Brisbane Urban Growth Model: Integrated Sustainable Urban and Infrastructure Management in Brisbane

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Abstract
Sustainable urban development and the liveability of a city are increasingly important issues in the context of land use planning and infrastructure management. In recent years, the promotion of sustainable urban development in Australia and overseas is facing various physical, socio-economic and environmental challenges. These challenges and problems arise due to lack of capability of local governments in accommodating the needs of the population and economy, (i.e. land supply, employment distribution, open space, infrastructure, and amenities), in a relatively short timeframe. The planning of economic growth and development is often dealt with separately and not included in the conventional land use planning process. There is also a sharp rise in the responsibilities and roles of local government for infrastructure planning and management. The increase of responsibilities means that local elected official and urban planners have less time to prepare background information and make decisions. The Brisbane Urban Growth model has proven initially successful to warrant timely and coordinated delivery of urban infrastructure.

Keywords: Urban infrastructure management, sustainable urban development, urban modelling, Brisbane Urban Growth Model.

Introduction

Sustainable urban development and the liveability of a city are increasingly important issues in the context of land use planning and infrastructure management. Rapidly growing urban development has become a major concern to all societies around the world. Conventional land use planning and urban management approaches used by local governments to tackle emerging urban growth issues are often based on trends and broad assumptions rather than on groundtruthed data and information of the local area. It has been suggested that there is a constant mismatch between what is a planner's view of desirable spatial outcomes and the realities of evolving urban structures and such a mismatch is a result of our limited understanding of localised urban patterns (Gleeson & Randolph, 2001; Forster, 2006).

In recent years, local government has a rapidly increasing responsibility for managing urban growth. Local government urban management practices have evolved from conventional land use planning approaches to more wide ranging urban growth and infrastructure management approach to cater for a rapidly growing population. Aside from managing daily operational functions of a city, such as the assessment of property development applications and maintenance of urban streetscapes, local governments are now also required to undertake economic planning; manage urban sprawl; be involved in major national and state infrastructure planning; and even engage in achieving sustainable development objectives.

The sharp rise in the responsibilities and roles of local governments mean that local elected officials and urban planners have less time to make decisions. They have greater reliance on planning support systems (PSS) which inform decision-making processes and improve urban management practices. Urban modelling tools have

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been widely used in developed countries for this purpose. However, many of these models are generally 'one-off' applications with a single purpose rather than multi-dimensional applications. As a result, many of them become obsolete in a relatively short period of time.

The aim of this paper is to examine the complex relationship between land use planning approaches, economic development and infrastructure management processes and to illustrate why there is an urgent need for local government to develop a robust planning support system to facilitate better infrastructure management. The development of the Brisbane Urban Growth (BUG) Model has proven initially successful for Brisbane City Council to move toward the path of sustainable urban and infrastructure management. Compared to conventional land use planning approaches, this is a better approach to facilitate sustainable urban development and infrastructure management.

Planning For Sustainable Urban Development

Contemporary land use and urban planning originated from the industrial revolution that began in the 1850s. Planning by public authorities was first used as a tool for improving the health of the working population due to epidemics, water contamination and urban slums. Gradually local authorities took responsibility for providing urban infrastructure such as clean water, and the removal of domestic waste such as sewerage and garbage.

In modern times, greater emphasis on decentralisation of the urban governance structure has meant that the traditional roles of local government in managing basic land use, infrastructure and services are no longer sufficient to meet the local community needs. Local governments are now increasingly involved in regional and national level strategic planning initiatives and programs such as regional economic development planning, major road and public transport infrastructure projects, and management of urban growth (Haywood, 2005; Atterton, 2007). Urban planners are now also required to provide strategic advice on many issues ranging from rezoning of land (e.g. for community use such as a school) to strategic distribution of public transport routes. Due to the demand on greater linkages and accountability between different projects, planners can no longer deal with issues in isolation. Therefore, this brings forward the concept of urban management in the context of the land use and infrastructure planning.

In order to examine the concept of urban management including the management of infrastructure, it is important to firstly understand the responsibilities and functions of governments. Table 1 depicts the typical responsibilities of a local government. Local governments assume these primary responsibilities because they directly provide services and usually have authority to levy charges for the services they provide (Carnegie & Baxter, 2006; Worthington, 2007). The provision of infrastructure, services and their maintenance are, therefore, viewed as rights that the community expect, partly as a result of the taxes they pay and partly because of the political legitimacy that they give to both federal and local authorities.

