International Conference on Whole Life Urban Sustainability and its Assessment
M. Horner, C. Hardcastle, A. Price, J. Bebbington (Eds)
Glasgow, 2007

A Review of Urban Sustainability Assessment Methodologies

Emmanuel Adinyira [a,*], Samuel Oteng-Seifah [b], Theophilus Adjei-Kumi [c]

[a,*],[b],[c] Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

ABSTRACT

Sustainability has emerged as a planning concept from its beginnings in economics and ecological thinking and has widely been applied to urban development. Urban sustainability is simply described as a desirable state or set of urban conditions that persists overtime. Just as the task of defining sustainability has progressed in response to early economic thinking, so has the task of its assessment. Many urban sustainability assessment methods can be identified from literature. However an examination of these methods reveals largely three methodological foundations. Focusing on the context of urban development, this paper presents an appraisal of the relative potentials and limitations of methods developed around the three identified methodological foundations. The paper agrees with the much held view that, most currently available urban sustainability assessment methods fail to demonstrate sufficient understanding of the interrelations and interdependencies of social, economic and environmental considerations. It further points to a wide gap between assessment theories and practices. To help narrow this rather wide gap, the paper recommends a pragmatic shift in focus, from theory development to application and auditing. A suggestion is made for the application of key assessment methods in a given urban area and across various issues, spatial and time scales so as to allow for method comparison. It is hoped that the parallel application of existing methods will greatly accelerate the urban sustainability assessment learning process and will help in the improvement of both theory and practice.

Key words: Assessment Methods, Review, Urban Sustainability.

1 INTRODUCTION

Sustainable development as a concept has been gaining increasing popularity across various sectors since the Brundtland Commission Report in 1987 (WCED, 1987). This report captioned, *Our Common Future*, is taken as a starting point for most current discussions on the concept of sustainable development. However, it is neither the starting point nor the possible end of the conceptual development process.

Sustainability has emerged as a planning concept from its beginnings in economics and ecological thinking and has widely been applied to urban development. Urban sustainability is seen as a desirable state of urban conditions that persists overtime. It is often characterised by issues such as inter-generational equity, intra-generational equity, protection of the natural environment, minimal use of non-renewable resources, economic vitality and diversity, community self-reliance, individual well-being, and satisfaction of basic human needs.

As the task of defining sustainability progressed in response to early economic thinking, so did the task of its assessment. Ever since sustainable development became the catchword in most international discussions, several approaches to its assessment have been developed. According to Lawrence (1997), sustainability assessment is simply applying the broad principles of sustainability to ascertain whether, and to what extent, various actions might advance the cause of sustainability. The term “Sustainability Assessment” is used in both literature and practice in two very different contexts. Firstly, it is used in the context of checking if a community or organisation is progressing towards sustainability. Here, it serves as an auditing or performance testing system. In the second context, it serves more as impact assessment processes in that it attempts to assess the sustainability of proposed projects, plans, policies or legislation before they are implemented (Devuyst, 2000).

Over the past half-century, much effort in a variety of disciplines has been made at developing approaches to sustainability assessment. Efforts have ranged from assessing change that pushes beyond an emphasis on economic signals to more complete treatment of human and ecosystem well-being (Hodge, 1997). Much of the literature and theory surrounding sustainability assessment have argued that current assessment methods often fail to involve sufficient vision and understanding of the interrelations and interdependencies of social, economic and environmental considerations. This paper thus seeks to contribute to the urban sustainability assessment debate by reviewing the underlining methodologies for the major assessment methods identified and present their potentials and limitations.

2 REVIEW FRAMEWORK

In carrying out a comprehensive review of identified methodologies, a review framework that allows for the involvement of most issues relevant to sustainable urban development was employed. For each methodology, issues such as the origin and status of the methodology from well established to experimental were looked into. As part of the review, various assessment methods developed on the basis of the identified methodologies were appraised. The data requirements of these methods and their application to urban developmental activities such as planning, property development, design, construction and operation were looked into. This allowed for the strengths, weaknesses, potential applications, data inputs, outputs and applicability at various spatial scales for the various methods to be identified.

