Spatial planning, infrastructure and implementation: Implications for planning school curricula

Garth Klein, Neil Klug & Alison Todes

Abstract

Infrastructure plays key roles in shaping the spatial form of the city at a macro- and a more local scale, and it influences the sustainability, efficiency and inclusiveness of cities and local areas. Linking infrastructure and spatial planning is therefore critical. Wide-ranging sets of knowledge and skills are required to enable planners to make these links, from technical knowledge of different types of infrastructure delivery systems, institutions and finance, to normative dimensions, such as sustainability, inclusion, liveability, efficiency, and their spatial implications, to socio-political, governance and institutional dimensions, such as the politics of decision-making, community participation, and negotiation. A matrix of knowledge and skills is produced, and the way these fields of study have been taken up in the undergraduate/honours planning programme at the University of the Witwatersrand is explored. The teaching methodologies and approaches which might be used to address these issues are discussed.

RUIMTELIKE BEPLANNING, INFRASTRUKTUUR EN IMPLEMENTERING: IMPLIKASIES VIR DIE BEPLANNING VAN SKOOL KURRIKULUMS

Infrastruktuur speel 'n belangrike rol in die vorming van die stad op 'n makro en meer plaaslike skaal, en dit beïnvloed die volhoubaarheid, effektiwiteit en inklusiwiteit van stede en plaaslike areas. Dit is daarom krities om infrastruktuur en ruimtelike beplanning te koppel. 'n Wye verskeidenheid stelle van kennis en vaardighede word vereis om beplanners in staat te stel om hierdie koppeling, vanaf tegniese kennis oor verskillende tipes infrastruktuurleweringstelsels, instansies en finansies, tot normatiewe dimensies soos byvoorbeeld volhoubaarheid, inklusiwiteit, leefbaarheid, effektiwiteit en hul ruimtelike implikasies, tot sosiopolitieke, regerings- en institusionele dimensies, soos die politiek van besluitneming, gemeenskapsdeelname, en onderhandeling. 'n Matriks van kennis en vaardighede is geproduseer, en die manier waarop hierdie velde van studie in die voorgraadse/honneurs beplanningsprogramme aan die Universiteit van die Witwatersrand opgeneem is, word ontdek. Die onderrigmetodes en -benaderings wat gebruik mag word om hierdie sake aan te spreek, word bespreek.

MORALO WA SEBAKA, WA MARANGRANG A DIPALANGWANG LE MEBILA LE PHETHAHATSO YA TSONA: MATHATA A LENANE LAL DITHUTO (KHARIKHULAMO) LA MORALO WA SEKOLO

Marangrang dipalangwane le mebila e etsa mesebetsi ya bohlokwa ho bopa sebopeho sa sebaka sa motse wa ditoropo ka boholo le haholo ka tsa lehae., ebile a susumetsa ho boloka, bokgoni le ho kenyeletswa ha dibaka tsa metse ya ditoropo le tsa lehae. Ka mokgwa o jwalo, ho hokahanya marangrang a mebile le dipalangwang le moralo wa sebaka ke ntho e thata ruri. Ho hlokeha dihlopha tse batsi tsa tsebo le mahlale ho kgontsha baradi ho kgona ho etsa maqhaama ana, ho tswa tsebong e tshophodi ya mefuta e fapaneng ya mekgwa ya ho fana ka ditshebeletso ya marangrang, meaho le tsa ditjhelete maemong a phahameng jwaloka ho boloka, ho kenyeletsa, ho phela, le bokgoni) le mathata a tsona a sebaka, ho tsa kahisano le dipolotiki, ho busa le maemo a meaho, e kang dipolotiki tsa ho etsa diqeto, ho ikakgela ha setjhaba kapa baahi ka setotswana kgabong, le ho buisana. Sebopeho sa ditsela tsa tsebo le mahlale, le kamoo mafapha ana a boithuto a amohetsweng kateng lenanehong la moralo wa mane baithuti ba batjha ba qalang dithuto tsa yunivesithi kapa ba lengolo la honours mane Yunivesithing ya Witwatersrand o a ithutwa. Mekgwa ya ho ruta le dikatamelo eo e ka sebediswang ho sebetsa ditaba tsena e a buisanelwa.

1. INTRODUCTION

There is a growing recognition that infrastructure plays key roles in shaping the spatial form of the city at a macro- and a more local scale, and that it influences the sustainability, efficiency and inclusiveness of cities and local areas (UN-Habitat, 2009: 152). Infrastructure includes the following broad categories: physical infrastructure including transport; energy, water and drainage, waste; information, communication technology (ICT); green infrastructure including rivers, open spaces and coastlines, as well as community and social infrastructure including public space, health, education, community services and sometimes including low-cost (state-provided) housing.

Traditional forms of spatial planning assumed that infrastructure development and implementation would follow automatically from the production of master plans. However, this has not generally been the case in African cities. Rather, in many contexts, infrastructure departments have tended to ignore spatial plans. In addition, the failure of governments to build sufficient infrastructure to accommodate urban growth has meant that it is provided on a privatised basis for those who can afford it, either following development, or in small enclaves of the wealthy. Further, informal residential developments driven by the imperative of access to land rather than access to services is superseding master plans and tending to determine the direction and spatial form of cities. Where infrastructure is provided in these contexts, it follows existing developments, with detrimental impacts on issues of sustainability. New forms of strategic spatial planning address several of the problems associated with master planning, which has been criticised widely, but experience with this type of planning in South Africa and elsewhere suggests that the links to infrastructure development and implementation are also often insufficient. There are nevertheless interesting examples of initiatives to make these links both at the level of metropolitan planning (Todes, 2009) and within local

Mr Garth Klein, Senior Lecturer, School of Architecture and Planning, University of the Witwatersrand, Johannesburg, South Africa. Phone: 011-7177616, email: <Garth.Klein@wits.ac.za>

Mr Neil Klug, Senior Lecturer, School of Architecture and Planning, University of the Witwatersrand, Johannesburg, South Africa. Phone: 011-7177710, email: <Neil.Klug@wits.ac.za>

Prof. Alison Todes, School of Architecture and Planning, University of the Witwatersrand, Johannesburg, South Africa. Phone: 011-7177702, email: <Alison.Todes@wits.ac.za>

development programmes. Within international urban development circles, important arguments are being made that view infrastructure development as central to spatial planning (UN-Habitat, 2009: 152; Neuman, 2009; Angel, 2008; Mattingly, 2001; Devas, 1993: 88).

Planning of this sort, however, is not purely a technocratic approach in which spatial planners collaborate with engineers to agree on the directions for future development. Although it requires technical knowledge of infrastructure systems and their implications, and of questions of budgets, finances and management, it also needs to be informed by normative dimensions. It requires an understanding of the forces shaping city form, the politics influencing development and decisions, and the requirements of collaborative engagement which may be necessary to give effect to the planning-infrastructure link and to make implementation possible (Un-Habitat, 2009: 165; Todes, 2009: 10).