Table 1: Typical functions of a local government (Wekwete, 1997:4)

Key Functions	Typical Components
Public Utilities	Water supply, sewerage and drainage, and electricity
Social Services	Community education, health, social welfare, and social housing
Transportation	Highways, suburban roads, street lighting, and public transport
General Urban Services	Garbage collection, parks and recreation, markets, cemeteries, fire protection, and local law enforcement
Planning & Engineering Services	Development assessments, infrastructure construction, business permits and licensing, and administer land use plans

Local governments are intimately linked to communities because they can address local economic, social and environmental issues through regulatory regimes and provision of infrastructure and services more effectively (Warburton & Baker, 2005; Westendorff, 2007).

Effective operational management of a local government requires, in modern times, cross sectional analysis of various issues (Wilmoth, 1987; Wekwete, 1997). Many local governments in developed and developing countries have been facing the issue of rapid urban sprawl and increasing pressures by global and local communities demanding sustainable population and economic growth (Lewis, 2001; Hall, 2002). There has been a myriad of literature written about the lack of integration between different local government policies in tackling urban sprawl and failing to achieve sustainable development (Haywood, 2005; Boyle & Mohamed, 2007). There is also plenty of research discussing different approaches to tackling these urban management issues (Roberts, 1999; Nelson *et al.*, 2004). Nonetheless, there is only a handful of example cities that have been successful in achieving sustainable urban management such as Vancouver and Copenhagen (K'Akumu, 2007; Brunet-Jailly, 2008).

Achieving a sustainable urban development is among the key goals of most local governments internationally (Blumenthal & Martin, 2007; K'Akumu, 2007). The confirmation of current resource consumption patterns and living habits of both developed and developing countries resulting in global warming, inter-generational inequity, and the rapid destruction of eco-systems have made national and local governments revise their strategic directions and management of their cities and urban areas (Tregoning *et al.*, 2002; Nijkamp *et al.*, 2007).

Concepts of sustainable urban development is generally implemented through conventional planning approaches which utilise macro level information to support local government policy setting for local areas (Meadowcroft, 1997). The current macro (global and national) level land use and infrastructure planning and urban growth management approaches have shown their limitations in achieving sustainability at the micro (local and parcel) level (Cho, 2002).

Over the last decade the global economy has shifted from the traditional production (neo-classical) economy to a knowledge-based economy. Knowledge, human capital and technology are no longer considered as external influences to production. In a knowledge-based economy, knowledge is included directly into production functions and investments in knowledge have increased productive capacity of the other factors of production. The promotion of sustainable urban development in Australia and overseas is facing various physical, socio-economic and environmental challenges. These challenges and problems arise due to a lack of capability of local governments in accommodating the needs of their residents (i.e. land supply, employment distribution, open space, infrastructure, and amenities) and growth. Historically, local authorities generally focused on tackling these challenges by conventional land use planning and urban management approaches at the local level with limited knowledge of the local areas and the nature of the proposed developments.

Local governments have an insurmountable role in ensuring sustainable urban development is achieved at local level. The majority of the urban developments are required to be assessed and approved by local governments, hence the implementation of an effective operational assessment framework at this level of government is critical. Even though the concept of sustainable urban development has been discussed for over three decades now, effective implementation of this concept is still elusive to many local governments (Alexander & Tomalty, 2002; K'Akumu, 2007). While many approaches have attempted to achieve sustainable urban development, they have either been narrowly focused in one or two aspects of development, especially in respect to environmental or economic sustainability, or too imprecise with no clear outcomes to be achieved.

Cities around the world take shape in different spatial shapes and forms. Urban decentralisation, urban sprawl and low density residential areas at the outer fringe of a city have been suggested as the underlying factors that are responsible for many of the undesirable and non-sustainable outcomes for cities (Wassmer, 2008). The provision of appropriate infrastructure to support growth is also essential for cities.

