor, reviewer of a future BGI Manual?
Instruction: Describe in a few words how could you see yourself being involved.

51. This is the end of the survey.If you have any further questions or remarks, please mention them here.

Thank you very much for your time, on behalf of the project partners.

ANNEX III
INDIVIDUAL STAKEHOLDER PROFILES

ANNEX III - INDIVIDUAL STAKEHOLDER PROFILES

This annex outlines the key findings per individual stakeholder. The tables below presents an overview of the main findings for each stakeholder individually, as well as a transcript of the interviews.

- **Activities** describe the ways in which the stakeholder operates in the BGI value chain.
- **Outputs** refers to the digital or physical outputs developed by the stakeholder.
- **Methods** refer to the approaches applied in daily operations.
- The **Dependencies** are the most important relevant relationships of the stakeholder when carrying out BGI activities.
- By **Bottlenecks**, we refer to the main barriers for implementing BGI, as mentioned by stakeholders.
- Finally, the **Future BGI Manual** is a snapshot of each stakeholder's needs and requirements (in terms of interface and content), and his/her role in the development of the final BGI Manual.

Stakeholders are anonymized by name and identifiable by their organization.

1. UNIVERSITY OF NORTHUMBRIA, NERC	
ACTIVITIES	**1** Research on design and development of green and silver infrastructure. **2** Evaluation: assessing design and impacts of BGI. **3** Communication and setting up actions for R&D. **4** Engaging authorities / administration for reaching a common ground & vision. **5** Educating policy-makers on BGI impacts.
OUTPUTS	**1** Academic-professional papers to share knowhow. **2** Web-portal Green Infrastructure Partnership for networking. **3** GI standards, ESS tools for evaluations of BGI/GI. **4** Workshops with local authorities.
METHODS	**1** Policy matrix for evaluation of attractiveness and potentials of Green Infrastructure (GI). **2** Natural capital planning tool for assessing the impact of new or proposed developments and plans. **3** Build-with nature for design, implementation and management of green infrastructure with planners.
DEPENDENCIES	**1** Local authority (town-planners) provide city plans, receive advice on planning approach of GI. **2** Public administration 'Welsh Government' provide funds, laws, receive GI plans (town and country) and publications for policy-making.
BOTTLENECKS	**1** Communication issues in interactions between different silos/actors. **2** Language & terminology of available information on GI. **3** Struggle in bringing authorities together (i.e. water, land). **4** Lack of a link between research and policy objectives. **5** Lack of a link between research and needs of practitioners. **6** Struggle in pinning down intangible values of nature during decision making. **7** Difficulty to distinguish which method fits which purpose in GI. **8** Unclarity on how BGI contributes to the economy. **9** Lack of participation across planners, policy-makers, and researchers.
FUTURE BGI MANUAL	**1** User interface: online platform. **2** Features: Labelling of methods/tools according to purpose, Multi-stakeholder relevance of selected content, Enable user contribution and data inputs from users. **3** Roles: User, Contributor, Reviewer.

1. University of Northumbria, NERC

The respondent works at Environmental Geography at the University of Northumbria and a fellow researcher at the Natural Environment Research Council (NERC). His focus around BGI is research and development of new knowledge and its application in the practice. He has been working on science-policy, and involved in the establishment of the Green Infrastructure Partnership[1], as well as the development of GI standards for the UK. Moreover, he maintains an online portal on BGI, and has published related scientific papers and reports. His outputs are used to feed local development plans and the formulation of national strategies. Therefore, the main dependencies of this stakeholder lie on Local authorities and Public administrations.

A serious bottleneck he has identified in his operations is the vast amount of developed research that is not labelled according to purpose in such a way that practitioners can eventually use it. This issue can be alleviated by creating an inventory of methods, strategically grouped and labelled according to best application uses. In addition, he recognises the fact that researchers do not usually take the extra mile to translate and deliver their findings to practitioners. A possible intervention to act upon this tendency is adjusting the way information is communicated, in order to relate to standards applied in various sectors and policy objectives.

As BGI development takes place in the silo of the environmental sector, related projects do not come with the necessary interdisciplinary approach. This seriously hampers the mainstreaming of the concept. Identifying the hooks that practitioners from other sectors (such as water management, health, energy, construction etc) might gain from BGI approaches could facilitate multi-sectoral involvement.

Finally, despite the fact that the number of studies on economic valuation of ecosystems is growing fast, the respondent notes that not enough attention is dedicated on finding the right mechanisms to capitalize on this value. Therefore, the contributions of nature to the economy is usually undermined.

The respondent believes that future BGI developments must interact with different audiences, including sections that specifically address those user groups. He argues that it would be useful to create a community of interest in the form of an online platform that can take collective responsibility for these resources before, during and after the completion of the project. Therefore, he considers it to be meaningful for someone to take up the role of coordinating BGI projects and bringing resources together. He is convinced that the highest value lies in piggy-backing, rather than the development of new knowledge.

1. https://www.tcpa.org.uk/pages/category/green-infrastructure-partnershipl

2A. UNIVERSITY OF ANTWERP	
ACTIVITIES	**1** Community engagement: facilitate involvement of local groups through citizen science approaches. **2** Design: plan the development of physical BGI (green roofs & walls) in the city of Antwerp. **3** Education: training NGOs and civil society actors on BGI approaches. **4** Evaluation: use of scientific methods, digital simulation, and modelling tools to assess the design of physical BGI. **5** Implementation: applying physical BGI projects in Antwerp, Belgium. **6** Monitoring: track BGI performance with sensor monitoring technology. **7** Operate: managing physical BGI i.e. green roofs & green walls. **8** Research: developing knowledge around BGI benefits on air purification and climate change adaptation.
OUTPUTS	**1** Scientific papers on BGI design & performance. **2** Event presentations to practitioners and public on BGI benefits. **3** Reports & manuals for the non-scientific community to engage in BGI. **4** Inventory lists of species performance on ESS. **5** Data libraries from monitoring processes. **6** Maps of urban air quality. **7** Sensor monitoring systems in on-going BGI projects. **8** 2 projects on green roofs, Antwerp. **9** 1 project on green walls, Antwerp.
METHODS	**1** Model simulations on functioning of BGI in terms of climate regulation and air pollution mitigation. **2** ESS assessments. **3** Sensor monitoring systems.
DEPENDENCIES	**1** Local authorities of the City of Antwerp provide relevant data on urban BG spaces and technicians for technical installations, receive analyzed information on BGI for local development planning. **2** Environment and Planning departments of the Flemish Government assist with research process by providing space and giving permissions for measurements, receive relevant information for decision making. **3** Civil society & NGOs participate in citizen science based data gathering, get involved with development process and actively influence decision making.
BOTTLENECKS	**1** Lack of communication between different sectors (e.g. academia, NGOs, startups) on the city-scale. **2** Data standardization issues from sources on different scales complicate system monitoring. **3** Time frames of research development and planning process do not align. **4** Difficulty in promoting innovative approaches due to traditional ways of thinking of related government bodies. **5** Research not linked with policy objectives. **6** Research not linked with practitioners' needs. **7** Ensuring funding for BGI projects is not usually a priority of budget spending. **8** Not easy to pin-down the economic contribution of BGI.
BOTTLENECKS	**1** Lack of legal framework that would bind BGI actors into collaboration for and implementation of BGI. **2** Lack of participation of planners, policy-makers, researchers.