Wide-ranging sets of knowledge and skills are thus required for planners to be able to link spatial planning, infrastructure development and implementation – from technical knowledge of different types of infrastructure delivery systems and their links to spatial planning, to the way infrastructure influences urban spatial organisation at a city and a local scale, to connections to normative dimensions (sustainability, inclusiveness, efficiency, liveability), to an understanding of governance and institutional issues, finance and management, and the politics of decision-making, as well as an ability to engage in negotiation with agencies involved in infrastructure delivery, and community participation on the forms of infrastructure development in local areas.

Incorporating and integrating complex and diverse aspects of integrated development and infrastructure planning, tying this to spatial planning, understanding the technical logic, ensuring the application of abstract normative principles together with a finely attuned knowledge of institutional relationships poses huge challenges in teaching and learning in planning education. In the literature and ongoing debates about planning education there has been acknowledgement of the change of planners' roles (Cuthbert, 1994); the need to recognise the forces shaping planning education and the

need to draw from multiple theories of practice (Dalton, 2001: 423); the concern for the provision of appropriate entrepreneurship skills in planning education (Frank, 2007), and changes in social and economic conditions that call for a review of the core curriculum (Friedmann, 1996). For a thorough review of planning education literature over the past three decades, the work of Frank (Frank, 2006) is invaluable.

This article provides an overview of these links and connections, and produces a matrix of areas of knowledge and skills (Table 1). It explores the way these fields of study have been taken up in the undergraduate/honours planning programme at the University of the Witwatersrand, and considers the teaching methodologies and approaches which might be used to address these issues.

2. CONCEPTUALISING INFRASTRUCTURE-SPATIAL PLANNING RELATIONSHIPS

2.1 Spatial planning and infrastructure links[1]

Infrastructure plays an important role in shaping the spatial development of cities at a city wide and more local scale. This section considers some of these links, and their intersection with the normative objectives of sustainability, efficiency, liveability and inclusiveness.

Perhaps the most obvious link is between transport, land use and city form. At the heart of this relationship is the importance of accessibility for economic activity and residential developments, and its implications for land values. Thus, for example, economic activities requiring high levels of accessibility cluster around transport routes and nodes of importance to their users (Boarnet & Haughwout, 2000: 10). Housing developments also seek accessibility, thus the creation of new routes and transport systems influences the long-term spatial development of cities. Since higher income groups can pay for access, they are able to locate near to routes that support their preferred modes of transport, and are able to make choices about proximity and travel times.

It is often argued that highways underlie suburbanisation and urban sprawl, both of which are generally viewed as

antithetical to the objectives of sustainability. These relationships, however, are debated (Boarnet & Haughwout, 2000: 6). The spatial form of cities is of course influenced by a range of social, political, institutional and regulatory conditions in various contexts, and these need to be understood in considering city form. Low-density cities structured around the motor car are often difficult to access for those unable to afford or use cars. A focus on the motor car neglects pedestrian and non-motorised transport which is so important in developing countries (Behrens, 2005; Rao & Sharma, 1995). The design and layout of local areas are important in shaping ease of movement, safety and convenience for pedestrians or people using non-motorised transport, and for the viability and frequency of public transport (Behrens & Watson, 1996: 76; Curtis, 2005).

Public transport systems can also influence the spatial organisation of cities, with differences between rail, tram, bus and taxi systems (Cervero, 2004). Rail lines and train stations may help to create a set of nodes around which development occurs. Buses are more flexible, and require lower densities to operate. They are less likely to have much impact on spatial organisation, but the use of dedicated bus-ways creates more structured routes around which more intense development can occur. Taxi systems can operate under congested conditions, but also emerge in sprawling low-density cities. Their flexibility means that they can operate in a variety of contexts, but major collection points can become significant places for the emergence of markets, particularly those focused on informal trade.

Water, sewerage, electricity and telecommunications systems also shape the spatial form of cities, particularly through large fixed investments and the availability of capacity which enable growth in specific areas. Stand-alone systems of water, sewerage and energy provision such as sewerage package plants, septic tanks, water tankers, solar energy, and so on are alternatives to connection to major networks, allow more diverse development, and have varying implications for sustainability and inclusion.

There is still some debate over the influence of information and communication technologies (ICTs) on urban form. While new patterns of work from home

---

1 This section draws from work undertaken towards chapter 8 of UN-Habitat (2009).

are evident, predictions that cities and central places would disappear have not been borne out as a consequence of agglomeration economies and the importance of interpersonal contact. Nevertheless, greater shifts may occur over the long term. Physical infrastructure associated with ICTs follows the lines of other infrastructure such as roads, electricity, sewerage and water pipelines (Rutherford, 2008). Infrastructure to support new technologies is generally provided by the private sector and follows customers, so that digital divides tend to overlay patterns of wealth and poverty in cities (Odendaal & Duminy, 2008).

An emerging concept in the UK and the United States is that of green infrastructure. One useful definition by the Conservation Fund, an American organisation, is "an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations" (Benedict & McMahon, n.d.: 5). For them, green infrastructure differs from conventional approaches to open-space planning in that it deals with conservation values and actions together with land development, growth management and physical infrastructure planning. Green infrastructure is having an increasingly significant impact on urban form, whether it be sensitive grassland areas, wetland areas or coastlines, as it usually constrains urban development in these areas, resulting in either further urban sprawl or the need to densify developments. In some instances, the need to conserve green infrastructure can result in increased physical infrastructure costs whether it be bridging wetland areas or having to extend bulk physical infrastructure such as pipelines over conservation areas in order to reach developments. Green infrastructure is also key to urban sustainability. Appropriately addressed, it helps to protect against disasters and other hazards associated with climate change, and also affects spatial quality and liveability in cities.

The spatial form of cities, their liveability and inclusiveness, is also shaped by access to a large number of facilities and amenities, including places of education; health facilities; libraries; crèches; safe spaces for recreation; spaces for religious and cultural practices; markets and retail outlets, and spaces for economic activity. Analysis of the supply and demand for a range of social facilities, norms and standards for facility provision to ensure access, and their appropriate spatial organisation remain important elements of planning and help to structure cities at various scales (Green & Tansy, 2011). Planning needs to create places that address the daily needs of diverse groups of people: men and women; old and young; the disabled; sexual minorities; different cultural groups, and so on. Understanding and responding to these diverse needs is an important part of the skill set for planners, and can include drawing on traditions of gender analysis and gender mainstreaming, as well as a range of other methodologies associated with planning for diversity. Participatory approaches and methodologies may be key in this instance.

Understanding the diverse space and infrastructural needs of various economic activities and livelihood strategies are also critical. For example, informal trading activities are sensitive to pedestrian movement, and cluster in points of high access.

2.2 The technical logic of infrastructure delivery

Similarly, understanding the implicit technical logic of infrastructure delivery in relation to the variables of cost, terrain, built form densities and affordability/maintenance capacities is also essential, particularly with regards to roads, water, sewage, and electricity.