In mid 1990s, the concept of ‘Smart Growth’ emerged as an effort to address the policy debate of urban decentralisation, urban sprawl and low residential density development at the outer fringe of a city (K'Akumu, 2007). Among the characteristics of smart growth are economically efficient land uses; the promotion of higher densities, mixed uses and public transit; the revitalisation of existing neighbourhoods; and the provision of affordable housing (Degrove, 2005; Filion & McSpurren, 2007).

Urban consolidation and increase density have been the major planning policies for managing growth in Australia and other overseas cities. It has offered a series of solutions to a range of pressing urban growth issues, but increasing consolidation is now slowly reaching the threshold of a city’s limits and gradually tips the balance (Searle, 2004). Potential limits on urban consolidation include: infrastructure capacity, land capacity, loss of economic activity and market demand (Searle, 2004). Insufficient spare capacity can seriously constrain the density of consolidation. Residential density beyond this capacity is not impossible without significant costs required for the upgrading the infrastructure network. There is also limited open space and recreation area to sustain the growing population in the inner city area.

The current land capacity of the inner city may have already reached its full potential and the cost of new open space areas will not be economically viable (Searle, 2004). The success of any growth management approach will require massive investment in infrastructure. There are many reasons for failing to confine urban growth including: unavailable consistent and reliable planning support databases, failure or nonexistence of integrated evaluation framework to enable strong and well-grounded decisions to be made (Haywood, 2005; Joshi *et al.*, 2006).

Urban systems are becoming increasingly complex and large in scale as local urban economies, social and political structures, transportation systems, and infrastructure requirements evolve. Sustainable and efficient usage of scarce resources together with competing economic and social priorities are now part of everyday decisions required to be made by local governments (Andersson *et al.*, 2006). Many mathematical, engineering and theoretical models have been used to attempt to develop understanding of aspects of urban structure, transportation and socio-economic relationships (Cheng & Masser, 2003; Fragkias & Seto, 2007).

The use of geospatial models to assist policy making, urban planning and management is not new. Modern urban simulation models have been widely used in developed countries to evaluate major public and private sector urban development projects and forecast development patterns (Cheng & Masser, 2003; Wilson *et al.*, 2003). The steady incremental increase of local governments' responsibilities as mentioned in earlier sections have also resulted in development of a multi-modal approach to urban and transportation modelling, including mode choice, travel demand management, land use policies change, working hours, and congestion pricing (Waddell & Ulfarsson, 2004; Marinoni, 2005).