2A. UNIVERSITY OF ANTWERP	
FUTURE BGI MANUAL	**1** User interface: online platform to interact with BGI knowledge and stakeholders, software simulation and economic evaluation. **2** Features: Inventory of available methods, Visual material on performance and distribution of BGI, Multi-stakeholder relevance of selected content, Modelling capacities for use by non-specialized groups. **3** Roles: User, Contributor, Reviewer.

2a. University of Antwerp

This respondent is a professor at the Department of Bioscience Engineering, University of Antwerp and the Lab of Environmental and Urban Ecology (EUREC-A). His research focuses on urban ecology and the mitigation of air pollution by using plants. Relevant outputs to BGI include peer reviewed literature, reports & manuals, sensor monitoring systems and maps. Interestingly, he is one of the very few stakeholders analyzed who is also involved in physical BGI solutions. Currently, he is running 2 pilot projects on green roofs, and one project on green walls. His ongoing projects provide the opportunity to apply his research and test various monitoring methods. Having walked the whole path from knowledge to practice, the respondent has a comprehensive understanding of the value chain complexity. He is working primarily with public and European administrations, local governments where he provides the information produced by his research while he is depending on this relationship to acquire funding for projects. In addition, he is interacting a lot with civil society and NGOs with which he sometimes co-develops projects to create powerful illustrative data that can be easily understood and used by citizens, like urban air pollution maps.

BGI, he argues, is a concept that includes many different domains and includes several aspects such as technical, administrative, economic, ecological. Therefore, related projects need to be very interdisciplinary in their approach. However, usually researchers will look very deep in one of all these aspects which is not enough to bring findings in economic application. At the city scale, the lack of communication between different groups is mentioned as a serious bottleneck.

Moreover, the administrative sectoral organization of local authorities and the attachment of different practitioners to traditional ways of thinking is what prevents the upscale of pilot BGI projects.

Finally, he identifies a lot of potential in the consumer driven changes of the property market due to the increasing demand for quality living spaces as well as the role that a clear legal framework can play.

The researcher wishes for a new development in BGI, to provide general rules of thumb for BGI implementation, illustrative and flexible enough to adapt to local contexts. In addition, he argues that visual content and maps would be essential with those regards. His ideal solution would be the combination of a method inventory list with an overarching tool that has the ability to reliably model the reconstruction of an area and the integration of BGI. This could be used from citizens and promote co-development and co-creation approaches.

2B. UNIVERSITY OF ANTWERP	
ACTIVITIES	**1** Research: developing knowledge around BGI benefits through provision of ESS. **2** Evaluation: use of scientific methods, digital simulation, and modelling tools to assess the design of physical BGI.
OUTPUTS	**1** Peer reviewed articles on BGI. **2** Spatial BGI assessments. **3** BGI guidelines. **4** Transdisciplinary research project(s).
METHODS	**1** Groeninventaris Antwerpen (GI spatial inventory for Antwerp). **2** ENVI-met model. **3** Geospatial analysis (QGIS).
DEPENDENCIES	**1** Working closely with academic colleagues from on-going BGI projects (BIOVEINS) for designing and carrying out research. **2** Depending on local authorities (City of Antwerp) for securing funding and support research by e.g. allow access in restricted areas for sampling. **3** Commercial companies in the greenery sector (not specified). **4** Citizens (not specified).
BOTTLENECKS	**1** Challenging to secure funding for carrying out scientific research projects. **2** Economic feasibility of BGI is complicated. **3** Limited comparable precedents of physical urban BGI for scientific study.
FUTURE BGI MANUAL	**1** User interface: online platform. **2** Features: Models & Tools for BGI design and evaluation, Frameworks & Guidelines of implementation, Infrastructure specifications on different BGI solutions. **3** Roles: User, Contributor.

This stakeholder was not interviewed after filling in the online questionnaire.

3. INSTITUTO POLITÉCNICO COIMBRA	
ACTIVITIES	**1** Research and design, development of BGIs. **2** Engagement of local communities through the 'citizen science' (i.e. involvement of citizens into projects R&D). **3** Design, engineering, and planning of physical BGI realisation. **4** Education: training local communities and governmental planners on BGI approaches. **5** Implement: urban gardens in Lisbon. **6** Monitor BGI performance in terms of ESS. **7** Operate: coordination and management of BGI projects. **8** Evaluation: assessing the types and functions of BGI in different European cities. **9** Communication and outreach through events and workshops with practitioners. **10** Educating practitioners on BGI approaches - tapping into an extended professional network.
OUTPUTS	**1** Scientific papers, reports, disseminated material. **2** Urban Garden in Lisbon.
METHODS	**1** Geospatial analysis. **2** Sensoring and sampling flows of water, energy, nutrients.
DEPENDENCIES	**1** Local authorities provide a location for BGI implementation, and receive advice on BGI and community engagement. **2** Public administrations provides funding for research. **3** Civil society provides data through citizen science and advocate for action.
BOTTLENECKS	**1** Lack of interaction between actors such as civil society, city planners, policy-makers, and researchers. **2** Administrative sectoral organisation of related government bodies, lack of clear BGI implementation process. **3** Lack of interdisciplinarity in BGI projects.
FUTURE BGI MANUAL	**1** User interface: Online platform, Software. **2** Features: Technical guidance on BGI construction, Implementation guidance on the overall process, Standards & Specifications for different BGI solutions, Inventory of methods, Links of BGI concepts with policy objectives, Modelling capacities. **3** Roles: User, contributor.

3. Instituto Politécnico Coimbra

This respondent is a professor of the master's degree in Environmental Management at ESAC / Polytechnical Institute of Coimbra. He is also the Scientific Coordinator of the Research Centre for Natural Resources, Environment and Society (CERNAS). As an academic, he is primarily focused on R&D, capacity building and networking. He issues scientific papers and reports, manuals and dissemination material. In addition, the respondent is involved in ongoing BGI projects as a project coordinator and currently, he is running a project on urban gardens in Lisbon. Moreover, together with his colleagues he is developing an assessment of Urban Green Infrastructure types, and their functions in different cities as well as a mobile app for citizens to map the occurrence of green spaces in their city. In order to disseminate new knowledge, he collaborates with other research institutions and universities. Furthermore, he has important relationships with regional authorities, local governments and municipalities for using his research. Other dependencies mentioned by the stakeholder have to do with project funding for which he depends on related national organizations.

The main bottleneck that this stakeholder sees in his operations is related to the difficulties he experiences when working with politicians. This stems from the fact that politicians usually have other priorities, and may not employ an innovative enough mentality for Nature Based Solutions (NBS). He argues that politicians very rarely have a technical-scientific background: it is therefore almost impossible to effectively communicate research findings to them. Instead, he believes that researchers should be focusing in working closer with planners, practitioners, technicians and public servants from municipalities and departments. These actors enjoy a position where they can better understand the scientific information they are provided with, so that they can directly make use of it in the practice as soon as they have the right connection. Furthermore, he points out that these professionals are usually the ones with a broader, longer-term vision within an organization, in contrast with the short political cycles on which politicians are used to think and operate.