At the macro- or city wide scale bulk infrastructure constitutes a significant proportion of the development cost to a city. To get a sense of magnitude of cost, a new water treatment plant that can treat about 15 million litres of potable water a day costs in the order of R600 million (Wait, 2010). To give this figure some comparative value, the entire Johannesburg budget for 2008/2009 was R26 billion, of which the entire housing budget amounted to R637 million. Further evidence that even the cost of maintaining these bulk infrastructure facilities is proving prohibitive to smaller local municipalities in South Africa, is the Department of Water Affairs' (DWAF) finding that there is a mere 3% compliance level, with only 32 out of the country's approximately 970 water treatment plants meeting safe discharge requirements, (Naidoo, 2010: online). Given the above, it can be assumed that only a limited number of these bulk infrastructure facilities and associated bulk network could be built within a city wide area within a particular timeframe due to cost constraints. By implication, the location of these facilities then tends to have a significant influence on where development of a particular density can and cannot occur over time (in a sustainable and efficient manner). Therefore, their locality has to be carefully considered against a wide range of factors, given their impact on spatial growth within an urban area. From a terrain perspective, both water and sewage are gravity flow. As such, at a crude level the least cost option would be to run bulk infrastructure networks down a valley line as opposed to across in order to avoid expensive capital and maintenance costs of pumps. Similarly, road and rail should run along valleys as opposed to across them in order to avoid expensive bridges. With regards to densities of built form, a study in South Africa in 2000 concluded that "in terms of the provision of services, ... densification or compaction is not necessarily the cost-effective alternative, in all situations and under all conditions" (Biermann, 2000: 1). Related to the issue of densities is the ability of the residents to afford the maintenance of the bulk service infrastructure network through their rates. On the other side of the coin is the capacity of the local government to maintain these networks.

However, the issues of cost and affordability have a greater technical logic in terms of the infrastructure services delivery at the micro- or local scales. Firstly, the logic that potable water should not be piped onto a site that does not have a means of either treating the utilised water on site or disposing of the water off site is fundamental. This is to effectively avoid the spread of waterborne diseases through the accumulation of polluted water. Therefore, if potable water is piped onto a site, it has to have a waterborne system that pipes the used water off site via a bulk pipe or either a treatment plant serving a small number of units or alternatively an on-site disposal system. With the former options densities of built form can be high while the last option requires minimum plot sizes based on the geotechnical conditions of the particular areas. The decision on whether to pipe potable water onto a site in the first place is, therefore, often based on resident affordability levels. Alternative methods of water delivery, i.e. standpipes and communal facilities, immediately limit the densities of built form possible. Secondly, from a purely technical perspective, minimum frequency of usage is required of waterborne systems to keep them

unblocked, which again determines a minimum population density for such a system to be used effectively.

Low-cost housing, sometimes considered or argued to be a form of infrastructure, has also had major impacts on the built form of South African cities. The fact is that the unintended consequences of buying cheap land for low-cost housing has resulted in them being built on the peripheries of urban areas. Furthermore, their low density has significantly contributed to the sprawl of South African cities, often in opposing directions to planned infrastructure delivery.

2.3 Finance and management

As suggested earlier, the financing of bulk infrastructure is a major issue for local governments in South Africa. These can be broken into three 'big ticket' items for the cities:

- infrastructure top-ups for low-cost housing backlogs (arguably part of the green infrastructure);

- infrastructure for growth (notably roads, storm water, water and sanitation), also new transport service infrastructure, and

- maintenance and refurbishment backlogs, notably roads, storm water, water and sanitation (Hunter, Van Ryneveld & Yorke, 2007: 49).

In the case of eThekwini, in 2007 it was estimated that the city had to spend R20.000 of the R30.000 unit cost for surfaced roads, storm water drains, and waterborne sewage. For an annual housing delivery target of 16.000 units (as set by the National Housing Department), the Council would have to contribute R320 million per annum in just CAPEX costs (Hunter *et al*., 2007: 44).

In 2009 eThekwini appointed consultants to undertake the preparation of scenarios regarding the cost implications of addressing the housing backlogs and associated infrastructure delivery. Two scenarios were prepared, broadly outlined as follows: the first a 'base scenario' was based on providing 16.000 'RDP'-style houses per annum (which would not eliminate the housing backlogs by 2019), and removing the water but not the sanitation backlog by 2019. The second was based on a 'social scenario' of providing everyone with housing, with a strong focus on incremental housing and getting rid of the sanitation and electricity backlogs by 2019.The findings were that, in the case

of the first scenario, the city could just afford it at current capital budget allocations (assuming an economic growth rate of above 3% per annum for the city), and that rehabilitation of existing infrastructure would be compromised. In the second scenario, it was found that it would be "very difficult to cut without sacrificing the long term sustainability of the city" (Palmer, 2009: 6).

With regards to infrastructure delivery for growth, one of the conventional ways of ensuring physical infrastructure provision to coincide with development is through developer contributions, i.e. a capital contribution per development by the developers. However, a problem faced in Johannesburg is that, through a combination of accumulated existing development rights and uncoordinated developments, the developer contributions are not sufficient to cover the capital costs of the required bulk infrastructure for expected growth (Klug & Naik, 2008: 54). This either results in the inadequate provision of physical infrastructure, development being halted, or alternatively private sector investment provision of this infrastructure determining urban form and growth in these areas.

With regard to maintenance and refurbishment the SACN report (Hunter *et al*., 2007: 46) concludes that most South African urban areas have grown between 2001 and 2004 and few if any have been able to match infrastructure provision with the growth. The issue of waste-water management alone is clearly articulated in the following excerpt by an expert water services consultant Kathy Eales who said,

> the widespread failure to upgrade and maintain infrastructure over many years could cost billions of rand to remedy. This was mainly due to government's focus on eradicating service backlogs and expanding service coverage, while failing at the same time to give adequate attention to expanding and upgrading the supporting infrastructure for wastewater collection and treatment as well (Naidoo, 2010: online).

With regard to operating costs, the SACN report found that local municipalities have been underspending on maintenance, i.e. with the major cities only spending between 2% and 14% of their operating budgets on repairs and maintenance. This suggests that asset stripping is taking place and that major refurbishments will be required in the near future to maintain the current

level of services (Hunter *et al*., 2007: 28-29). In response to the above growth, refurbishment and maintenance issues, municipalities have begun to explore public-private partnerships and other alternative approaches to finance their infrastructure programmes (Hunter *et al*., 2007: 47).

Internationally, the current trend in developing countries is to develop public-private partnerships for the provision of affordable and sustainable infrastructure services. To this end, the World Bank Institute's Public Private Partnerships in Infrastructure programme has been established to support developing countries' efforts to establish a sound regulatory and business environment conducive to the development of these public-private partnerships (World Bank, 2010).