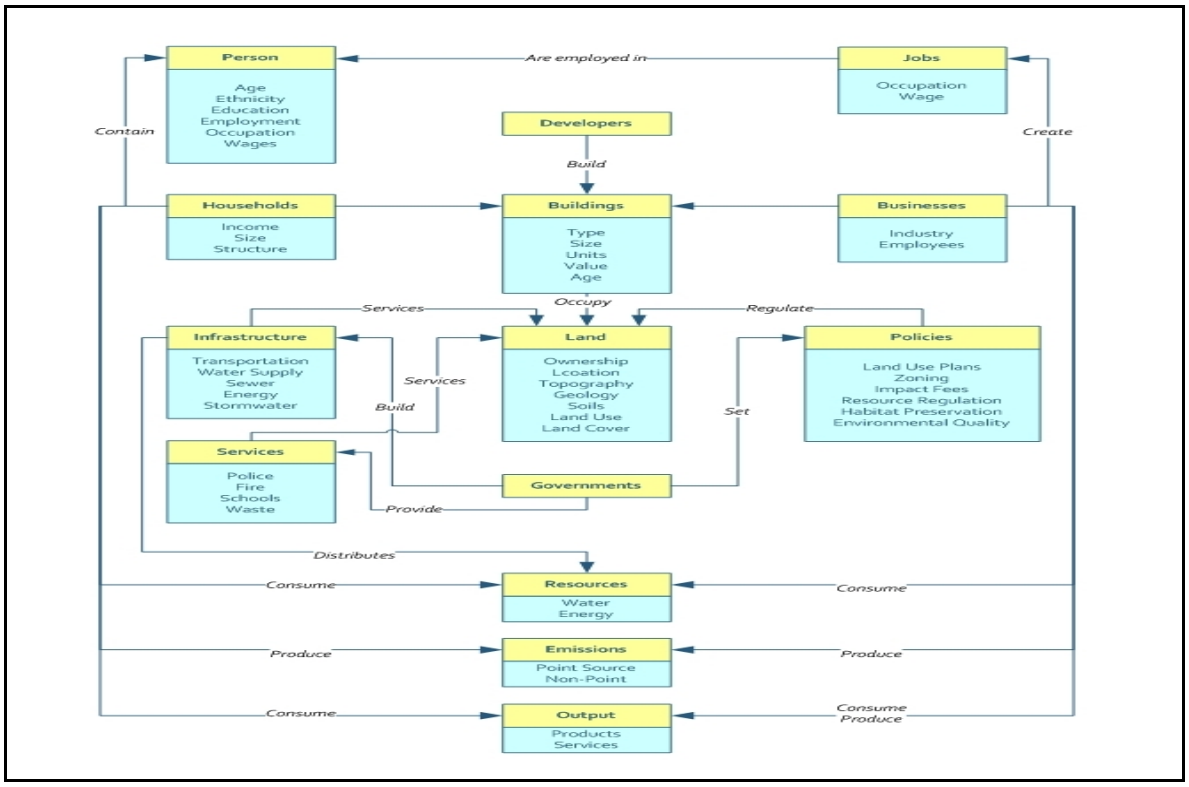

Figure 1: Agents, choices and interactions in an urban model (Waddell & Ulfarsson, 2004:14).

Figure 1 depicts the typical conceptual framework of an urban model, with a clear emphasis on physical planning and infrastructure provision. The agents, choices and interactions provide an overview of linkages that connect a broad range of policy inputs to outcomes. Government action such as regulations and infrastructure investment would cause systematic changes in the final outputs of urban development and vice versa.

There have been many attempts by urban planning scholars to put forward urban models as tools to inform better public decisions making, however, often due to poor and inconsistent evaluation frameworks adopted by local governments, the ultimate goal of using urban models as public decision making tools has failed (Waddell & Ulfarsson, 2004; Filion & McSpurren, 2007).

A New Approach for Urban and Infrastructure Management

Current best practice in search of attaining integrated urban management predominantly focus on the development of robust and integrated planning support systems to inform and enable greater public and private sector engagement in the decision making process. The states of Oregon and Florida, for example, have implemented containment strategies in the early 1990s with the use of robust land use and planning support systems to inform urban planners and decision makers on effectiveness of existing land use policies (Boyle & Mohamed, 2007). As a result of having a consistent land use and planning support system decision makers were able to regularly evaluate the impacts of their urban management policies, in particular, in relation to efficiency of public transport systems and other development infrastructure to meet the demand of urban growth. Nonetheless, literature and research on integrated urban management to date have not explored the further development of robust planning support systems in an effort to develop effective growth management policies into an integrated urban management system that has the potential capacity to become a dynamic business system (Hohn & Neuer, 2006; Worthington, 2007).

The recent introduction of the BUG model at Brisbane City Council has successfully revolutionised the approach to forecasting development and the planning and management of urban infrastructure.

Brisbane is anticipated to grow rapidly in the next 15 years as one of the fastest growing cities in the South-East Queensland region and Australia. Various scales of brownfield redevelopment are already in progress. It is expected that the rate and scale of brownfield redevelopment will intensify further as the last remaining greenfield land becomes fully developed while Brisbane continues to grow strongly as a major economic capital of Australia.

At the present, various planning documents set out planning priorities for Brisbane including urban renewal and neighbourhood plans, Transit Orientated Developments (TODs), major transport projects and other major developments. All these projects are closely related and urgently require an integrated framework to ensure land use planning, glocal economic development and infrastructure provision will be delivered to meet the needs and demands from the anticipated economic and population growth.

The unprecedented urban growth has prompted Brisbane City to develop a robust urban simulation model, the BUG model to provide strategic directions to urban planners and its political decision makers on anticipated sequence and scale of future greenfield and brownfield development clusters. The BUG model is a promising tool for local government to warrant timely and coordinated delivery of urban infrastructure to ensure sustainable urban development could be achieved throughout Brisbane.

