SUSTAINABLE INFRASTRUCTURE – THE FORGOTTEN DIMENSION

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Abstract: Sustainable development is the *sine qua non* of our times. The definition of sustainability is widely repeated and is generally agreed to incorporate environmental, social and economic aspects. However, when we look at projects around the world which seek or claim to be sustainable, we find that not all of these aspects are treated equivalently. Issues which are enshrined in legislation or policy are dealt with most effectively, as are matters which can be readily measured, such as energy usage. Some of the environmental and social aspects, however, are difficult to quantify and are often overlooked. In this paper, I outline a technique for a more holistic approach to sustainability, with particular reference to the management of biodiversity and ecosystem services in major infrastructure projects.

1 Introduction

Delivering sustainable developments is no longer an option; it is an essential requirement the world over. This recognises not only the environmental imperative for making better use of finite resources and reducing carbon emissions, but that the correct approach to sustainability reduces development and whole life costs. More importantly, people are finding that sustainable developments are good places to work and live in and can bring a range of local benefits throughout the development cycle.

It is projected that over the next 20 years, China will add 350 million more people to its cities – more than the entire population of the USA (MGI, 2008). Time is running out to tackle the impediments to truly sustainable development as new urban infrastructure developments have long lifespans and will put pressure on available resources for an extended period (Kennedy *et al*., 2009). The pressure of climate change adds a further imperative to develop solutions that will allow communities to thrive within the design limits of planned developments (Barron, 2009). To achieve this goal requires a large number of

interlinked activities to be visioned, planned and more importantly delivered on the ground within an economic framework that recognises the current market conditions. Past approaches have been inflexible and focussed on buildings or other sub-elements of the overall development. It is clear that sustainability must be integrated into entire projects and "owned" by the engineers tasked to deliver the infrastructure.

2 "The Hyder Heartbeat"

Sustainability assessment is gaining importance in decision-making, but it is not a separate issue that can be considered only at the start of a project in a way that is divorced from the reality of detailed design and construction processes. Ng & Hui (2007) identified significant barriers to the application of sustainability assessment at the regional planning level in the Pearl Delta region of China, citing institutional fragmentation and competing development objectives. The effectiveness and relevance of sustainability appraisal is also severely limited when it is applied as a post-hoc assessment.

It is also important to recognise that the requirements of the developer, whether public or private sector, need to be taken into account in this process and that the project outcome must meet their priorities within practical constraints including budgets. This is of particular importance in times of economic change and fiscal restraint.

Whilst there have been few attempts at integrated sustainability assessment throughout whole project lifecycles, there are a wide range of tools available for assessing "green buildings". Tools such as HK-BEAM, LEED and BREEAM are widely used around the world, and while they serve to promote green design features in developments (primarily through energy efficiency, water efficiency and indoor environment quality), they do not necessarily promote the most sustainable outcome. In general existing sustainability tools have:

- Strong buildings focus with little or no consideration for the broader topics of urban sustainability or how these might be integrated to deliver a better outcome.
- A disconnect between the sustainability assessment, the final engineered solution and what can practically be achieved on the ground.
- Been almost forced onto the development process rather than being an organic, integral part of it.

- A retrospective focus to the process, measuring what has already been done and not driving what could be done.

- Accreditation rating mechanisms that are broad brush and are therefore often not focussed, relevant or realistic to the specific region or development in question. This gives rise to the potential for completely inappropriate activities and construction components to be undertaken just to achieve a "good" sustainability score.

- Rating mechanisms that require the user to apply the process to each individual project (or building) within a development. While it is absolutely critical that each project is considered in its own right, this approach means that lessons learnt are not recorded and applied where relevant to future projects. So each new project starts all over again, effectively discarding valuable information.

- No clear mechanism to overcome the disconnect between the technical solutions to sustainability and engagement from the community in which they are to be applied, especially in the area of community engagement to achieve the critical behavioural and cultural changes that are often required.

- Binary outcomes that fail to adequately reward incremental improvements

Our approach to these deficiencies has been to develop a more holistic assessment tool that utilises all of the relevant dimensions of sustainability, not just those that can be easily scored or measured (Wray *et al*., 2009). As our approach is designed to serve the lifeblood of the community we call it the Hyder Heartbeat.