Obviously, a danger in these partnerships is that the private financing of infrastructure could result in significant private sector influence on the location and nature of the delivery of such infrastructure, potentially influencing spatial patterns of development in ways which may not always be in a city's interest (UN Habitat, 2009: 154).

The above illustrates the importance of including in any planning curriculum an understanding of capital and operating expenditure and budgetary cycles with regard to infrastructure as well as an understanding of the infrastructure cost implications when planning for other developmental aspects such as low-cost housing or economic growth. In addition, there is a need to include the institutional dimensions of cooperative governance as well as institutional implementation tools such as understanding private-public partnership (PPP) arrangements. These aspects add to the more traditional understanding of engineering aspects of development linked to local layouts and site development, which remain important elements of a relevant planning curriculum.

2.4 Governance, political and institutional dimensions

While spatial planning aims to give direction to where and how infrastructure is provided, agencies which control the provision of infrastructure are usually in other departments within local government and/or at provincial and national level. Silo-ised prioritisation and delivery of infrastructure is common across levels of government and within local government. Planning education thus needs to provide the understanding,

tools and skills to enable graduates to be effective in this context.

Integrated development planning, as an approach to planning, attempts to link together the work of different departments, governments and agencies around a common analysis and plan for the future development of an area, including infrastructure development and its links to spatial planning. The methodologies associated with this kind of planning (multi-sectoral analysis and projections, visioning, scenario-building, strategic thinking, the formulation of development strategies, programmes and projects, *inter alia*) would form an important element of a curriculum focused on developing the link between infrastructure and spatial planning. It would also be critical for students to gain an understanding of governance and institutional frameworks within their local contexts, and inter-institutional dynamics within local government and across levels/spheres of government. Theories and methodologies on how institutions relate, make decisions, and the way in which power and politics shape outcomes (and the influence of extra-governmental forces) would also be significant. Processes and methodologies of participation, forms of collaborative planning (and the difficulties and limits of these processes) would also be key in both developing appropriate forms of integrated development planning and linking infrastructure and spatial planning.

Getting beyond silo-ised delivery systems that make integrated development and infrastructure planning well linked to spatial planning will not be the result of a plan on paper, but will require active engagement with infrastructure departments and the skills of negotiation and mediation in order to carry it through. Planners in this context require an understanding of the technical logic of various types of infrastructure development, its timing/scheduling and the implications of finance and budgets for delivery. Thus linking infrastructure with spatial planning requires a better understanding of the technical and financial dimensions of infrastructure development, but also an engagement with methodologies that assist in carrying through ideas and approaches within institutions. Several institutional theories help to explain how and why working in 'integrated' ways is so difficult, and begin to explore how this might be done.

The redevelopment or regeneration of particular parts of the city may be important dimensions of spatial planning and frequently involve infrastructure planning as part of broader integrated area-based initiatives. This type of planning requires an ability to analyse the context, to formulate multi-sectoral local development plans that are strategic, and bring together key agencies, actors and communities working in an area (reading the politics of this context),as well as to project manage processes of change. It requires an understanding of strategies and approaches to this kind of development, as well as an appreciation of the limits and potentials of infrastructure development in this context.

With respect to governance issues, major metropolitan areas such as Johannesburg have come to recognise the importance of the link between infrastructure delivery and spatial planning through the recent development of the Growth Management Strategy (GMS). The GMS was first formally adopted in Johannesburg in 2008 and offers some interesting approaches in terms of linking infrastructure provision to spatial planning. The GMS seeks to achieve the following:

- Determination of priority areas for short medium-term investment and allocation of future development rights;

- Re-directing of the respective capital investment programmes of the City's service providers to address the short-term hotspots and strategic priority areas;

- Limiting of future development rights in infrastructure hotspot areas within the City until backlogs have been addressed;

- Identifying of priority investment areas for the public and private sector, specifically in respect of municipal infrastructure;

- Introduction of development conditions that are congruent with global best-practice standards relating to resource efficiency (energy, water, fuel);

- Introduction of development obligations relating to the full spectrum of inclusionary housing (i.e. subsidized housing, bonded, rental / social housing) in identified priority areas;

- Application of a package of incentives to promote and facilitate development that subscribes to the

socio-economic and spatial imperatives of the City; and

- Establish monitoring and evaluation mechanisms to review the status of the infrastructure hotspots and the limitations placed on these areas (CoJ, 2008: 6).

Other examples of planning tools used in South Africa to assist planners in their negotiations around infrastructure provision include spatial development frameworks, cost surfaces models, and analysis of social facility provision. Spatial Development Frameworks (SDFs) are long-term strategic plans that attempt to spatially indicate where future development should or should not take place. The cost surface model used in eThekwini, as with the SDF, is used in conjunction with the delineation of an 'urban edge' beyond which service delivery becomes unsustainable. The cost surface model is a powerful tool for indicating relative costs of infrastructure and servicing sites at a strategic level (Breetzke, 2008). As such it can be used as a basis for comparing the costs of infrastructure, land and transport across a city. Both eThekwini and the City of Cape Town together with the Council for Scientific and Industrial Research have undertaken analyses of social facility provision and access, using norms and standards for facilities (CSIR, 2010; Green & Tansy, 2011). In the case of eThekwini, this kind of analysis was invaluable in moving towards a more rational provision of facilities in new housing projects, rather than seeing them in isolation, and in enabling clustering in nodes and corridors identified by spatial planning (Breetzke, 2008).

In order to achieve the above aims the following skills would be required: an understanding of land-use planning and rights; project preparation and project management; CAPEX budgets; technical knowledge of the various physical infrastructure components; a knowledge of the South African housing policies as well as practices regarding incentive mechanisms, and finally a knowledge of monitoring and evaluation mechanisms. Johannesburg's growth management strategy and eThekwini's cost surface model have also depended on extensive consultative processes with stakeholders and negotiation within the bureaucracy, pointing to the importance of these areas of skills and knowledge. The human factor, including experience, interpersonal skills and the ability to overcome obstacles are clearly critical.

3. THE UNIVERSITY OF WITWATERSRAND, PLANNING PROGRAMME – CASE STUDY

As a case study we will describe how infrastructure and spatial planning is taught in the Undergraduate/Honours Urban and Regional Planning Course at the University of Witwatersrand, and attempt to reflect on its strengths and weaknesses. The main points are also contained in Table 1.

The notion of infrastructure is first introduced at a second-year level (in the first semester) where the technical specifications of the various infrastructure aspects are covered in terms of the range of types, how they work, as well as where and under what conditions the various types are most appropriately utilised. This is undertaken by the civil engineering department and is taught by a technical engineering specialist. This teaching is undertaken through a series of lectures. However, field trips to see these particular infrastructure facilities in operation would also be very useful. On the institutional side, broad concepts of policy and policymaking in the context of cooperative governance is also introduced in the second year in the course Development Policy and Processes, which also considers policy on gender, poverty and related dimensions.