The conceptual framework of the BUG model was first developed and implemented at Gold Coast as a one off exercise for the preparation of the Priority Infrastructure Plan (PIP) for Gold Coast City Council. The BUG model is an advanced oracle database linked with GIS analytical and visualisation interface for analysing and identifying future developments and sequences. Its prime data is extracted from the local government rates database and where local environmental constraints such as slope gradient, flooding and waterways corridors were groundtruthed and included into the BUG model. The BUG model uses the information in the spatial database and basic development factors (e.g. property values, land values and conversion rates) to forecast development potential at property level for the city.

Figure 2 illustrates the conceptual framework of the BUG model. The operational framework of the BUG model consists of a variety of urban and property development factors as well as transport accessibility factors to ensure maximisation of future urban development along public transport nodes and corridors. The BUG model focuses on supply side information, uses detailed bottom-up growth forecasting approach and provides a triple bottom line sustainability planning and policy approach for its municipal government (BCC, 2008).

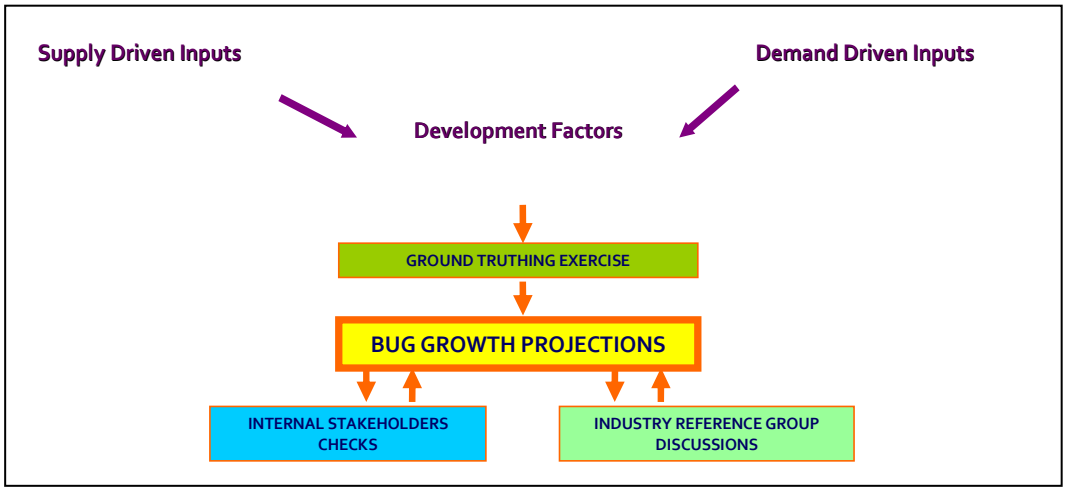

Figure 2: Conceptual Framework of the BUG model

This model is anticipated to be the fundamental tool to assist planners to understand the local environment limitations and planning implications on a city. The results of the model outputs enable urban planners and decision makers to provide better planning, policy and infrastructure that adequately address the local needs and achieve the sustainable outcome and spatial form.

The infrastructure planning and management processes used by Brisbane City under the BUG model framework provide greater linkages within internal infrastructure providers. Planning studies and assumptions are carried out in a coordinated manner between different infrastructure providers. Information such as the SEQ Regional Plan and the City Plan provide a strategic direction rather than absolute outcome. Throughout the BUG model framework and processes, this information is being groundtruthed through detailed planning studies and the outputs are then used to inform and refine the objectives of these statutory documents.

Assessing and planning for a city requires consideration of the complex interactions between economic, environmental and social factors. While the BUG model framework has proven to be initially successful for the delivery of urban infrastructure and its management, there is a need to include a more comprehensive economic component into the model. The current BUG model does not fully consider the local economic factors such as commercial and industrial land availability and its implication to the planning and management of infrastructure. A conceptual framework, labelled Integrated Glocal and Sustainable Urban Development Framework (IGSUD), currently under development, is based on sustainable urban development, glocal economic developments, growth management and urban simulation model and could be a possible solution to improve the existing BUG model framework. Figure 3 illustrates the key components of the IGSUD framework. The conceptual IGSUD framework provides the missing economic linkage to urban infrastructure management under the existing BUG model framework.