On the purely scientific side, he identifies BGI as a complex issue that involves a great number of variables which are highly challenging to bring together, sample and relate. This usually leads to extensive use of scientific jargon, so that the message cannot be targeted at various groups. Moreover, he argues that involving all stakeholders in a common vision and strategy has been problematic in the past. Additionally, he mentions that it is usually very difficult to develop a BGI network because the structure of a city is quite old and difficult to change. This does not allow for a proper placement, shape and function of BGI. Therefore, in this stakeholder's opinion it would be very useful to have a collection of policy documents and a number of planning options to help him to identify what is needed first, and an inventory of modeling and simulation tools, assessment methodologies, frameworks and guidelines.

His ideal BGI tool would be an online platform not only meant for communication and capacity building, but also featuring GIS based modelling capabilities that would enable the simulation of the impact of BGIs.

4. IUCN	
ACTIVITIES	**1** Actions for bringing different BGI actors together. **2** Facilitating involvement of local groups. **3** Training actors on BGI approaches, Planning spatial implementation of BGI network. **4** Helps actors with available funding options. **5** Developing knowledge around BGI. **6** Interacting with different actors to create common ground.
OUTPUTS	**1** Scientific papers & reports. **2** Knowledge products & tools. **3** Platforms for knowledge exchange and interaction.
METHODS	**1** Scientific standards (https://www.iucn.org/theme/species/publications/standar). **2** Partnerships (https://www.iucn.org/theme/forests/about/partners). **3** Policy-frameworks (https://www.iucn.org/tags/work-area/cbd).
DEPENDENCIES	**1** Academia & Researchers provide expertise on species and ecosystems. **2** Private sector provides funding. **3** Local authorities of cities receive scientific guidance in the design of resilient cities. **4** Civil society and NGOs provide advocacy and implement solutions.
BOTTLENECKS	**1** Interaction between different BGI actors. **2** Language & terminology of available information lack a compatibility with others and a clarity. **3** Research not linked with policy objectives. **4** Research not linked with needs of practitioners. **5** Hard to advocate Intangible values of nature in decision making. **6** No effective labelling of available methods/tools. **7** Creating funding/incentives/business models for BGI is challenging. **8** Insufficient Economic integration of the proposed BGI solutions from perspective of natural capital. **9** Lack of clear (i.e. step-by-step) BGI implementation guidelines. **10** Lack of technical specifications for BGI. **11** Lack of awareness of BGI potential. **12** Conflicting policies on land management. **13** Lack of interdisciplinary knowledge in BGI projects leads strengthening of the latter bottlenecks.
FUTURE BGI MANUAL	**1** User interface: Online platform, Report/Manual. **2** Features: Technical guidance on BGI construction, Implementation guidance (step-by-step process), Standards & Specifications for different BGI solutions, Inventory of available methods, Best practice examples, Visual material, Links of BGI concepts with policy objectives, Benefit demonstration of BGI solutions, Business case options for developing BGI, Multi-SH relevance of selected content, Communication forums for exchanging knowledge & experience, Training workshops for communicating learnings. **3** Roles: Reviewer.

4. IUCN

This respondent is the European Programme Manager on Nature Based Solutions (NBS) at the European Regional Office of the International Union for Conservation of Nature (IUCN). She is the focal point for local and regional authorities for the project and also the author of the book 'Nature of Cities'. She directs the NBS project of IUCN, part of which involves the development of knowledge tools and scientific reports as well as creating the necessary platforms for exchange, learning and multi-stakeholder dialogues. As an actor operating on the interface between different scales and sectors, this stakeholder depends on various types of organizations in the pursuit of BGI related targets. She works closely with national governments, NGOs and civil society, but also increasingly with the private sector and practitioners from the extractive industry and financing. She also depends on academia and the scientific experts of the IUCN Commissions to provide and develop related knowledge. The produced output is then used to guide city network initiatives (100 Resilient Cities, ICLEI, C40) and urban developments to be more biodiversity-friendly.

According to the respondent, one of the biggest issues is the fact that natural capital is not part of the economic system, and this way, she argues, it is nearly impossible to give priority in decision making processes, budget planning of a regional government, of a city or a land manager. Awareness is pivotal. Moreover, she mentions the occurrence of contradicting subsidies as well as harmful effects caused by the subsidies given for land management. As there is lesser priority for maintaining intact nature spaces, this fragmentation has tremendous impacts on biodiversity all over Europe.

Another bottleneck can be identified in the fact that research is, most of the time, not carried out interdisciplinarily - hence reducing the use of scientific results in practice. Most of the times, in fact, real life problems can only be solved by cross cutting and multi-disciplinary teams and approaches, through shared language and terminology that facilitates interaction across different actors. This lack of interdisciplinarity hampers the integration of the value of ecosystems in water policies, health policies, and climate change policies. The amount of research available is so vast that it becomes too difficult to identify what is useful for practice.

According to this stakeholder, in order to guide practitioners advocacy is needed to signpost different methods according to purpose. On the other hand, she also points out that to some extent, BGI implementation is hampered by the challenge of creating a business model based upon nature that really fits with the current way of thinking among practitioners. The same applies to a national government when deciding how to fund investments in land and functionalities of land use. However, she also sees that at EU level, there is consistent funding available to be channelled into the implementation and upscaling of BGI, that currently lies unexploited. This is due to an overall lack of capacity on the local and national levels to apply for funding in such a way that fulfills the requirements.

Therefore, she would find it very useful to provide the necessary guidance to local actors on how to develop a BGI project in a way that can secure EU sourced funding. Further value could be added through raising awareness on potential funding sources for stakeholders that might not be able to tap into international frameworks and payment schemes. For instance, cities need clear technical guidance on how to implement NBS on the ground, what kind of maintenance it implies, which types of species can be applied, how investments can be directed towards BGI projects, how an investment plan can be developed, and what are the technicalities of such a process. Practitioners guidance, best practice examples, user friendly tools, inspiring videos and infographics are essential components in an ideal BGI tool according to this respondent. For the future, she imagines a platform that brings all these elements together in an interactive online manual, as well as workshops for training practitioners.

5. ISOCARP	
ACTIVITIES	**1** Bringing BGI actors together, and facilitating involvement of local groups. **2** Training local urban planners on BGI approaches and building alignments. **3** Planning spatial implementation of BGI networks globally. **4** Research support in developing urban plans around BGI.
OUTPUTS	**1** Publications. **2** Technical reports. **3** Planning guidelines. **4** Conferences. **5** Book on Green Cities.
METHODS	**1** Sustainable Development Goals. **2** The New Urban Agenda Guidelines. **3** International urban planning guidelines. **4** Planning for climate change.
DEPENDENCIES	**1** Local authorities provide location. **2** Public administration provides funding. **3** European Union provides funds and support in EU projects. **4** International Organisations (e.g. UN Habitat and Chinese Planning associations) provide urban plans and implement guidelines.
BOTTLENECKS	**1** Lack of interaction with different actors. **2** Administrative sectoral organisation of related government bodies. **3** Language & terminology in produced knowledge is not relevant for intersectoral implementation in cities. **4** Creating funding/incentives/business models on BGI is challenging. **5** Lack of legal framework around BGI that binds actors to take action and collaborate. **6** Lack of clear BGI implementation process (step-by-step guidance). **7** Lack of technical specifications on BGI solutions. **8** Lack of awareness on social, economic, and environmental BGI potentials. **9** Lack of information on and access to existing and active local network of existing BGI. **10** Difficult to access the Land for developing a BGI network and solutions. **11** Unfamiliarity of practitioners with the BGI approaches.
FUTURE BGI MANUAL	**1** User interface: Online platform. **2** Features: Technical guidance on BGI construction, Implementation guidance on the overall process, Standards & Specifications for different BGI solutions, Best practice examples, Links of BGI concepts with policy objectives, Benefit demonstration of BGI solutions, Multi-SH relevance of selected content. **3** Roles: User, contributor.