3 ASSESSMENT METHODOLOGIES

Many urban sustainability assessment techniques can be identified from literature. A recent review of urban sustainability assessment techniques conducted using the built environment quality evaluation for sustainability through time (BEQUEST) framework, revealed several methods available for sustainability assessment of urban activities (Deakin et al, 2002; Ugwu and Haupt, 2005). However a careful examination of existing assessment methods point to notably three groups of methods when grouped on the basis of their methodological foundations. These are namely; 'environmental in general' methods, Life cycle assessment methods and sustainability indicator assessment methods.

3.1 'Environment in general' methods

Sustainability assessment methods based on environmental assessment dates back to the pre-Brundtland era where sustainability mainly focused on environmental issues such as resource consumption, pollution and impact on bio-diversity. Across the range of urban activities, the environmental dimension of sustainable development has greatest coverage. With this methodology, environmental impacts tend to be identified mostly using methods such as checklists or matrices and evaluations carried out using methods such as logical framework, cost-effectiveness analysis and multi-criteria assessments. Resources consumption, pollution and environmental valuation, under various building scales, urban forms and policy plans are given prominence under this methodology. Environmental valuation methods such as cost-benefit analysis, contingent valuation, hedonic pricing and the travel cost methods all have environmental assessment as their methodological foundation. On the basis of this methodology, many sustainability assessment methods that focus on energy and material flow and address both resources use and waste arising across a wide range of urban activities have been developed.

A careful look at ‘environment in general’ methods of sustainability assessment reveals rather significant limitations with respect to the range of sustainability issues they are capable of addressing. They are mostly limited to applications at the levels of policy planning, programme development and urban design (Guy and Marvin, 1997; Brandon et al, 1997). In view of the rather minimal coverage of urban development activities by ‘environment in general’ methods of urban sustainability assessment, they have lost their appeal. (Brandon et al, 1997; Bergh et al, 1997; Nijkamp and Pepping, 1998).

3.2 Life Cycle Assessment methods

The origin of life cycle assessment methods can be traced to after the Agenda 21’s call for the integration of environment and other aspects of urban development such as the social, economic and institutional issues (UNCED, 1992). This resulted in a shift of focus in method development from environment evaluation to life cycle assessment (LCA). LCA methods attempts to address broader sustainability issues such as environmental limits, social equity concerns and the need for stakeholder participation. They are based on a structured methodology that can be utilized to evaluate impact of urban development across their life cycle.

In comparison to ‘environmental in general’ methods, LCA methods appear to address a much broader range of urban activities and scales. This can be attributed to the fact that they focus on both social and economic issues of urban development. LCA methods attempt to address social and economic issues as well as environmental issues, but they fail to integrate all this in one assessment. They often address social or economic issues using approaches from the earlier ‘environment in general methods (Bizarro and Nijkamp, 1997). LCA methods are seen as methods based on a well established and standardized methodology (Sahely et al., 2005).In spite of this, LCA methods still show a limitation with respect to the range of sustainability issues they are able to address. They are seen not to perform well with respect to social and institutional issues of urban development. Some major weaknesses of such methods include complex and time-consuming nature of analysis, and large data requirements. Furthermore, LCA methods fail to integrate environmental, economic and social aspects of the task of urban sustainability assessment. This notwithstanding, LCA methods have contributed significantly to sustainability assessment by widening coverage of urban activities and spatial scales.

3.3 Sustainability Indicator methods

With sustainability assessment, there is the need to integrate issues and seek their cumulative and synergistic impact on the environment. How environmental, social and economic information is analysed, integrated and presented to decision-makers is the most critical concern of sustainability assessment. Methods developed on the basis of 'environment in general' and the LCA methodologies have all in one way or the other failed to achieve this requirement. 'Environment in general' methods, focused on environmental issues with policy, programme and infrastructure provision and LCA methods attempted to address social and economic issues in addition to environmental concerns, but in a piecemeal manner. In view of this, a third methodology that seeks to achieve integration of all issues of sustainability has gradually evolved. This methodology employs a wide range of indicators to characterise the different dimensions or aspects of urban development. Under it, the assessment of sustainability is actually considered as an assessment of indicators by which people can track their progress towards sustainability.