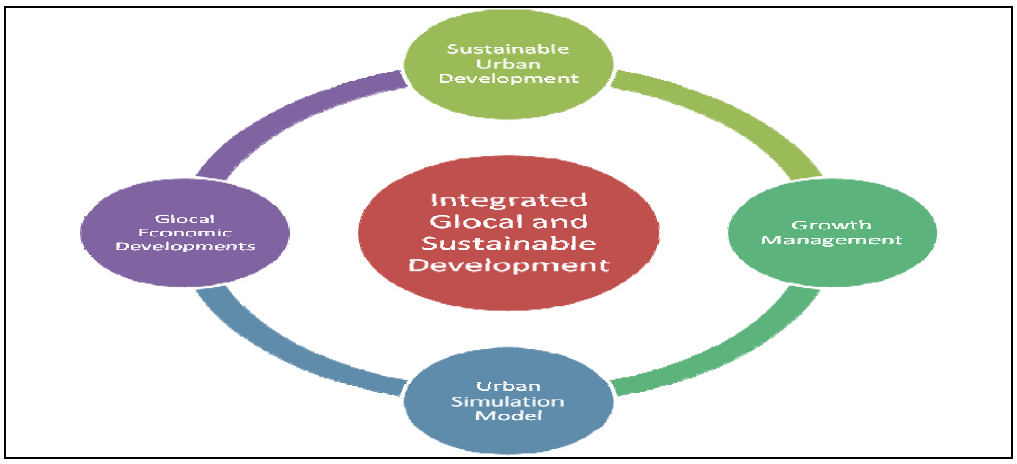

Figure 3: Conceptual Integrated Glocal and Sustainable Development Framework

Conclusion

The roles and responsibilities of local government are expanding beyond the daily operational maintenance of a city and assessment of property development applications to include: economic planning; management of urban sprawl; involvement in major national and state infrastructure planning and even engagement in achieving sustainable development objectives. Delivering sustainable urban development and maintaining the liveability of a city is become increasingly important for local governments around the world. The use of a conventional land use planning approach can no long facilitate sustainability without upsetting particular aspects of the complex urban environment. The evolution of computer and internet technologies in past decades has made public information more accessible and as a result, the

performance of elected local officials and governments are constantly under the media spotlight (Henriksson *et al.*, 2006; King, 2006). Local communities from both developed and developing countries have demanded greater transparency in public sector reporting. There have been numerous examples of publicly demanded inquiries to force those decision makers to be accountable for poor performance and ill-informed decisions.

In the last two decades, the public sectors of many Western countries have embraced New Public Management (NPM) and according to Kluvers (Kluvers, 2003) NPM consists of seven elements: (1) a shift towards greater disaggregation into corporate units; (2) a shift towards greater competition between public sector organisations and public sector and private sector; (3) greater use with the public sector of private corporate management practices; (4) greater stress on discipline and parsimony in resource use; (5) more hands-on management; (6) more explicit and measurable standards of performance; and (7) attempts to control public organizations in a more 'homeostatic' style according to preset output measure.

The rise of corporate management and planning, program budgeting and performance measurement in public sector management mean that local elected officials are confronted by a greater volume of documentation but with no increase in time to evaluate key projects and programs being delivered (Felmingham & Page, 1996). Effective urban management is the key responsibility of local governments and efficient corporate management of local government organisations enables and ensures that objectives of urban management are attainable. There are samples of research showing that poor corporate management of local government organisations lead to poor or sometimes adverse outcomes in major urban development projects due to the unavailability of comprehensive planning information and disjointed projects, policies and decisions evaluation frameworks (Cannadi & Dollery, 2005; Kloot & Martin, 2007). However, there is very limited literature on how effective urban management practices such as having comprehensive planning support system have led to significant improvement in local government corporate management practices and vice versa (Reddel, 2002; Kluvers, 2003).

The objective of perusing long-term sustainable urban development, effective urban management and comprehensive infrastructure management require good understanding of the complex relationship between the above elements. This paper has examined and identified limitations of the contemporary planning approach to facilitate sustainable urban development and effective urban management. The BUG model is a good example where a planning tool, originally developed to provide a transparent forecasting process for future development, has acted as the catalyst for the change in corporate infrastructure management. The BUG model has proven initially successful for improving the effectiveness and efficiency of infrastructure management. It has also improved the accountability of the planning and delivering of infrastructure by providing an integrated development forecasting framework to facilitate sustainable urban development.