The Hyder Heartbeat provides the framework for assessing the integration of sustainability considerations into any development and then measures the results that have been achieved. To enable delivery of genuinely sustainable projects, current standards and methods were assessed and reviewed critically. Guidelines and principles were established and arranged in the form of a toolkit that aligns practical engineering and commercial/budgetary requirements with the best sustainable/ environmental outcomes. The relevant criteria were developed in association with our own sustainability experts, environmental experts, engineers, academia, accreditation organisations, and expert consultancies. We have also included a third-party validation process offered through any credible accreditation body. In the UK, we employ the UK-based Buildings Research Establishment (BRE) for this purpose.

All components of master planning are integrated and managed via the Hyder Heartbeat framework, including the engineering design associated with the Master Plan. The Hyder

Heartbeat is divided into ten key areas to control information flow, communicate a holistic approach, and guide project management. The key areas comprise the following:

At the outset of a project, we build a bespoke model using these ten dimensions of sustainability. The relative importance or weighting given to each dimension will vary depending on the project, from no relevance (or something we cannot control) to of over-riding importance for that project.

Our scoring framework measures achievement in each of the sustainability categories identified by the toolkit. This approach enables scoring throughout the design stages and after project completion. In addition, scores in each of the categories allow for comparisons between projects and for data to be accumulated and carried forward to future projects. This

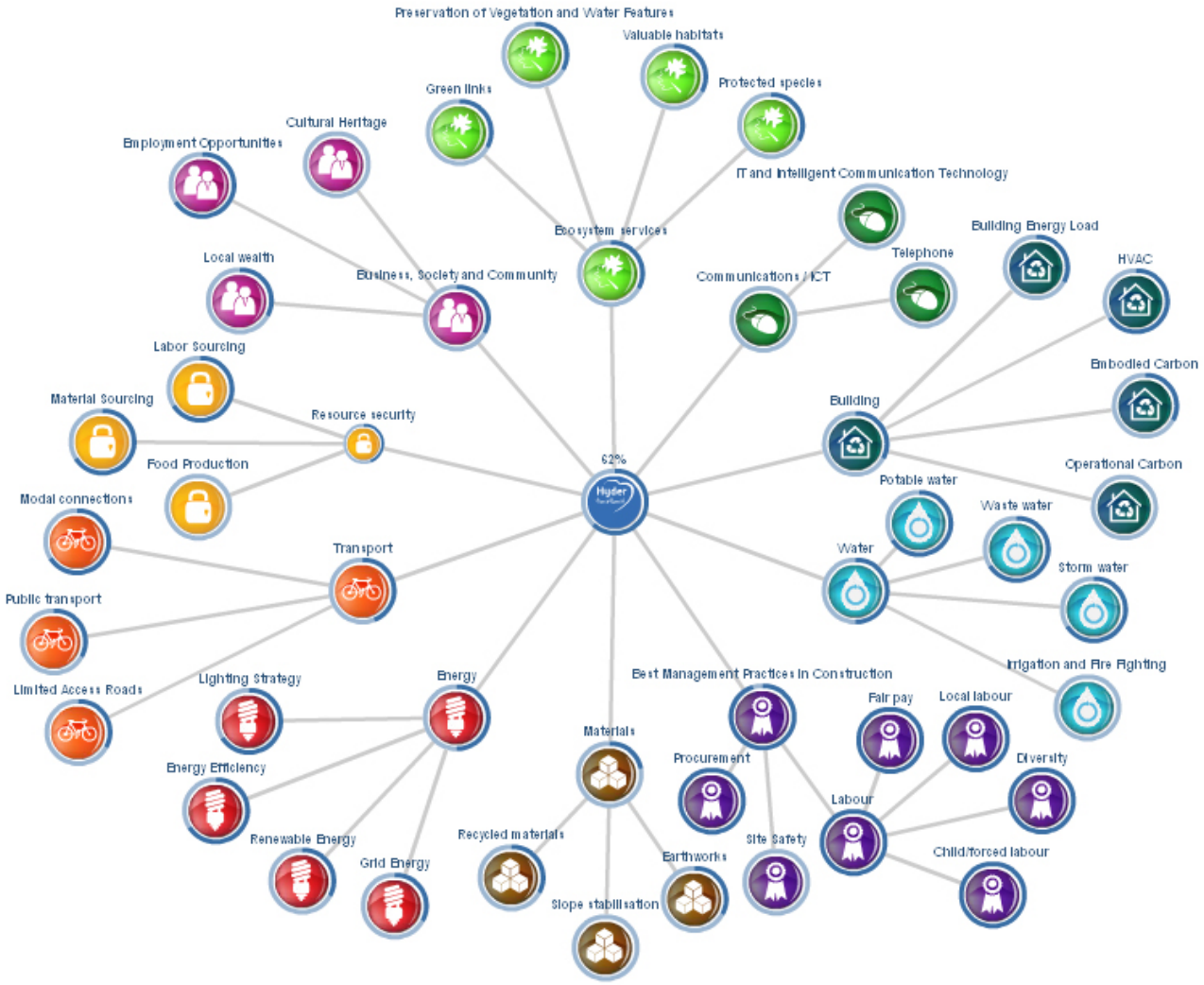
is because we are measuring the delivered project against the agreed best practically achievable outcome rather than an ideal score.