Sustainability indicators are seen as an essential component in the overall assessment of progress towards sustainable development. They are useful for monitoring and measuring the state of the environment by considering a manageable number of variables or characteristics (McLaren and Simonovic 1999). Several studies at the urban, regional, and national levels have compiled extensive lists of sustainability indicators (Foxon et al. 2002; Hellström et al. 2000; Alberti 1996; Maclaren 1996). From these, many assessment methods have been developed which attempt to simplify the holistic assessment of urban sustainability. Such methods rely on key interactions and feedback mechanisms between infrastructure and surrounding environmental, economic, and social systems and uses sustainability criteria and indicators as a way of understanding and quantifying such interacting effects.

From a methodological standpoint, sustainability indicator methods are recognised as useful integration tools to evaluate a situation in several dimensions and to test sustainability. The main problem with such methods however, is relating what the indicators measure to actual sustainability. Sustainability indicators are not useful when considered in isolation, but rather their usefulness comes from monitoring relative changes in the state of the environment. The use of sustainability indicator methods of assessing urban sustainability has had mixed results in practice and, in some cases, minimal effects on policy (Levett, 1998).They are unavoidably value-laden, and sometimes present difficulties in interpreting whether or not any progress towards sustainability is actually being made.

4 CONCLUSIONS AND RECOMMENDATIONS

The primary object of any urban sustainability assessment exercise is to provide the opportunity for more inclusive and informed decision-making regarding issues of urban development. Thus the ability to address economic, social and environmental interdependencies within policies, plans, legislations and projects has become the basic requirement of all urban sustainability assessments methods. A look at the development of urban sustainability assessment methodologies reveals a steady progress toward achieving this requirement. Much of this improvement can be put down to attempts at addressing the limitations of the pre-Brundtland assessment methodologies. The evolution of methods that attempt to holistically assess the impact of development across most urban spatial scales can be traced to much recent methodologies. In spite of this, most currently available methods still fail to demonstrate sufficient understanding of the interrelations and interdependencies of social, economic and environmental considerations. Many reports on sustainability assessment methods points to the absence of truly integrated urban sustainability assessment methods. It is the view of this paper that further improvement in assessment methods can only be achieved when existing methodologies a critically reviewed and further research into methodological improvement carried out.

One major shortfall of current developments in the area of urban sustainability assessment is the relative lack of implementation of developed methods. As demonstrated in this review, much progress has been made in the improvement of urban sustainability assessment theories. However, a wide gap still exists between assessment theories and assessment practices. Cooper (1997; 1999) alludes to this fact and states that the practice of assessment lags well behind development of theories. New assessment methods remain largely experimental with relatively few applications in practice. An amble demonstration of this is the current situation where most assessment methods in widespread use fail to make assessments that adequately address most issues underlying the sustainable urban development process. To improve on the present situation, there is the need to identify those aspects of urban activities and issues at various spatial scales which are poorly covered by available assessment techniques. On the basis of the gaps identified, cross-fertilisation of methodologies can then be employed to develop methods which will be capable of addressing most if not all urban activities and spatial scales. The paper further recommends a pragmatic shift in the focus of urban sustainability assessment from theory development to more of application and auditing. Methods must quickly move beyond the experimental phase to practical application. A suggestion is thus made for major assessment methods developed to be used in assessing urban sustainability over a given urban area and across the various issues, spatial and time scales so as to allow for method comparison. This parallel application of existing methodologies will greatly accelerate the urban sustainability

assessment learning process and will help in the improvement of both theory and practice.

5 REFERENCES

Alberti, M., 1996. Measuring urban sustainability. Environmental Impact Assessment Review, **16**: 381–42.