Reference

Alexander, D., & Tomalty, R. (2002). Smart Growth and Sustainable Development: challenges, solutions and policy directions. *Local Environment, 7*, 397-409.

Andersson, C., Frenken, K., & Hellervik, A. (2006). A complex network approach to urban growth. *Environment and Planning, 30*, 1941-1964.

Atterton, J. (2007). Europe's city-regions competitiveness: growth, regulation and peri-urban land management. *Journal of Environmental Planning and Management, 50*, 856 - 858.

BCC. (2008). *Brisbane Urban Growth Model - Background Materials and Assumptions. Extrinsic Materials for Brisbane City Priority Infrastructure Plan (Confidential Draft)*. Retrieved. from.

Blumenthal, D. L., & Martin, E. J. (2007). Urban Sustainable Development, Lower Income Communities, and Transorganizational Public Administration. *International Journal of Public Administration, 30*, 95-107.

Boyle, R., & Mohamed, R. (2007). State growth management, smart growth and urban containment: A review of the US and a study of the heartland. *Journal of Environmental Planning and Management, 50*, 677-697.

Brunet-Jailly, E. (2008). Vancouver: The Sustainable City. *Journal of Urban Affairs, 30*, 375-388.

Cannadi, J., & Dollery, B. (2005). An Evaluation of Private Sector Provision of Public Infrastructure in Australian Local Government. *Australian Journal of Public Administration, 64*, 112-118.

Carnegie, G. D., & Baxter, C. (2006). Price Setting for Local Government Service Delivery : An Exploration of Key Issues. *Australian Journal of Public Administration, 65*, 103-111.

Cheng, J., & Masser, I. (2003). Modelling urban growth patterns: A multiscale perspective. *Environment and Planning, 35*, 679-704.

Cheng, J., & Masser, I. (2003). Urban growth pattern modeling: a case study of Wuhan city, PR China. *Landscape and urban Planning, 62*, 1999-1217.

Cho, C.-J. (2002). The Korean growth-management programs: issues, problems and possible reforms. *Land Use Policy, 19*, 13-27.

Degrove, J. M. (2005). *Planning Policy & Politics: Smart growth and the States*. Cambridge: Lincoln Institute of Land Policy.

Felmingham, B., & Page, B. (1996). National competition policy and its implications for local government. *Australian Journal of Public Administration, 55*, 26.

Filion, P., & McSpurren, K. (2007). Smart Growth and Development Reality: The Difficult Co-ordination of Land Use and Transport Objectives. *Urban Studies, 44*, 501 - 524.

Filion, P., & McSpurren, K. (2007). Smart Growth and Development Reality: The Difficult Co-ordination of Land Use and Transport Objectives. *Urban Studies, 44*, 501-524.

Forster, C. (2006). The Challenge of Change: Australian Cities and Urban Planning in the New Millennium. *Geographical Research, 44*, 173-182.

Fragkias, M., & Seto, K. C. (2007). Modeling urban growth in data-sparse environments: A new approach. *Environment and Planning B: Planning and Design, 34*, 858-883.

Gleeson, B., & Randolph, B. (2001). Social Planning and Disadvantage in the Sydney Context. *URBAN FRONTIERS PROGRAM ISSUES PAPERS*, 1-10.

Hall, P. (2002). *Urban & Regional Planning* (4th Edition ed.). London: Routledge.

Haywood, R. (2005). Co-ordinating Urban Development, Stations and Railway Services as a Component of Urban Sustainability: An Achievable Planning Goal in Britain? *Planning Theory & Practice, 6*, 71 - 97.

Haywood, R. (2005). Co-ordinating Urban Development, Stations and Railway Services as a Component of Urban Sustainability: An Achievable Planning Goal in Britain? *Planning Theory & Practice, 6*, 71-97.

Henriksson, A. T., Yi, Y., Frost, B., & Middleton, M. R. (2006). *Evaluation instrument for e-government websites.* Paper presented at the In Proceedings Internet Research 7.0: Internet Convergences.

Hohn, U., & Neuer, B. (2006). New urban governance: Institutional change and consequences for urban development. *European Planning Studies, 14*, 291 - 298.

