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A Strategic Project Appraisal framework for ecologically sustainable urban infrastructure

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ABSTRACT

Actors in the built environment are progressively considering environmental and social issues alongside functional and economic aspects of development projects. Infrastructure projects represent major investment and construction initiatives with attendant environmental, economic and societal impacts across multiple scales. To date, while sustainability strategies and frameworks have focused on wider national aspirations and strategic objectives, they are noticeably weak in addressing micro-level integrated decision making in the built environment, particularly for infrastructure projects. The proposed approach of this paper is based on the principal that early intervention is the most cost-effective and efficient means of mitigating the environmental effects of development projects, particularly macro infrastructure developments. A strategic overview of the various project alternatives, taking account for stakeholder and expert input, could effectively reduce project impacts/risks at low cost to the project developers but provide significant benefit to wider communities, including communities of future stakeholders. This paper is the first exploratory step in developing a more systematic framework for evaluating strategic alternatives for major metropolitan infrastructure projects, based on key sustainability principles. The developed Strategic Project Appraisal (SPA) framework, grounded in the theory of Strategic Environmental Assessment (SEA), provides a means of practically appraising project impacts and alternatives in terms of quantified ecological limits; addresses the neglected topic of metropolitan infrastructure as a means of delivering sustainability outcomes in the urban context and more broadly, seeks to open a debate on the potential for SEA methodology to be more extensively applied to address sustainability challenges in the built environment. Practically applied and timed appropriately, the SPA framework can enable better decision-making and more efficient resource allocation ensuring low impact infrastructure development.

1. Introduction

The overwhelming threat to development posed by climate change means that more and more emphasis is being placed on the need to integrate sustainability considerations into all areas of policy making, planning and development (Urwin and Jordan, 2008). However, while current sustainability strategies and frameworks have focused on wider national aspirations and strategic objectives, they are noticeably weak in addressing micro-level integrated decision making in the built environment (Ugwu et al., 2006b). While notable developments have successfully applied sustainability principles in the built environment, particularly at the building scale (De Meester et al., 2009; Jack and Swaffield, 2009; Ortiz et al., 2009b), these initiatives have tended to be narrow in scope, frequently looking at embodied or operating energy or considering mainly energy efficiency aspects at the building scale. There have been few practical examples of successful integrated application of sustainability principles for major infrastructure development projects in the built environment; across all stages of development including design, planning, construction, operation and de-construction phases and across project and city level impacts. Without comprehensive investigation of the potential impacts of major projects, irreversible and unforeseen impacts to the environment may occur (Tullos, 2009). In addition, impacts of current decisions are 'locked in' for 50–100 years or more. Such investigation is therefore necessary at the earliest stages of the proposed development, to provide the widest possible scope of assessment and to consider a broad range of possible alternative mitigation and adaptation measures (Seht, 1999).

This paper is the first exploratory step in developing a systematic framework for evaluating strategic alternatives for major metropolitan infrastructure projects, based on key sustainability principles. The work reported in this paper draws from existing literature but focuses on investigating a framework for assessing the impact of infrastructure projects at the early stages in the project life cycle. The key underlying aim of the paper is to address the implementation

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gap that exists concerning the translation of sustainability principles into development practice for large-scale development projects. The framework is anchored in established Strategic Environmental Assessment (SEA) theory and practice and applies the concept of assessment 'tiering' to develop a 'basket of indicators' to provide broad ranging project appraisal. The developed *Strategic Project Appraisal (SPA)* framework, while in need of further testing, provides a means of practically appraising project impacts and alternatives in terms of quantified ecological limits; addresses the neglected topic of metropolitan infrastructure as a means of delivering sustainability outcomes in the urban context and more broadly, seeks to open a debate on the potential for Strategic Environmental Assessment (SEA) methodology to be more extensively applied to address sustainability challenges in the built environment. The topic is of international relevance and presents a challenge to practitioners active in this space.

2. Challenges with operationalising sustainability

2.1. The Sustainable Development paradigm

Despite debate over definitions of Sustainable Development (SD), the process, and sustainability, the end-state or goal, SD has become a fundamental aim of public policy since first emerging in the Brundtland report over two decades ago (Sheate et al., 2001). The concept has prompted policy-makers to formulate new strategies for achieving a balanced economic and technological pathway to safeguard the environment now and into the future (Nijkamp and Vreeker, 2000). One of the few areas of widespread agreement in on-going debates concerning the definition and meaning of the SD is that it encompasses, at a minimum, biophysical, social and economic dimensions (Hacking and Guthrie, 2008).

Bell and Morse (1999) for example, define sustainability as a dynamic balance amongst three mutually interdependent elements: (1) Protection and enhancement of natural ecosystems and resources; (2) Economic productivity; and (3) Provision of social infrastructure. Practical SD is ultimately concerned with combining, balancing or trading-off aspects of these elements (Mazza and Rydin, 1997).