The second aspect of the teaching is to explore the various approaches that could be taken in relation to infrastructure service delivery. Key themes underpinning such approaches are environmental sustainability, community participation in the delivery process, and appropriate technologies. These approaches are all incorporated into a single course covering housing, infrastructure and transport delivery. As such, this course also includes viewing infrastructure delivery in a broader developmental sense, taking into account the political, economic, social and environmental prerogatives. The teaching methods used include using lectures, case study analysis to identify best practices, comparative studies, again to identify best practices, and a field trip. Additional methods which would be useful include role-playing techniques to give students a sense of the tensions and disparate demands associated with infrastructure delivery.

The environmental aspects of planning and implicitly service provision are covered in the second-year environmental management course. In this course the impacts of infrastructure and development on the environment and vice versa are covered. It embodies the concepts of sustainability, particularly under the umbrella of sustainable city infrastructure. In addition, in the first half of the second year, infrastructure management is addressed in the land management course. This course examines the links between strategic spatial planning and development management, which implicitly includes infrastructure and services management.

In second year, the Histories and Futures of Planning and Philosophies of Planning courses involve understanding communities and community participation, as well as critical perspectives on planning and its history. This allows for reflection on the nature of planning as an activity and should help to avoid modernist conceptions of planning as a plan on paper that is rolled out by the state.

In 2010/11 the School of Architecture and Planning was engaged in an all-school vertical project (in other words, across all years of study) termed Yeoville Studio. This has allowed for an intense study together with traders, school learners and restaurants in the Inner City neighbourhood of Yeoville. The close engagement has picked up on the diverse groups of people in cities and their needs and perceptions. This is related to concepts regarding diversity, theories of conflict, power and communicative theories inherent in contemporary planning theory. The positive benefit of this engagement in the form of a case study has been valuable in developing depth of understanding. The second year of study includes design-based courses that link physical design to the underlying philosophies and the socio-political relationship with quality of environment. Greater emphasis on infrastructure in design would be ideal but is often constrained by time.

Courses on integrated development planning and regional planning introduce municipal and regional analysis (demographic, economies, environment, spatial, and so on), scenarios and visioning which provide the basis for understanding future development. These courses also include spatial framework planning, and the role of infrastructure. They attempt to deal with planning as a strategic activity based on contextual analysis and assessment of what is possible. The institutional aspects of how cooperative governance between sector departments can be undertaken and methods of implementation, including PPP's, may require additional emphasis in these courses.

The course African Cities picks up the realities of many of the contexts in which we work, which includes the nature of the state, capacity questions, the predominance of informality in African cities, and infrastructure/service delivery crises in many cities. The course Johannesburg as a City in Africa picks up on institutional issues. Two optional courses in third year also take these dimensions further – the urban politics course picks up on this dimension, while the housing course deals with housing as a form of infrastructure, but also the various social needs in the city and the way in which housing and housing policy relate to it.

Finally, in the Honours year, students undertake an integrated planning project in which a particular study area is selected and prepare a spatial plan for the area incorporating infrastructure delivery strategies, i.e. bringing it all together.

The Wits course thus covers many of the dimensions that are important in understanding infrastructure-spatial planning links and in enabling students to give effect to these links in practice, though it may be weaker on finance and management dimensions than is desirable. It could also be argued that learning is not necessarily tied to infrastructure-planning links (e.g. students learning about politics and power, but not necessarily how it relates to this topic). Thus students may experience this learning in a fragmented way and may miss the overall story or the connections between different components. This could perhaps be rectified through the use of case studies at critical moments, particularly in the fourth-year integrated planning project. The constant battle between adding more content within the ever broadening field of planning and the time constraints seem to be a common issue raised by many colleagues in both our programme and other planning schools. This tension between quantity and the ability to develop deep learning/problem-solving may begin to be addressed through different pedagogic approaches.

4. POSSIBLE PEDAGOGIC APPROACHES

The above discussion has highlighted a growing number of areas of learning which need attention, and the need to integrate all these different aspects poses ever-increasing pressures for us to constantly review pedagogic approaches.

Reflecting on learning and teaching practices, possibly most, if not all, planning schools can articulate a set of competencies required by planners to operate skillfully in contemporary urban environments. Moreover, planning schools can articulate, in one form or another, how, where and why we teach key substantive concepts such as infrastructure, governance and spatial planning. The challenge to embed key contemporary societal, economic and political issues such as environmental sustainability are most often recognised and incorporated into our curricula even if occasionally cursorily. Similarly, most schools will reflect on the way(s) in which each of these topics are taught. These modes of teaching include, for example, studio/project-based, chalk-and-talk, seminar series, and so on. What seems to be lacking, however, is clarity on what key ingredients are required to move from a set of competencies and different instruction modes to how it may be possible to integrate the complex and diverse set of issues set out in this article through different teaching and learning strategies or methodologies. In other words, what are the pedagogic approaches and how do we test these?

Table 1 maps the key areas of knowledge, how they are addressed in our courses, and possible methodologies. In addressing the rubric set out in this article we have been able to identify each of the core competencies required by planners when scrutinising our own courses and where key areas are taught.

In identifying a list of the areas of knowledge we believe are necessary to equip students with, the rubric indicates the title of the course or topic and the key instruction mode. In laying out this critical assessment, we have identified some of the gaps in the teaching of the relationships between spatial planning infrastructure and other logics. Some teaching and learning methodologies are then outlined in the Table. It

is apparent that a combination of methodologies are appropriate for different types of material, ranging from traditional lectures to seminars to studio projects, to engagement in live projects, and to the use of gaming and case studies (e.g. of the City of Johannesburg's growth management strategies and the participatory and collaborative processes, as well as the institutional engagement which has been required to make it work).

These discussions open a critical debate that recognises the need to reflect on teaching and learning methods that (a) are able to deal with the complexity of integrating key aspects such as the relationships between spatial planning and the logics of infrastructure, finance and management institutional dimensions and normative ideals inherent in planning, and (b) if it is indeed possible to understand this complex set of arrangements, what methodologies are available/appropriate to draw these skills together.

Whether or not one agrees with the notion of competencies, they do indicate the need for some strategies for teaching and learning and for the skills required to work as a planner. Furthermore, not to underestimate the importance of core competencies in any educational setting, these knowledge areas are pointless if not underscored by some notion of 'critical thinking' or if these detail a set of items to be ticked off as a checklist. The idea of critical thinking, which is subject to a range of definitions depending on the philosophical approach, will also depend on teaching methods, assessment, application, levels of autonomy, and so on. Competencies cannot be assumed to emerge from a set of instructional inputs. The list of core competencies set out in planning institutions such as the set of competencies outlined in the Bloemfontein Competencies (cited in Harrison, Todes & Watson, 2008: 255), the competencies required by the Planning Institute of Australia,[2] and the RTPI Education Commissions Report (2003) certainly all aspire to "a shift from instructional input to indicative learning outcomes as the driving force" (Boyle, 2003: 356). The question is what methods are available and what can work better.