5. ISOCARP

The respondent above is an urban planner and landscape architect, member of the International Society of City and Regional Planners, and chair to the Habitat Professionals Forum. He has large experience in Urban and Regional Planning, Landscape Planning, Infrastructure, Environmental Management and Integrated Strategies. As a planner, implementing the BGI strategy on the ground through the urban planning process is his main task in the value chain. He is a practitioner, the recipient and user of any implementation material. He has several related academic publications, and has been involved in drafting technical reports, planning guidelines and a book on Green Cities. He identifies relevant dependencies on international organizations like the UN and the World Bank, as well as associations of urban planners. Additionally, he interacts frequently with local authorities and academia.

The main bottlenecks that he perceives for urban planners, is the lack of an effective implementation process in place, and that the available technical specifications cannot be standardized due to the differences the differences between different cities, peoples and contexts. According to this respondent, this is a multi-layered process and it is rather difficult to identify where a green corridor should be placed, at what stage should communities be involved or where are the investors. He acknowledges the fact that the municipalities will have the greatest influence, as they are the ones to take any decision on the development of cities, and at the end of the process this will always be a political decision. Due to this reason, he believes that legal instrumentation plays a key role. Furthermore, he argues that BGI information needs to fine-tune with the regulated planning instruments (land use plans, construction plans, transportation etc) through which an urban master plan is realized in order to be implemented in a city. Another main problem planners face is the access to land: while most of urban land is privately owned, it is the municipality who is usually responsible for building BGI.

From a solutions perspective, he would find valuable if someone could create a rule of thumb on how BGI can be effectively implemented, and provide an explanation on how this can strategically be planned. For example, the different steps for securing land, building up communities of interest and involve stakeholders, secure financial support, reward schemes and motivations for implementing BGI in a city's master plan. Moreover, he argues, it would be valuable to clearly highlight how BGI is connected to the SDGs, as they do have significant influence on how cities are currently planning their future development. Furthermore, better demonstrations of win-win examples of the various benefits of BGI are deemed useful, as these would provide more arguments to convince municipalities. The interviewee is frustrated by the separation, for instance, between water management and the management of green spaces in a city. Therefore, blue and green administration levels need to strengthen their interaction on a common platform. Finally, according to him solutions related with climate change, pollution, air quality, heat island effects, water management and quality of life are the most pressing focus areas today.

6A. GREEN SURGE/ REPRESENTED BY TECHNISCHE UNIVERSITÄT MÜNCHEN	
ACTIVITIES	**1** Research on planning, making and operation of BGI projects **2** Evaluation and assessing planning and impacts of BGI in various national and international contexts. **3** Research on ecosystem services provided by UGI elements such as trees, façade greening and roof greening **4** Communication and outreach through transdisciplinary events and conferences. **5** Engaging authorities/administration to create common ground through workshops and living labs. **6** Informing policy-makers on BGI impacts and practitioners on BGI approaches by providing academic training (e.g. summer schools). **7** Transdisciplinary international projects.
OUTPUTS	**1** Scientific papers & modelling tools on BGI performance in providing ESS (climatic and carbon storage, hydrological functions). **2** Guidance BGI planning handbooks & manuals (GREEN SURGE project: Urban Green Infrastructure Planning: A Guide For Practitioners; Guidance for Germany on green infrastructure planning, and BGI guidance from Center for Urban Ecology and Climate Adaptation (ZSK) of TUM.). **3** Workshops and conferences for researchers, policy-makers and practitioners for knowledge sharing & capacity building around BGI. **4** Dissemination of information to the wider public e.g. via radio interviews.
METHODS	**1** Spatial simulations & modelling as well as field research of ESS provided by BGI. **2** Case study research e.g good practice examples in municipalities. **3** BGI Planning and Governance handbooks from the GREEN SURGE project.
DEPENDENCIES	**1** Organisations (e.g. SLU Alnarp, Copenhagen University, University of Mainz) for carrying out joint research projects. **2** Environmental & Planning departments of City of Munich and Wurzburg are research partners and provide BGI relevant data on the city scale, receive analysed information for local development planning. **3** Bavarian Ministry of the Environment and Consumer Protection as well as the Federal Ministry for Education and Research and the Federal Agency for Nature Conservation provide funding and support research, receive information for policy planning and regional development. **4** Relevant EU instruments such as H2020, Interreg that fund and coordinate EU wide research.

6A. GREEN SURGE/ REPRESENTED BY TECHNISCHE UNIVERSITÄT MÜNCHEN	
BOTTLENECKS	**1** Communication issues between research and practice: ESS scientists are not well informed on what is needed and how they should supply this information. **2** Timing issues e.g. strictly planned research projects are at variance with erratic decision making processes. **3** Organisations in public administration that can create the right platforms for the different disciplines to collaborate do not exist. **4** Ensuring funding from regional and national authorities for BGI research is usually challenging. **5** Lack of legally binding framework around BGI that can coordinate implementation and commit actors. **6** Lack of local quality BGI standards on what is needed and how it can be generated by green-blue spaces. **7** Lack of proper local assessments and monitoring of the available urban green and blue space resources and the ESS they provide **8** Land access for developing a BGI network is not easy as most of the urban area is privately owned. **9** Unfamiliarity of practitioners with BGI approaches and lack of awareness of the potential of BGI on different sectors. **10** Data standardisation issues from sources on different scales that complicate systematic monitoring.
FUTURE BGI MANUAL	**1** User interface: Online platform, Report/Manual. **2** Features: Technical guidance on BGI construction, Implementation guidance on the overall process (step-by-step guide), Standards & Specifications for different BGI solutions, Links of BGI concepts with policy objectives, Benefit demonstration of BGI solutions, Modelling capacities for users at different experience levels. **3** Roles: User, Reviewer, Contributor.

6a. GREEN SURGE/Technische Universität München [1]

GREEN SURGE was collaborative project between 24 partners, coordinated by the University of Copenhagen. The overall focus of the project was on on how Urban Green Infrastructure can contribute to a sustainable future for cities by addressing major urban challenges. This respondent is a professor and Chair for Strategic Landscape Planning and Management at the Technical University of Munich. His main activities around BGI include the development of new knowledge and scientific papers, related tools (e.g. for modelling and assessment), as well as guidance manuals and practical handbooks for BGI planning. This researcher covered the role of the project coordinator of GREEN SURGE in its final year. He is active in scientific policy advice and particularly interested in developing transdisciplinary research to find ways to deploy related knowledge on the ground. To this end, for his BGI operations he collaborates with departments at other universities and research institutes for developing research, departments from local authorities (e.g. City of Munich) and public administrations (e.g. Bavarian Ministry of the Environment and Consumer Protection).