This means that the toolkit is capable of learning, can be continually updated as changes in technologies, approaches, funding mechanisms etc occur. A further benefit is that economies of scale are developed which can be applied to future projects meaning that we are ahead of other assessment tools not only in terms of functionality but also in terms of time and money. All of the Hyder Heartbeat components are independently validated at the end of the process.

Because of this flexibility of approach, we can also use the Heartbeat to retrospectively appraise finished projects to identify where improvements can be made in subsequent developments.

In practice, our chosen categories of sustainability considered in synchronisation results in a continually- evolving database of all the possible options and outcomes that could be implemented in any given project. We can then continue to develop sustainable options under each category and review for each given application based upon the potential impact it has on the overall sustainability of the project and crucially, our ability to influence the outcome. This means that a project is measured in terms of sustainability based on what it is able to achieve. As an example, in an arid region the use of water resources and the high energy costs of desalination and cooling would result in a heavier weighting for these factors. It is not difficult to envisage how different projects would be weighted quite differently in, for example, regeneration of an area post-earthquake, in the natural habitat of an endangered species, such as the panda, or in downtown Hong Kong.

Based on these weightings, a project-wide score is assigned to provide an indication of the overall sustainability of the project. The breadth of a typical analysis is demonstrated below:



This approach of individually assessing, understanding and weighting the different dimensions of sustainability is new and requires more thought than using an off-the-shelf tool, but it does deliver a much more meaningful result, identifying what the key issues are for an individual project or portfolio.

3 Ecosystem Services, Biodiversity and the "Cinderellas" of sustainability

Biodiversity is, in my view, the aspect of sustainability which is treated least effectively in many sustainability assessments. Biodiversity quite simply means the sum of all of the variation of life on earth. That wide definition may well account for its poor treatment in sustainability assessment and development projects generally. It seems too big a concept to apply to an individual project or series of projects, and yet the concept surely lies at the heart

of sustainable development. Our aim must be to ensure that new development can be absorbed without detriment to the functioning of the natural systems around us.

Until recently, it was difficult to place a value on biodiversity. There is, most people believe, some intrinsic benefit to the world in having coral reefs, or tropical rain forests, but that benefit was difficult to quantify. The only measures we had were based on qualitative studies of the population's "willingness to pay" for nature conservation. How much of an increase would you be prepared to see in your tax bill to make sure the world continues to support polar bears, for example?

Recent developments in economics, however, have allowed us to look at biodiversity in a different way, by considering the values of the products and services that the natural world provides for us. These "ecosystem services" include the ability to grow food and fibre, the provision of clean water and pure air, the processing of waste and the control of temperature. By looking at the costs that would be incurred by loss of or damage to these services, we can monetize biodiversity, and we then start to have a common currency in which to understand its value. Once we can value it, we can make judgements of cost and benefit for a specific project.

All businesses and projects rely on ecosystem services to function. Most rely on the natural processes of regeneration and assimilation to deal with the waste materials they produce, we all require clean water and clean air to breathe, and some rely on the harvest of wild or naturalised plants or animals. Whilst a single business cannot take on responsibility for protecting air quality for the entire planet, they can play their part by managing their own emissions. In exactly the same way, we can manage biodiversity in our own back yards, and contribute to a wider network of linked sites that will maintain biological diversity over a wider area.