The relationship between core competencies, the development of critical

thinking skills together with different teaching and learning methods, we would argue, set the basis for a more rigorous approach to being able to deal with the different logics and dimensions inherent in the link between infrastructure and spatial planning. Some pedagogic approaches such as seminars, case studies and scenario-building continue to be useful in teaching ways in which to grapple the multifaceted nature of planning. A further range of pedagogic approaches have been suggested in planning literature education and tested out in one way or another – from work-based education (see, for example, Freestone, Thompson & Williams, 2006) to problem-based learning (Shepherd & Cosgrif, 1998), role playing (for example, Richmond, 2007) and other aspects of gaming simulation (Barclay, 2010) together with innovative ideas such as 'entrepreneurship and enterprise skills' (Frank, 2007) and communities of practice (Schweizer, Howard & Doran, 2008). However, what is critical, is how these may be taught (the details of the method), when they are taught (at what level of the curriculum) and how this leads to critical thinking skills. In terms of drawing different aspects of integrated development and infrastructure planning and tying this to spatial planning it would appear that hybrid methods are possibly the most ideal. From our experience at the Honours year level of the BSc URP course, for example, the students are mature enough to begin to juggle the different aspects, can deal with the nature of problem-solving and can interrogate the different logics associated with spatial planning. However, we have been disappointed in the depth and level of developing spatial frameworks, and the students' ability to communicate the strategy. We should also add that adopting a problem-based learning approach is time consuming.

In more general terms, we would argue that the most ideal teaching methods are those which are field-related, and which can be linked to a problem – in this sense a typical 'problem-based learning approach', but this probably can only occur at the more senior years of study. Developing a problem-based learning approach can also result in false expectations of both communities and students. In order to overcome this, extensive community interaction was required in the Yeoville studio project. Purely research-based projects, although

---

2   See, for example, pp. 8-12 of the Accreditation Policy for the Recognition Of Australian Planning Qualifications, adopted by PIA National Council on 18 November 2010 (PIA, 2010).

ideal in certain circumstances, result in a failure to appreciate the socio-political and institutional dimensions and to slip into decontextualisation. Similarly, purely technically focussed courses or those courses relying only on theory fail to address the complexities of the nature of planning. Other issues that need to be considered in applying different pedagogic approaches include our expectations for planning students as young adults to be able to engage maturely with some of the complexities involved in, for example, community-based projects. Certainly some of these issues emerged during the Yeoville Studio projects. Although our experience and commitment to projects that involve extended field trips, studio-based learning and engagement outside of the traditional classroom remains a high priority, staff capacity, cost, time frames and organisation of such pedagogic approaches are often prohibitive.

Developing natural inquisitiveness in students, producing less dependent learners, improving on basic skills such as writing, graphic and verbal communicative skills, all remain high on the agenda of improved teaching and learning in the often diverse classroom. Transferring of skills from one course to another horizontally in a year and vertically between years remains a continued challenge in teaching and learning strategies.

Finally, in raising some of the pedagogic challenges, there is a further need to consider the extent of continually adding the ever-broadening nature of planning without considering the impact of this on workloads.

While we do not suggest any ideal 'best' practice, what we do suggest is the need to begin to document our teaching methods and learning strategies in order to develop empirical data and methodologies that begin to assess these different pedagogic methods in the light of the need to understand the logics, dimensions and complexities of planning.

5. CONCLUDING COMMENTS

Given all of the above, the curriculum dealing with spatial planning and infrastructure should always maintain a critical view of the underlying concepts as explored, for example, by Allmendinger & Haughton (2009) in their commentary on spatial planning in the UK.

It is becoming more universally acknowledged that the main aim of spatial planning concerns itself with integration and delivery/implementation (Morphet, 2011: 287; Taylor, 2010: 99, 105). Therefore, the key challenge in teaching spatial planning and infrastructure planning is the interpersonal skills required to ensure integration between organisations' activities as well as the many and varied skills required to facilitate implementation which is often beyond the immediate control of planners. In our case study of our activities at Wits, we have identified some of the skills and areas of teaching them but they remain fragmented. Further documentation of pedagogic approaches to deal with the complexities of teaching spatial planning and infrastructure will be a valuable addition to planning literature in Africa.

Finally, questions might be raised about whether the ways of thinking about spatial planning infrastructure links outlined in this article still assume a well-functioning formal system, and essentially constructs planning in a technocratic modernist form. Ironically, the push to link infrastructure to spatial planning is viewed as an alternative to traditional forms of spatial planning focussed largely on land-use management and development control which assumed that the state could control these activities. Nevertheless, there are dangers that a paradigm of linking infrastructure to spatial planning becomes a new form of spatial engineering, or that it fails in the face of the real politics shaping the way development occurs – as has been the case in some initiatives to do this. This prospect can be mitigated by a strong contextual understanding, attention to the politics and institutional questions that face this kind of planning, and a critical view of planning that avoids conceptualising planning as a technocratic activity that is rolled out over space, and understands it as strategic set of interventions in a city shaped by many actors and forces.

ACKNOWLEDGEMENTS

Table 1: Matrix of areas of knowledge and skills

Content areas -		Teaching methodologies			
		Some examples[1]	Relates to core competencies/ Knowledge areas[2]	Teaching methods what we do[3]	Gaps and comments
Normative dimensions	Sustainability / resilience	2 Environmental course	Environment	Project[4], lecture/ talk and chalk[5], role play	Does not link directly to infrastructure or to logics of socio political
		2 Design Course	Design and Layout + IT	Field based project with studio. Participatory Design process with community based project	Does not address the logic of infrastructure or implications of Finance and Management
		2 Infrastructure, Housing and Services	Sustainability	Seminars	Deals with concepts, but could be experienced as disjointed from considerations around infrastructure
	Efficiency + productivity	2 Housing Infrastructure and Services	Service Delivery	Lectures and case studies	Some links made to alternative service delivery
	Liveability + spatial quality	2 Design course	IT + Place making + Layout	Community participatory methods	The course attempts to work with the City of Johannesburg or a community in trying to identify what concepts such as 'liveability' actually look like
		3 Design specialist stream	Design + Place making + 2 and 3 Dimensional communication	Studio based design (in the Architectural tradition)	Does not necessarily link to infrastructure and finance and management
	Right to the City + inclusion + poverty, gender, inclusion Diversity	2 Philosophies and Theories	Research.	Seminar + lecture	Does not articulate easily with infrastructure, finance and management.
		4 Advanced Planning Thought	Theories	Seminar + Lecture	While students have a good theoretical understanding, the ability to translate this into infrastructure, finance and management may be lacking. However, the normative positions from this course have been well integrated and applied to the Integrated Planning Project course in the same year of study.
		2 Development Policies and processes	Gender, poverty exclusion, policy making	Seminar, role playing and lectures	Not specifically related to infrastructure
		2 Histories of Planning	Community participation, working as a team	Field based project. Problem based learning + lecture	Infrastructure as it relates to local scale and conflict, power and communication drawn in.
		4 Integrated Planning Project	Normative dimensions of spatial planning and its implications	Intensive field project – international field trip. Elements of PBL + Seminars + Scenario Building	Appears to work well – learners carefully consider normative position in developing the Spatial framework. However, may be insufficient in linking to infrastructure

1   Number refers to the year of study (e.g. 2 is second year of study)

2   These reflect a range of areas of knowledge or competencies expected by planning graduates. They are generic and indicative rather than being specific.