Having an in-depth view of the BGI implementation process, this stakeholder mentioned a few serious bottlenecks at various levels that he has experienced over the years. He identifies an overall lack of effective communication and collaboration between research and practice that hampers the flow from knowledge to implementation. Different time frames cause strictly planned research projects

1. In this analysis, the Copenhagen University-led GREEN SURGE research project was represented by two researchers from TU Munchen, who covered leading roles at the time of the project. In their responses, the researchers provided their personal experiences and opinions as Green Infrastructure experts - which might not be representative for other GREEN SURGE researchers, and go beyond experiences from within GREEN SURGE.

to be at variance with erratic decision making processes. Besides, the scope of flexible approaches to transdisciplinary projects seem not long-term enough. A lack of useful information on what BGI implementation requires those doing the assessments, is perceived. Therefore, ES scientists are not well informed on what is needed and how they are expected to provide this information. Planners and other urban decision makers, however, may know what kind of information is needed as it needs to steer their planning systems, regulations and initiatives. However, they are often tightly bound into administrative systems that leave little room for looking outside the box and take risks, e.g. by adopting innovative BGI. A possible way to produce insightful results could be an approach where research is co-designed with inputs from policy makers and practitioners on a common platform, in order to make it fit to regulatory operations. According to this respondent, BGI is, by definition, an attempt for integrated planning to combine grey infrastructure - i.e. planning, roads, sewage systems - with green space planning. But this approach can only take place if also forms of organization in public administration are integrated, creating the right platforms for the different disciplines to collaborate. He also acknowledges that the regulatory instrumentation will be a decisive factor, and wishes to see BGI implemented in other policy sectors as a requirement. However, the technical aspect is also problematic, as a lack of proper assessments of the urban green and blue urban space resources is perceived. There is not enough knowledge on what is where, what are the dynamics of these resources, what are the ES and the overall value they provide, with information on supply and demand.

From a future development on BGI implementation, he would like to see convincing narratives in the form of guidelines that are not just "cook books", but are adaptable and flexible enough to support tailoring locally specific BGI development. From a technical aspect, not only he would find extremely useful to have models that can be easily applied in planning situations (e.g. for scenario workshops), suggestions for standards, and BGI design specifications, but also policy relevant data to facilitate implementation. Ideally, this tool would consist of an online platform.

6B. GREEN SURGE/ REPRESENTED BY TECHNISCHE UNIVERSITÄT MÜNCHEN	
ACTIVITIES	**1** Carry out research: research on ecosystem services, green infrastructure and nature-based solutions (national and European). **2** Training and capacity building: lectures and presentation on green infrastructure in different European countries. **3** Communication & Networking by contributing to conferences and other expert events. **4** Teaching at universities (lectures, workshops and studios with architecture and urban planning students). **5** Facilitating stakeholder engagement through action research with different European cities and other stakeholders.
OUTPUTS	**1** Scientific reports and peer reviewed papers on BGI. **2** Guidelines on green infrastructure. **3** Massive Open Online Courses on related subjects. **4** Spatial data on green infrastructure in different cities; design proposals, e.g. for nature-based solutions. **5** BGI research projects on forest based adaptation to climate change, energy production, aesthetic quality (Urban Forest Laboratory, Cologne).
METHODS	**1** ESS assessments. **2** Geospatial analysis and modelling. **3** Literature review (e.g. Science Direct, Google Scholar). **4** Recommendations from ResearchGate & colleagues. **5** Search engines (e.g. google). **6** Newsletters (e.g. from Publishers). **7** Planning guidelines (e.g. books and reports on BGI). **8** Adobe Creative Suite
DEPENDENCIES	**1** Spatial Planning and Design Research Institutions (e.g. **2** Urban Planning, Regional Planning, Agriculture). **3** Planning practitioners in local urban authorities. **4** NGOs and Capacity building organisations (e.g. City networks).
BOTTLENECKS	**1** Terminology: too many similar terms, used in different ways. **2** Too many different (and established) traditions of landscape planning, landscape architecture and environmental planning. **3** Complexity of the topic (no concept can fully embrace all task and issues related to urban green spaces). **4** Very challenging to upscale BGI solutions.
FUTURE BGI MANUAL	**1** User interface: Online platform for cooperative and integrated research approaches. Printed & Digital Manual. **2** Features: Flexible guidelines, Clear conceptual frameworks, Tools, Good practice case studies, Design examples. **3** Roles: Reviewer; Contributor.

This stakeholder was not interviewed after filling in the online questionnaire.

7. WELSH GOVERNMENT - PLANNING DIVISION	
ACTIVITIES	**1** Governance of policy development of BGI at national scale. **2** Evaluation of policy implementation. **3** Monitoring of policy performance. **4** Planning policy strategy. **5** Stakeholder engagement: interacts with different government sectors and the public to aid implementation.
OUTPUTS	**1** National Green Infrastructure policy. **2** Policy implementation guidance documents.
METHODS	**1** Specialist sectoral guidance e.g Landscape Institute. **2** NGO guidance. **3** National government guidance. **4** lower tier government steer/requests. **5** Ministerial steering/preference.
DEPENDENCIES	**1** Academia & Research (NRW) for providing scientific knowledge that can guide policy planning. **2** Local authorities are the receivers of the strategy and need to provide feedback on implementation. **3** Civil society & NGOs provide input for drafting strategy and advocate for implementation.
BOTTLENECKS	**1** Time framing of research development and practice needs do not align. **2** Research is not linked with policy objectives. **3** Research not linked with the needs of practitioners. **4** Not enough guidance for practitioners to choose from available methods according to purpose. **5** Lack of awareness of BGI potential in different sectors. **6** Unfamiliarity of practitioners with BGI approaches delays implementation and upscale.
FUTURE BGI MANUAL	**1** User interface: Online platform, Report/Manual. **2** Features: Technical guidance on BGI construction, Implementation guidance on the overall process (step-by-step guide), Standards & Specifications of different BGI solutions, Guidance in selecting appropriate methods according to purpose, Best practice examples, Links of BGI concepts with policy objectives, Benefit demonstration of BGI solutions, Multi-SH relevance of selected content, Communication forums for exchanging knowledge & experience. **3** Roles: Contributor.

7. Welsh Government - Planning Division

This respondent is a Planning Policy Officer at the Planning Department of the Welsh Government (WG). She is the policy lead within the Welsh Government Planning Team (town and country planning) for GI. Her work aims to develop (and is responsible for) policy on behalf of Government Ministers to steer policy on GI within the planning system in Wales. Her main function is policy development, and apart from drafting the national policy on GI her organization also publishes policy implementation guidelines for local authorities and other stakeholders for GI implementation on the national level. In addition, she is the key contact for all GI related issues in the WG.

The main dependencies of this stakeholder come from 3 different domains. First, she is very dependent on the statutory environmental advisor - the NRW, to provide the relevant scientific information that will constitute the basis of the policy development. Furthermore, she frequently interacts with different departments and speaks along with key individuals working on related policy areas across governments both in Wales and nationally. Moreover, as part of her policy implementation activities, she is working closely with officials from local authorities (as in, the recipients of the strategy) to receive feedback on the policy implementation process.