The first step for infrastructure is to understand what the local issues are by carrying out a simple biodiversity survey or audit of your site(s). This can just involve a simple walkover survey coupled with research into existing records in the area. An ecologist can help the team to understand what the results mean in terms of protected or rare species that might be present. The Environmental Impact Regulations drive this to a certain extent, but there is a danger of this being used as a "tick box" exercise simply complying with legislation rather than informing the development. There is sometimes a view "But why would I want to find out

what I have on my site? Surely then it will just become a constraint." I can understand that view, but it is far better to know as early as possible what the constraints are. When dealing with natural systems and processes there can be seasonal constraints. Certain species can only be surveyed at certain times of the year, and if mitigation needs to be put in place, there may be only narrow windows of the year when this can be done.

Once the issues are for a particular project have been identified, then the potential impacts can be assessed and crucially appropriate mitigation designed. If we take as examples, some of the ten infrastructure schemes coming forward in Hong Kong, we see a strong focus on communities, and on good design practice. We do not see much reference to biodiversity or health of ecosystems, but that is what will sustain these developments into the future.

The natural world doesn't need to be a barrier to development, but it needs careful design to integrate the development into its surrounding environment. Where large scale areas are to be re-developed, such as the Kai Tak development which is over $3km^2$, consideration needs to be given to the type and location of green space, not only for the benefit of local communities, but also to ensure that it is most effective as green lungs for the city, and that it serves as appropriate habitat for the plants and animals native to the area. By planting locally-native species, not only will you be guaranteed a better planting success rate, but you will provide the right environment to maintain the local ecosystems as undisturbed as possible.

Another of the key issues is fragmentation. If populations of animal or plant species are fragmented, then they can be isolated, physically and genetically, and the populations can dwindle and become at risk of extinction. Fragmentation is typically an impact of linear developments such as road and rail/ MTR schemes. However, this potential impact can readily be mitigated by sensitive design, altering the vertical and/ horizontal alignment, or the incorporation of various crossing structures. The aim is to ensure that linear developments are as porous as possible to wildlife, whilst segregating it from traffic.

Once the design is complete, it is advisable to develop a biodiversity action plan for the assets in question. This doesn't need to be a long or complex document, but just needs to set out what the issues are and how they will be managed to prevent damage to, and preferably to enhance the natural resources of the site. Biodiversity Action Plans (BAPs) have been developed at the national, regional and local scales since the Rio Convention in 1992. As yet,

very few private sector organisations or developments have done so – there is no legal or policy incentive to do so, it doesn't win you extra "points" in your sustainability assessment, and in such difficult economic times business can't afford to spend on any non-core projects.

But does biodiversity have to represent a cost? There are opportunities associated with better management of biodiversity. Certainly there are CR benefits around relationships with customers, regulators and other stakeholders and potentially access to capital. However in some cases, there are also savings in cash terms. The management of sites to benefit biodiversity is not necessarily complex nor intensive. Indeed it may simply represent a relaxation in a typical maintenance regime, as one of the significant risks to biodiversity in urban or semi-urban settings is "over-tidying". Some examples of typical management prescriptions might include: decreasing the frequency of grass cutting to allow the grasses to flower and set seed; allowing hedges and planting areas to grow taller to provide opportunities for nesting birds; or allowing some areas to regenerate naturally with locally-native species, rather than importing ornamental plants. All of these would represent cost savings.

Beyond the immediate costs savings, there are capital projects that can have relatively short paybacks, such as the use of green roofs or walls. These – as well as providing habitat for a range of insects and birds - can manage run-off, extend roof lifespan and provide significant insulation, resulting in lower cooling loads in the summer

4 Conclusions

There are many dimensions to a truly sustainable project. Commonly-applied sustainability tools do not provide detailed coverage of all aspects, being focused primarily on green buildings. Some dimensions are almost overlooked or treated so superficially as not to contribute significantly to sustainable outcomes. It is recommended that bespoke tools are used to understand the constraints and opportunities on the basis of individual projects or project portfolios. This will deliver more sustainable projects and benefit the bottom line.

Biodiversity is one aspect of sustainability which is typically treated very superficially in standard tools, where focus is typically on the existence of protected areas, or in the number of species planted. However in order for biodiversity to be better integrated into projects, a

more detailed understanding of ecological processes in necessary. An understanding of ecosystem services will allow us to apply cost benefit analyses to these public goods.

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