3   These are some of the methods we use. It is not a comprehensive list but outlines a variety rather than getting into specific methods. A combination of methods are possible, including: Problem based Learning (PBL); Game simulation models for participation, collaboration, negotiation and illustration of implications of processes; Seminar based for critical thinking and concepts; Lecture based for certain aspects, overviews, technical information; Scenario Building; Case Studies of attempts to link infrastructure and planning (e.g. Jo'burg GMS, eThekwini) looking at both the technical and institutional/political issues

4   Project can take on a number of meanings. For example it may include anything from a poster presentation to a more intensive overnight field trip that may or may not have a range of real life situations built into it. Projects may or may not include weekly studio sessions. Studios are intensive three to six hour sessions per week where there is an iterative process of student presentations, one on one feed back and group collaborative work.

5   Chalk and talk is not necessarily seen as a negative teaching method. It refers to traditional lecture methods which are seen as valuable in some contexts.

Content areas -		Teaching methodologies			
		Some examples[1]	Relates to core competencies/ Knowledge areas[2]	Teaching methods what we do[3]	Gaps and comments
Logics and implications of/for finance and management	City governance	3 Integrated Development Planning (IDP)	Integrated Planning, data collection and analysis	Field based project + intensive studio sessions	Does not deal with links to infrastructure planning directly. But valuable in understanding policy and institutional frameworks and dynamics
		3 Johannesburg as a City in Africa	Institutional dimensions/issues	Lectures/seminars by a practitioner who worked in strategic planning section of the municipality	Valuable in being able to reflect from experience
		2 Land management	Land management	Lectures and project with studio	Does not reflect relationship between governance, finance and infrastructure
		4 Integrated Planning Project (IPP)	Integrated planning + spatial planning + working across scales	Intensive field project – international field trip. Elements of PBL + Seminars + Scenario Building	The course attempts to draw together a full range of competencies/ fields of knowledge. The international field trip has been highly successful and builds on aspects of phenomenological teaching methods (building on individual life and learning experiences). Student voice is built into the project. However, institutional dimensions may be lacking
	Finance + budgets revenue costs	3 IDP (to an extent)	Integrated Development Planning	Lectures	Might be too limited
		4 IPP	Budgeting and phasing	Project	Skills inadequate to apply to the spatial framework
	Planning systems and tools	3 IDP	Integrated planning	Lectures + Applied project	Might be too limited
		4 IPP	Spatial Frameworks	As stated above + the theoretical 'tools' aspect of this course is done through a series of group seminars	Transfer of the tools not realised in the relationship between infrastructure, budgets and finance, implementation and spatial plans
		2 Land management	Land use systems, infrastructure management	Lectures, applied project	Lacking in institutional understanding
		3 Regional Planning –	Regional scale, spatial distribution relationship to infrastructure	Lectures, seminar + applied project	
	Demographics and economics	3 IDP, regional, LED	Urban and regional Contexts, Demographics and economics	Seminars, lectures, project	Not specifically related to infrastructure
		3 African Cities	Urban contexts	Movies, Seminar, project, lectures	Useful in developing contextual understanding
	Institutional arrangements	4 IPP	Comparative systems	International Field Trip encourages reflection of institutional arrangement and spatial form	This aspect works well. There appears to be an understanding of different systems (possibly picked up in 3rd year comparative African Cities courses)

Content areas -		Teaching methodologies			
		Some examples[1]	Relates to core competencies/ Knowledge areas[2]	Teaching methods what we do[3]	Gaps and comments
(Technical logic) the logics of infrastructure	Infrastructure, utilities (E.g. roads, water, etc)	2 Land management, Urban Design, civil engineering, Housing Infrastructure, services and transport	Local layout, IDP, Land management, Urban Design	Traditional lectures, studio, projects, case studies	
	Green infrastructure	Environmental Planning	Environment	Lectures, seminars	May not be sufficiently spatial
	Spatial logic (local)	1 , 2 and 3 Design Courses	Design, layout	Lectures, seminars, projects and studio	May not connect directly with infrastructure (broadly dealt with + reliance from civil engineering knowledge) and there are gaps in implementation
		2 Housing infrastructure and services	Infrastructure delivery types	Lectures and case studies	
	Spatial logic (City scale and Urban form)	2 Housing Infrastructure and Services	Infrastructure and spatial form	Lectures and project work	Local scale infrastructure understood but logic of bulk infrastructure not spelt out adequately
		4 IPP	Integration. Planning at a number of scales	This section done in the form of an essay submission	Theoretical understanding of institutions and infrastructure but not transferred into the project aspect of this course
		3 IDP			
		1 Introduction to Settlement form and design	Urban form + place making + layout + urban components	Lecture (Basic skills). Overnight Field trip – preferably to another city (Gaberone, Durban). Elements of PBL. Essay writing + introduction to the discipline of studios	There is a good level of transference of skills and the development of critical thinking but infrastructure not considered in any depth – not carried across courses in any critical sense. The scale is often difficult to comprehend (city wide to local). Time and capacity constraints
Socio- political and institutional dimensions	Negotiation	2 Philosophies histories and theories	Negotiation	Lectures and seminars. Project (Yeoville)	Practical skills not developed. Yeoville project begins to highlight negotiation and politics of infrastructure delivery
	The politics of bureaucracy	3 Development Policy and processes	Institutional political understanding	Lectures/seminar	Infrastructure not specifically addressed
		Johannesburg as a city in Africa	Institutional structures	Lectures /seminars around case study	
	The dynamics of the property market and the politics of property development	3 Property economics	Property economics	Lecture and project	Infrastructure not specifically addressed in technical aspects. Politics of property not necessarily addressed
	Conflict, power, negotiation and mediation	2 Histories and Futures	Negotiation and Conflict	Lecture/seminar/ project (Yeoville)	Infrastructure not specifically addressed in technical aspects – but provision and conflict over infrastructure is central
	Stakeholders, participation	3 IDP	Participation	Lecture + project	Practical skills not necessarily developed to extent needed
		2 and 3 Histories and futures and Politics specialism	Participation	Lecture, project, community participatory processes	Infrastructure not specifically addressed in technical aspects – but provision and conflict over infrastructure is central

REFERENCES LIST

ANGEL, S. 2008. An arterial grid of dirt roads. *Cities*, 25(3), pp. 146-162.