The main bottlenecks identified by this stakeholder at the policy end of the process are caused by the completely different realities of research development and policy planning. Policy makers operate within political cycles (5 years in Wales) which hardly ever align with the progress and the process of scientific research. The contrasting timeframes appear to be very problematic for planning policy: this also relates to the ability of research to provide the information correctly when required by policy but also, the degree to which this information is delivered in a way that it is ready for use in the policy planning process. These issues can be addressed by creating a platform where scientists can co-design research together with policy makers, in such a way that the related policy objectives are met. The stakeholder also acknowledges that for a number of reasons some authorities are not familiar with BGI approaches, and that policy strategies can take up some time to bed in. Aiding practitioners to navigate through policy areas and articulate the wider benefits of BGI approaches would certainly help them to better negotiate along decision making.

From a future BGI implementation development, this stakeholder would like to see more effective sign posting of the different methods, some technical specifications, route mapping and examples of best practices. Also, clear links of research to national administration priorities and other sectorial policy objectives. She would also find a forum feature highly useful, for the sake of more effective policy-research interaction and communication of information.

8. ANONYMOUS EUROPEAN INSTITUTION	
ACTIVITIES	**1** Creates platforms to bring together governments, private sector, NGOs and civil society (e.g. GI & ecosystem restoration working group, Biodiversity & Business working group). **2** Engages with different stakeholders to create common ground through meetings, published documents and web channels. **3** Facilitates involvement of local groups through inclusivity and transparency in strategy development, Education: training representatives of member states on BGI approaches. **4** Evaluation of policy implementation on the European level. **5** Monitors policy performance against objectives and targets. **6** Helps actors with available funding options through related instruments. **7** Governance of policy strategy development on the European level. **8** Planning policy strategy.
OUTPUTS	**1** Green Infrastructure Strategy. **2** Policy reports and documents. **3** Green Infrastructure strategy implementation guidance documents. **4** Material to raise awareness. **5** Working Group on Green Infrastructure.
METHODS	**1** Call for information - policy monitoring. **2** Reporting databases. **3** Gathering of expert opinions.
DEPENDENCIES	**1** Academia & Research provide scientific knowledge to inform planning of strategy, receive funding, and support on international projects. **2** Private sector is involved in strategy planning and receives guidance on how to be involved. **3** Public administrations as addressees of strategy need to take action and report on implementation. **4** Civil society & NGOs advocate and support strategy receive support for local initiatives.
BOTTLENECKS	**1** Data standardisation issues from sources of different scales to fit tools. **2** Timeframes of research development and policy planning do not align. **3** Administrative sectoral organisation of related government bodies. **4** Creating funding/incentives/business models for BGI is challenging. **5** Hard to pinpoint economic contribution of BGI. **6** Lack of legal framework around BGI such as directive or regulation. **7** Lack of awareness on BGI potential in different sectors. **8** Lack of information on existing BGI network locally. **9** Unfamiliarity of practitioners with BGI approaches delays implementation and upscale.
FUTURE BGI MANUAL	**1** User interface: Online platform. **2** Features: Benefit demonstration of BGI solutions, Business case options for BGI solutions, Multi-SH relevance of selected content, Communication forums for exchanging knowledge & experience **3** Roles: Contributor.

8. Anonymous European institution
The above respondent is a biodiversity policy officer. She focuses on the implementation of GI Strategies on the European level, and her function around BGI is policy conception, design and implementation. These also include BGI project support regarding ecosystem services in decision making.

Along this task, this stakeholder depends on a number of actors from different sectors. First, she is critically dependant on the academia, the statutory research. Also, other inputs of scientific information come from related research-oriented institutions or projects. Their work is mainly guided by science, as they try to mainstream scientific information in the further development of policy commitments. Moreover, she works closely with relevant public administrations of different states for strategy implementation. Such administrations provide information that can reflect the current situation in regard to the achievement of policy objectives and obstacles that hinder implementation. Furthermore, she cooperates with the private sector and businesses, civil society and various NGOs. This stakeholder manages to directly interact with all the different actors through the working group on GI and Ecosystem Restoration, which holds meetings regularly. Each time a new step in the implementation of EU GI strategy is taken, she consults and informs this group.

From the perspective of a policy planner, among the key bottlenecks the interviewee mentions the lack of legislation, directive, or regulation on BGI. Therefore, due to the lack of reporting requirements states are not compelled to report on their strategies. There is no strict or elaborated monitoring system in place, so the institution is reliant on the good will of governments and other stakeholders to report in order to track the implementation process. This creates an issue with data compatibility because states apply different data collection methods for what is not covered by reporting obligations. Therefore, there is no compatibility between tools in place to deal and treat this data. She acknowledges space for progress towards more harmonised methods for data collection. In addition, the need for developing standards on BGI technologies that can be adopted at the European scale is highlighted. However, despite her attempts to initiate activities towards this goal, the interviewee feels that her capabilities are limited since this lies within competence of other bodies.

9. WELSH GOVERNMENT- ECOSYSTEM MANAGEMENT AND IMPLEMENTATION	
ACTIVITIES	**1** Communication-Networking with stakeholder events. **2** Promote biodiversiy and ecosystem management to public authorities **3** Production and oversight of Natural Resources Policy - which includes BGI **4** Funding of GI projects **5** Governance of the policy context. **6** Planning national BGI policy. **7** Stakeholder engagement to facilitate wider BGI implementation at the national context.
OUTPUTS	**1** Legislation: Environment (Wales) Act Well being of Future Generations Act, SUD's legislation. **2** Policy strategies: Natural Resources Policy; Planning Policy Wales. **3** Policy guidance documents: Guidance for Public Authorities on their S6 Biodiversity and Resilience of Ecosystems Duty.
METHODS	Not specified
DEPENDENCIES	**1** Academia & research (NRW) for providing scientific knowledge to guide policy planning. **2** Local authorities and public administration implement the strategy and provide feedback on implementation. **3** European Union provides EU strategy and receives information for policy monitoring. **4** Civil society and NGOs advocate and support strategy and receive support on local initiatives.
BOTTLENECKS	**1** Different relevant government departments need to communicate more effectively. **2** Language & terminology used might be confusing. **3** Research is not linked with policy objectives. **4** Research is not linked with the needs of practitioners. **5** No guidance for practitioners to choose from available methods. **6** Creating funding/incentives/business models around BGI is challenging. **7** Insufficient integration of the economic contributions of BGI solutions. **8** Hard to upscale and maintain solutions in the long term.
FUTURE BGI MANUAL	**1** User interface: online platform. **2** Features: Inventory of available methods, Guide for selecting appropriate methods according to purpose, Visual material, Links with (Welsh) policy objectives, Business case options. **3** Roles: User, Contributor.

This stakeholder was not interviewed after filling in the online questionnaire.