However, as discussed by Baumgärtner and Quaas (2010), sustainability is a multi-faceted and contested idea. Chief among the debates are disagreements on the best means of defining the interactions of human society with natural capital stocks, resulting in two clearly opposite positions regarding the practical meaning of sustainability: *weak* and *strong sustainability* (Marques et al., 2009). In its starkest form *weak sustainability* holds that SD requires the aggregate stock of human-made and natural capital to be maintained over time. *Strong sustainability* holds that since human-made capital cannot substitute for natural capital, SD requires that the stocks of human-made and natural capital be maintained separately (Neumayer, 2003). The assumption underlying *weak sustainability* is that there is no essential difference between different forms of capital or between the kinds of welfare which they generate. The advantage of *strong sustainability* is that, in keeping natural capital distinct from other kinds of capital, it can examine natural capital's particular contribution to welfare, distinguishing between its contribution to production (through resource-provision and waste-absorption) and its services that generate welfare directly (Ekins et al., 2003). This article does not attempt to provide a detailed analysis of alternative concepts of sustainability and a discussion of the measurement and accounting techniques appropriate to these various axioms is beyond the scope of this paper. For this, the authors would direct readers to work by Cabeza GutÈs (1996), Victor (2005), Dietz and Neumayer (2007) and Gasparatos et al. (2008). Rather, the purpose of this brief overview is to highlight that the debate over definitions is part of the wider problem of applying the SD concept practically.

2.2. Subsidiarity and policy responses to sustainable development

A prospective global sustainable development would depend on a mutual assistance and reciprocity amongst institutional and organisation constituents at various scales (Moldan et al., in press). National action towards sustainable development (SD), for instance, should catalyse SD action at sub-national and local levels to be considered strategic and effective (Mascarenhas et al., 2010), while synergising with international efforts (Volkery et al., 2006). The principle of subsidiarity, as forwarded by the European Union, presents a useful theoretical construct through which to structure policy responses to the challenges of SD across a range of scales. Subsidiarity advocates that institutional solutions must act on as low a level as possible, with priority given to decentralised solutions because of the informational, motivational and monitoring advantages involved (Rennings et al., 1999). Under this approach, strategic and coordinated action for SD is required at the international scale to tackle issues of global concern (Volkery et al., 2006). National plans are useful to provide policy overviews and to contribute to policy coherence at the State level (Meadowcroft, 2002), which also represents the most efficient scale for management of certain types of common resources, such as nationally raised taxes (Mascarenhas et al., 2010). Local and project level SD initiatives also have important roles. Van de Coevering and Schwanen (2006) and Mascarenhas et al. (2010) discuss the benefits of addressing SD at the local scale, citing boundary, scale and knowledge efficiencies, for example. At the organisational, or project level, the fostering of technological innovation is often considered to be important element of broader SD policy initiatives (Nill and Kemp, 2009). Faucheux and Nicolaï (1998) discuss the fundamental role that firm's strategies play vis-a`-vis the endogenisation of technological change, for example, which can largely determine the kinds of the environmental technological innovation which become more widely adopted. While Urwin and Jordan (2008) suggest that SD considerations need to be integrated into the development of new policies across these scales, including project, local, regional and national levels, to date vertical integration between SD strategies has generally been weak and when it exists, predominantly occurs between national and local scales (Mascarenhas et al., 2010). The 'mosaic of institutions' involved in aspects of SD governance described by Meadowcroft (2002), is likely a more realistic interpretation of the policy landscape. Meadowcroft (2002), in fact, argues that such a fractured institutional mosaic corresponds with the actual ('untidy' and 'disjointed') character of social–ecological interactions and may be best suited for effective SD governance. Of a similar view, Camagni et al. (1998) highlight that the site-specific environmental, economic, political and socio-cultural conditions across cities demand local and specific solutions. Nielsen and Elle (2000) argue that there is not a single, simple strategy for implementing sustainable infrastructures, for example; rather that the specific approach must be context dependent. For the purposes of this paper, it may be summarised that while international, national, regional and local policy initiatives are all critical for SD, individual project specific initiatives equally have an important role. Despite this, current sustainability strategies and frameworks for SD are noticeably weak in addressing micro-level integrated decision making in the built environment at the project level (Ugwu et al., 2006b). This is explored further in Section 2.3.

2.3. Scope of infrastructure projects to deliver urban SD outcomes

Cities may play an active role in producing SD in a multiplicity of relevant fields, including housing, energy use and economic development (Camagni et al., 1998). In this regard, urban infrastructure is of central importance. Once in place, urban infrastructure is difficult to reverse, and their longevity leads to a path dependency with regard to energy use and future development and re-development options (Seto and Shepherd, 2009). Key planning and design decisions have