BARCLAY, E. 2010. The application of gaming simulation as pedagogic tool in urban and regional planning tertiary education. Paper presented to the *Planning Africa 2010 Conference*, South African Planning Institute, 13-15 September 2010, Durban.

BEHRENS, R. 2005. Accommodating walking as a travel mode in South African cities: Towards improved neighbourhood movement network design practices. *Planning Practice and Research*, 20(2), pp.163-182.

BEHRENS, R. & WATSON, V. 1996. *Making urban places: Principles and guidelines for layout planning*. Cape Town: University of Cape Town Press.

BENEDICT, M. & MCMAHON, E. 2006. *Green infrastructure: Linking landscape and communities*. Washington: Island Press.

BIERMANN, S. 2000. Bulk engineering services costs, densities and sustainable urban form, In: *Proceedings of the Conference on Strategies for a Sustainable Built Environment*, 23-25 August, Pretoria.

BOARNET, M. & HAUGHWOUT, A. 2000. Do highways matter? Evidence and policy implications of highways' influence on metropolitan development. Brookings Institution Centre for Urban and Metropolitan Policy. [online]. Available from: <www.brookings.edu/ES/urban/boarnet> *[Accessed: 14 April 2008].*

BOYLE, R. 2003. Comments on the RTPI Education Commission's Report and its implications for planning education. *Town Planning Review*, 74(4), pp. 355-358.

CERVERO, R. 2004. Transit and the metropolis: Finding harmony. In: Wheeler, S. & Bentley, T. (eds.). *The sustainable urban development reader*. London: Routledge, pp. 89-103.

CITY OF JOHANNESBURG (COJ). 2008. Growth management strategy, Johannesburg: COJ, Development Planning and Urban Management.

CURTIS, C. 2005. Creating liveable streets: Developing traffic management guidelines for Western Australia. In: Williams, K. (ed.). *Spatial planning, urban form and sustainable transport*. Aldershot: Ashgate, pp. 183-202.

CUTHBERT, A. 1994. An agenda for planning education in the '90's. *Australian Planner,* 31(1), pp. 19-23.

DALTON, L. 2001. Weaving the fabric of planning as education. *Journal of Planning Education and Research*, 20(4), pp. 423-436.

DEVAS, N. 1993. Evolving approaches. In: Devas, N. & Rakodi, C. (eds.). *Managing fast-growing cities*. Harlow: Longman, pp. 63-101.

FRANK, A. 2006. Three decades of thought on planning education. *Journal of Planning Literature*, 21(1), pp. 15-67.

FRANK, A. 2007. Entrepreneurship and enterprise skills. *Planning Practice and Research,* 22(4), pp. 635-648.

FRIEDMANN, J. 1996. The core curriculum in planning revisited. *Journal of Planning Education and Research*, 15(2), pp. 89-104.

FREESTONE, R., THOMPSON, S. & WILLIAMS, P. 2006. Student experiences of work-based learning. *Planning Education Journal of Planning Education and Research*, 26(2), pp. 237-249.

HARRISON, P., TODES, A. & WATSON, V. 2008. *Planning and transformation: Learning from the post-apartheid experience*. London: Routledge.

HUNTER, R., VAN RYNEVELD, P. & YORKE, A. 2007. *State of the City Finances Report 2007*. Johannesburg: South African Cities Network.

KLUG, N. & NAIK, T. 2007. Land use management and democratic governance in the City of Johannesburg: Case study – Fourways. Unpublished research report prepared for the Ford Foundation and Urban Land Mark as part of a joint study undertaken by the Centre for Urban and Built Environment Studies and Planact, Johannesburg.

MATTINGLY, M. 2001. *Spatial planning for urban infrastructure planning and investment. A guide to training and practice*. London: Development Planning Unit, University College.

MORPHET, J. 2011. Delivering infrastructure through spatial planning: The multi-scalar approach in the UK. [online]. Available from: <http://lec.sagepub.com/content/26/4/285> [Accessed: 15 March 2012].

NAIDOO, Y. 2010. Sewage treatment report delayed – shocking findings suspected. [online]. Available from: <http://allafrica.com/stories/201003150820.html> [Accessed: 20 September 2010].

NEUMAN, M. 2009. Spatial planning leadership by infrastructure: An American view. *International Planning Studies*, 14(2), pp. 201-217.

ODENDAAL, N. & DUMINY, J. 2008. Does technology shape our cities? Understanding the relationship between digital technologies and urban change in eThekwini, 1992-2007. Paper presented to the *Planning Africa Conference*, South African Planning Institute, 14-16 April, Johannesburg.

PALMER, I. 2009. eThekwini MSFM scenarios – Summary of results of model runs. Unpublished report prepared for the eThekwini Metropolitan Municipality.

PLANNING INSTITUTE AUSTRALIA (PIA). 2010. Accreditation policy for the recognition of Australian planning qualifications for the urban and regional planning chapter (as adopted by PIA National Council on 18 November 2010). Sydney: PIA.

RAO, M. & SHARMA, A. 1990. The role of non-motorised urban travel. In: Dimitriou, H. (ed.). *Transport planning for third world cities*. London: Routledge, pp.117-143.

RICHMOND, J. 2007. Bringing critical thinking to the education of developing country professionals. *International Education Journal*, 8(1), pp. 1-29.

ROYAL TOWN PLANNING INSTITUTE (RTPI). 2003. Education Commission Final Report. January 2003. [online]. Available from: <http://www.rtpi.org.uk/download/236/Education-Commission-Final-Report.pdf> [Accessed: 10 August 2010].

RUTHERFORD, J. 2005. Networks in cities, cities in networks: Territory and globalisation intertwined in telecommunications infrastructure development in Europe. *Urban Studies,* 42(13), pp. 2389-2406.

SCHWEIZER, L., HOWARD, E. & DORAN, I. 2008. Planners learning and creating power: A community of practice approach. *Journal of Planning Education and Research*, 28(1), pp. 50-60.

SHEPHERD, A. & COSGRIF, B. 1998. Problem-based learning: A bridge between planning education and planning practice. *Journal of Planning Education and Research*, 17(4), pp. 348-357.

TAYLOR, N. 2010. What is this thing called spatial planning: An analysis of the British government's view. *Town Planning Review,* 81(2), pp. 93-108.

TODES, A. 2009. New forms of spatial planning? Linking spatial planning and infrastructure. Paper presented at the *Asian Planning Schools Association Conference, The Future of Asian Cities*, CEPT University, 24-26 November, Ahmedabad.

UN-HABITAT. 2009. *Planning sustainable cities: Global report on human settlements 2009*. Nairobi: UN-Habitat.

WAIT, M. 2010. Optimum coal launches R600m water treatment plant. *Creamer Media's Mining Weekly*, 18 June 2010. [online]. Available from: <http://www.miningweekly.com/print-version/reclamation-plant-launched-2010-06-18> [Accessed: 20 June 2010].

WORLD BANK INSTITUTE. 2010. *Public-private infrastructure advisory facility*. Washington: World Bank Institute.