10. VOLKERWESSELS	
ACTIVITIES	**1** Designing infrastructure (e.g. roads). **2** Financing infrastructure development projects, as well as Implement. **3** Monitoring and Operating.
OUTPUTS	**1** Digital repository with Reports and SOPs on infrastructural development, impact assessment of the design. **2** Physical: Waste-water treatment project: e.g. Biopolus
METHODS	Not specified
DEPENDENCIES	**1** Universities support research on infrastructure. **2** Dutch Ministries and private actors assign projects as clients.
BOTTLENECKS	Not specified
FUTURE BGI MANUAL	Not specified

This stakeholder was not interviewed after filling in the online questionnaire.

11. INFRASTRUCTURE COMPANY	
ACTIVITIES	**1** Designing BGI and plan the development of physical BGI. **2** Implement physical Outputs. **3** Monitor of BGI performance. **4** Operate and manage a physical BGI solution. **5** R&D around BGI knowledge. **6** Providing funding for BGI.
OUTPUTS	**1** Scientific papers. **2** technical (industry) guidelines on BGI implementation. **3** Check-lists of the clients.
METHODS	**1** Biodiversity Net Gain. **2** Ecological Impact Assessments. **3** UK good practice principles. **4** OP standards.
DEPENDENCIES	**1** Academia & Research provide latest know-how on BGI. **2** Private sector provides the project (e.g. real estate development). **3** Public administration assigns infrastructure projects and finances for realisation of infrastructure (e.g. roads). **4** NGOs participate in the conservation projects and receive funds for BGI as an offset of impacts in infrastructure developments
BOTTLENECKS	**1** Lack of collaboration between different stakeholders. **2** Data standardisation and compatibility issues. **3** Research publications are not linked with practitioners needs. **4** Hard to advocate for Intangible values of nature in competitive decision making process. **5** No sufficient guidance on which methods to use, and when - to address local problems and opportunities of BGI projects. **6** Hard to pinpoint contribution of BGI to the economy. **7** Lack of information on available resources and network for local realisation of BGI projects.
FUTURE BGI MANUAL	**1** User interface: Online platform, Software. **2** Features: Standards & Specifications for construction of BGI, Inventory of available methods, Guidance to choose appropriate methods. Access to the selection of best practices in BGI realisation. Links of BGI designs with policy objectives. Demonstrate the benefits of BGI solutions. Enable communication forums between practitioners for exchanging knowledge and experiences. **3** Roles: User, Contributor.

11. Infrastructure company
The respondent's role is to design, plan and implement infrastructure projects currently focusing on transportation infrastructure.

The respondent's primary relationship with other stakeholders is with the sustainability experts of client organizations. Together with them, she plans projects according to her client's needs - which do not always include BGI solutions. The client's drive is the baseline for designing the project. The respondent has witnessed a great improvement in the way the infrastructure and construction industries operate in regards to impacts on nature. This improvement was a result of the Biodiversity Net Gain, a scheme introduced in the UK that aims to make any development to have neutral biodiversity loss at worst. This is achieved through a hierarchical mitigation approach, where developers strive for the best plausible solution. When limited mitigation measures are in place, it is possible to offset impacts by funding local biodiversity groups. The policy has facilitated an exponential increase of the respondent's clients who want to apply this method, particularly among large infrastructure projects. It made remarkable improvements in the interaction of the sector with the vibrant activity of biodiversity-focused organizations in the country which has traditionally been tense and strongly disconnected. This has given the opportunity to collaborate, as the allocated funds are expected to demonstrate outcomes so the two worlds are encouraged to collaborate. In the respondent's opinion, this is where the true legacy lies. She also recognizes that not always it is possible for the infrastructure sector to integrate BGI concepts within their projects. For example, trees cannot stand next to a railway, due to maintenance and safety constraints. However, other specific infrastructures can be affected by flood risks and deteriorated air quality. In these cases, BGI can offer valid alternatives to grey infrastructure: the respondent believes that these issues provide a window of opportunity for integrating alternative approaches. Moreover, she sees great potential in the housing sector as BGI can have a direct impact on house prices and the value of the land.

One of the main bottlenecks she is experiencing is the little (or non existent) connection between academic literature and practice, due to the different vocabulary it is usually delivered. Also, having robust quantifications and economic evaluations of ecosystem services is essential for integrating such concepts in the infrastructure sector. This is especially true due to the need for a representative estimate on the amount that an organization has to make available to biodiversity groups for conservation/ restoration purposes. From the respondent's experience, every time she is asked from a client to do Natural Capital accounting, the interest of the client lies on monetary values. Therefore, from a contractor's point of view, monetary valuation is key.

Furthermore, the respondent believes it is very important for new approaches to follow the existing processes of the industry, and to be aligned with the way sector practitioners carry out their activities. A common problem she identifies is that the data used to undertake NCA are usually tailored to the national level. Therefore, these data cannot be used by the respondent in her particular project. This usually leads to improvisations, assumptions and uncertainties, while she believes that practitioners should manage to pull these data out and use them directly. She also finds the plethora of different strategies and policy plans from governments confusing, as it makes it harder for the industry to get involved.

A future BGI development would be useful for the respondent if it provides checklists and other practical tools that practitioners can use such as decision making trees, flow diagrams, case studies, and standards.

ANNEX IV
CATEGORIZED STAKEHOLDER PROFILES

ANNEX IV - CATEGORIZED STAKEHOLDER PROFILES

This annex outlines the key findings observed when grouping the 11 shortlisted stakeholders into three sectors:
Researchers, which includes the knowledge institutes and the GREEN SURGE project.
Decision-makers, which includes the governmental entities.
Practitioners, which includes the landscape architect and construction sector.

These tables represent repetitive sector-specific opportunities and bottlenecks, as well as a more elaborate explanation. The columns are divided in the following parts:

- The **Activities & Outputs** sections describe the ways these stakeholder sectors engage in BGI, and are strongly related with their role in the ecosystem with other 11 stakeholders.
- The **Bottlenecks** refer to the common problems in daily routine of a specific sector.
- The **Requirements** outline the solutions for overcoming the bottlenecks and improving the BGI experience (i.e. daily routine, activities).
- The **Indicators** explain the frameworks and the associated metrics used by the stakeholder sectors in research, design, evaluation and/or implementation of the BGI-related projects.

RESEARCHERS	
ACTIVITIES & OUTPUTS	**1** Publishing scientific papers on BGI case-studies (solutions) and methodologies for design and evaluation, research in the projects. **2** Development of digital tools for modelling, simulation and visualisation of BGI cases; and manuals & guidelines. **3** Innovation and data generation, public engagement and workshops, support in business case design. **4** Methodologies for research & evaluation, technical descriptions and manuals on how to construct and operate BGI. **5** Developing digital solutions to support research and decision-making. **6** Involved in building physical BGIs.
BOTTLENECKS	**1** No channels for effective collaboration with public authorities, policy-makers and researchers on the ongoing basis. **2** Administrative & sectoral organisation of land ownership. **3** Lack of transdisciplinary approaches. **4** Lack of engagement with finance sector. **5** Integration of economic indicators, conflicting policy frameworks, no transdisciplinary approaches. **6** Existing pool of knowledge (e.g. manuals, publications) lacks standardisation and compatibility on levels of terminology, geographical context, etc. **7** Lack of legislation that can commit actors to connect the blue-green network or to look for innovative solutions to manage space and resources.
REQUIREMENTS	**1** Knowledge application channels. **2** Co-design research with practice. **3** Business models, training & engagement platform. **4** Technical guidance on BGI construction, for example, a green wall. **5** Standards & Specifications for different BGI solutions (e.g. green roofs, rain gardens). **6** Links of proposed BGI conceptual designs to the policy objectives and city plans. **7** Demonstrate the benefits of BGI solutions for better argumentation. **8** Modelling capacities for users at different experience levels that can be easily applied in different contexts.
INDICATORS	ESS, mass flow, social and techno-economic indicators, IUCN lists (e.g. threatened species), biophysical indicators, sensor data.