Arditi, D. and Messiha, H.M., 1999. Life cycle cost analysis (LCCA) in municipal organizations. *Journal of Infrastructure Systems*, **5**(1): 1–10.

Bergh, J., Button, K., Nijkamp, P. and Pepping, G., 1997. Meta-Analysis of Environmental Policies, Kleuwer, Dordrecht.

Bizarro, F. and Nijkamp, P., 1997. Integrated conservation of cultural built heritage. In Brandon, Lombardi and Bentivegna, (Editors.), Evaluation of the Built Environment for Sustainability, E & FN Spon, London, pp. 451-471.

Brandon, P., Lombardi, P. and Bentivegna, V.,1997. *Evaluation of the Built Environment for Sustainability*. E&FN Spon, London.

Cooper, I., 1997. Environmental assessment methods for use at the building and city scale: constructing bridges or identifying common ground? Brandon, Lombardi, and Bentivegna (Editons). *Evaluation of the Built Environment for Sustainability*, E&FN Spon, London, pp. 1-5.

Cooper, I., 1999. Which focus for building assessment methods? *Building Research and Information,* **27**(4), 321-331.

Deakin, M., Lombardi, P. and Mitchell, G., 2002. Urban sustainability assessment: A preliminary appraisal of current techniques. Urbanistica, **118**, 50–54.

Devuyst, D., 2000. Linking impact assessment and sustainable development at the local level: The Introduction of Sustainability Assessment Systems. *Sustainable Development.* John Wiley & Sons Ltd and ERP Environment, New York, ***8***, 67-78.

Foxon, T.J., McIlkenny, G., Gilmour, D., Oltean-Dumbrava, C., Souter, N., Ashley, R., Butler, D., Pearson, P., Jowitt, P. and Moir, J., 2002. Sustainability criteria for decision support in the UK water industry. *Journal of Environmental Planning and Management*, **45**(2): 285–301.

Guy, S. and Marvin, S., 1997. Splintering networks: cities and technical networks in 1990s Britain, *Urban Studies*, **34** (2),191-216.

Hellström, D., Jeppsson, U. and Kärrman, E., 2000. A framework for systems analysis of sustainable urban water management. *Environmental Impact Assessment Review*, **20**, 311–321.

Hodge, T., 1997. Towards a conceptual framework for assessing progress towards sustainability. Social Indicators Research. **40**, pp.5-98.

Lawrence, D., 1997. Integrating sustainability and environmental impact assessment. *Environmental Management,* **21**(1), 23-42.

Levett, R., 1998. Sustainability indicators - integrating quality of life and environmental protection. *Journal of the Royal Statistical Society A*, **161**(3), 406-410.

Lombardi, P., 2001. Responsibilities toward the coming generation forming a new creed, *Urban Design Studies*, **7**, 89-102.

Maclaren, V., 1996. Developing indicators of urban sustainability: a focus on the Canadian experience. Intergovernmental Committee on Urban and Regional Research (ICURR) Press, Toronto.

McLaren, R.A. and Simonovic, S.P., 1999. Data needs for sustainable decision making. *International Journal of Sustainable Development and World Ecology*, **6**, 103–113.

Nijkamp, P. and Pepping, G., 1998. A meta-analytic evaluation of sustainable city initiatives. *Urban Studies*, **35** (9), 1481-1500.

Sahely, H,R., Kennedy, C. A. and Adams, B.J., 2005. Developing sustainability criteria for urban infrastructure systems. *Canadian Journal of Civil Engineering*. **32**, 72-85.

Ugwu, O.O. and Haupt, T.C., 2005. Key Performance indicators and assessment methods for infrastructure sustainability – A South African construction industry perspective. *Building and Environment* **42** (2007) 666-680.

UNCED - United Nations Conference on Environment and Development.1992. *Earth Summit 92 (Agenda 21),* Regency Press, London.

World Commission on Environment and Development, 1987. Our Common Future. . Oxford University Press, Oxford.