Joshi, H., Guhathakurta, S., Konjevod, G., Crittenden, J., & Li, K. (2006). Simulating the effect of light rail on urban growth in Phoenix: An application of the UrbanSim modeling environment. *Journal of Urban Technology, 13*, 91-111.

K'Akumu, O. (2007). Sustain no city: An ecological conceptualization of urban development. *City, 11*, 221-228.

K'Akumu, O. A. (2007). Sustain no city: An ecological conceptualization of urban development. *City, 11*, 221 - 228.

King, J. (2006). Democracy in the Information Age. *Australian Journal of Public Administration, 65*, 16-32.

Kloot, L., & Martin, J. (2007). Public Sector Change, Organisational Culture and Financial Information: A Study of Local Government. *Australian Journal of Public Administration, 66*, 485-497.

Kluvers, R. (2003). Accountability for Performance in Local Government. *Australian Journal of Public Administration, 62*, 57-69.

Lewis, D. H. (2001). *Urban Development: The Logic Of Making Plans.*: Island Press.

Marinoni, O. (2005). A stochastic spatial decision support system based on PROMETHEE. *International Journal of Geographical Information Science, 19*, 51-68.

Meadowcroft, J. (1997). Planning, Democracy and the Challenge of Sustainable Development. *International Political Science Review, 18*, 167-189.

Nelson, A. C., Burby, R. J., Feser, E., Dawkins, C. J.*, et al.* (2004). Urban Containment and Central-City Revitalization. *Journal of the American Planning Association, 70*, 411 - 425.

Nijkamp, P., Borzacchiello, M. T., Ciuffo, B., & Torrieri, F. (2007). Sustainable Urban Land Use and Transportation Planning: A Cognitive Decision Support System for the Naples Metropolitan Area. *International Journal of Sustainable Transportation, 1*, 91-114.

Reddel, T. (2002). Beyond Participation, Hierarchies, Management and Markets: â€˜Newâ€™ Governance and Place Policies. *Australian Journal of Public Administration, 61*, 50.

Roberts, P. (1999). *Urban regeneration: A handbook.* London: Sage Publications.

Searle, G. (2004). the Limits to Urban Consolidation: A framework to assessing limits. *Australian Planner, 41*, 42-48.

Tregoning, H., Agyeman, J., & Shenot, C. (2002). Sprawl, Smart Growth and Sustainability. *Local Environment, 7*, 341-347.

Waddell, P., & Ulfarsson, G. (2004). Introduction to Urban Simulation: Design and Development of Operational Models. In D. A. Hensher, K. J. Button, K. E. Haynes & P. R. Stopher (Eds.), *Handbook of transport geography and spatial systems*. London: Elsevier.

Waddell, P., & Ulfarsson, G. (2004). Introduction to Urban Simulation: Design and Development of Operational Models. In B. topher, Kingsley, Hensher eds. (Ed.), *Handbook in Transport, Volume 5: Transport Geography and Spatial Systems* (pp. pages 203-236.): Pergamon Press.

Warburton, J., & Baker, G. (2005). Integrity Systems and Local Government. *Australian Journal of Public Administration, 64*, 62-68.

Wassmer, R. W. (2008). Causes of Urban Sprawl in the United States: Auto Reliance as Compared to Natural Evolution, Flight from Blight, and Local Revenue Reliance. *Journal of Policy Analysis and Management, 27*, 536-555.

Wekwete, K. H. (1997). Urban management: The recent experience. In C. Rakodi (Ed.), *The urban challenge in Africa: growth and management of its large cities.* TOKYO - NEW YORK - PARIS: United Nations University Press.

Westendorff, D. G. (2007). More Urban, Less Poor: An Introduction to Urban Development and Management. *Development in Practice, 17*, 461 - 463.

Wilmoth, D. (1987). Managing Urban Expansion: Sydney's Urban Development Programme. *Urban Policy and Research, 5*, 156 - 166.

Wilson, E. H., Hurd, H. D., Civco, D. L., Prisloe, M. P., & Arnold, C. (2003). Development of a geospatial model to quantify, describe and map urban growth. *Remote Sensing of Environment, 86*, 275-285.

Worthington, A. (2007). Australian Local Government Economics. *Australian Journal of Public Administration, 66*, 389-390.