DECISION-MAKERS	
ACTIVITIES & OUTPUTS	**1** Policy strategy planning at national and european levels. **2** Developing strategy implementation documents for various stakeholders. **3** Monitoring of policy performance against objectives through reporting process.
BOTTLENECKS	**1** Different time frames of research development and policy process. **2** Communication with research as to what is relevant to policy objectives. **3** The language & terminology used can be confusing. **4** EU competence around BGI is limited due to the lack of a directive or regulation.
REQUIREMENTS	**1** Clear links of BGI project objectives with policy objectives and needs of practitioners. **2** Guidance in the selection of appropriate methods according to the practitioners needs. **3** Demonstration of benefits to articulate better argumentation in decision making process.
INDICATORS	ESS, SDGs, EU legislation (i.e. surface water discharge rates and concentrations) (e.g. COD), Policy monitoring indicators (e.g. performance against policy objectives).

PRACTITIONERS	
ACTIVITIES & OUTPUTS	**1** Development of the the city (masterplan)- and landscape planning guidelines, technical reports and urban development plans. **2** Turn-key (A-Z) realisation of the infrastructure projects. **3** Development of impact assessment reports. **4** Direct implementation of BGI in some infrastructure projects.
BOTTLENECKS	**1** Lack of communication between different relevant sectors in the urban planning context. **2** Language & terminology of other actors are confusing. **3** Lack of legal instrumentation that commits different actors to take action. **4** Volume of policy strategies is hard to grasp and stay updated. **5** Technical constraints of the client project requirements **6** Insufficient incentivisation for local administrations and individuals to implement BGI.
REQUIREMENTS	**1** Clear BGI design and implementation process (from A to Z). **2** Align research with applied planning standards of practitioners from different sectors. **3** Demonstrate the benefits of BGI to articulate better argumentation. **4** Communication hubs between sectors that can co-design, implement and maintain BGI solutions. **5** Guidance for adaptation of the ongoing and new infrastructure development projects to the legal BGI requirements and frameworks. **6** Easy-to-use framework for monetary valuation of BGI projects and their contribution to the clients' developments.
INDICATORS	Land-use types, spatial arrangement of land elements, SDGs, urban planning agenda (targets), urban master-plans, ESS, economic valuations of BGI, impact assessment reports, infrastructure performance indicators.

ANNEX V
RESEARCH KEYWORDS

ANNEX V - RESEARCH KEYWORDS

The table below presents the keywords and an example of the data-search formula. Group 1 was applied in the general search of the repositories. In case the repository was relevant to BGI data, the second and the third group of keywords were applied to expand the relevant research results; i.e BGI Methods and BGI Solutions.

Table 1 - The key words and combinations for screening the sources.

GROUP	KEYWORDS	NAME			
1	CORE KEYWORDS	Blue	Green	Infrastructure	Biodiversity
	DATA-SEARCH FORMULA	(Blue*Green) OR (Green*Blue) OR ("BGI") And (Infrastructure*)			
2	PRIMARY COMPLEMENTARY KEYWORDS	Water, River, Storm, Stream, Climate, Discharge, Runoff, Retention, Climate	Park, Forest, Flower, Farm, Agriculture, Wetlands	Security, Services, Streets, Pavements Roads, Highways, Building, Industry	Animals, Birds, Mammals, Insects, Pollination, Flora, Fauna, Wildlife, Habitat, Species
3	SECONDARY COMPLEMENTARY KEYWORDS	Roofs, walls, surface, bioswales, Blue Green Networks, natural based solutions urban forestry, patches, corridors, purification, management, alien, reed bed, Europe			

ANNEX VI
EVALUATION OF CRITERIA

ANNEX VI - EVALUATION OF CRITERIA

Each BGI Precedent in the long list was evaluated on each criterion:

3 for high performance /relevance.
2 for medium performance.
1 for low performance.

The sum of the 4 criteria in each precedent provided an overview for the final selection of BGI Methods and Solutions out of the 196 precedents in total that exist in the longlist. The criteria used for the selection of the most Prominent BGI Methods and Solutions.

CRITERIA	EXPLANATION	RANKING OF CRITERIA		
		1 LOW RELEVANCE	2 MEDIUM RELEVANCE	3 HIGH RELEVANCE
TECHNICAL DETAILS	Design, construction and operation data for BGIs.	Only simple Data or not at all.	Some data exist in relation to technical details but not detailed mentions.	Photos and schemes, step by step strategy or implementation methods. Mathematical formulas, tactics and practices are apparent.
MULTI-FUNCTIONALITY	The capacity of a precedent to present data for one or more benefits related to society, economy and environment.	It does not provide in depth information for the multi-functionality of a BGI.	It presents the benefits of a BGI in at least two aspects out of three.	It fully covers and presents the benefits of a BGI for society, economy and the environment.
DESIGN SCOPE	The depth of information in relation to scale of spatial planning for BGIs.	It does not consider the scale. No information for local, environmental and geographical conditions.	Information for local environmental and geographical conditions are there but not linked with the spatial scale.	Clear spatial planning description of the BGI precedent.
BIODIVERSITY	Values the inter-relationship between BGIs and biodiversity.	Just mentioned or not mentioned at all.	It is mentioned or taken into account either as mean or as a beneficial outcome.	Biodiversity considered important and is strongly mentioned within the precedent.

ANNEX VII
PERFORMANCE INDICATORS

ANNEX VII - PERFORMANCE INDICATORS

The following indicators were used for all BGI precedents:

INDICATOR	DESCRIPTION
NAME	Title of a BGI precedent.
TABLE	Identification number used for search in the excel sheets.
YEAR	When BGI precedent is created or published.
OWNER	Who owns the precedent.
DOMAIN	Whether precedent is performed in the domains of water, green, infra-structure or biodiversity.
PROBLEM	Main challenge addressed by the precedent.
OBJECTIVE	Main goal of the precedent.
TARGET USERS	Main users of the platform.
ROLE	Key values of the precedent.
FUNCTIONS	Main functions of the precedents.
OUTPUTS	Main data, products and/or services produced by the precedent.
DATA REQUIREMENTS	Which data was used as input in generating an outcome.
BGI SCALES	Scales of the BGI Method and Solutions researched or developed using this precedent.
ACCESS	Whether a platform requires registration, payments, or other, and if the data is fully-available or not.
OPERATION	What make this precedent running, legislation, collaborations, etc.
USER EXPERIENCE	Level of experience necessary to use the precedent, the ease-of-use, graphic presentation of outcomes, and the performance. It also reflects on the general layout, presentation and visualization of a BGI Precedent.

"Coming together is the beginning,
keeping together is progress,
working together is success."

› Henry Ford