Making space and place for knowledge production: knowledge precinct developments in Australia

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Abstract: The economic and social importance of knowledge production is clear, and it is an emerging social phenomenon and research agenda in the urban planning discipline. The impact of what has been broadly labelled the knowledge economy has, however, been such that even in the absence of precise measurement it is the undoubted dynamo of today’s global market and an essential part of any global city. Knowledge production, and where, how and by whom it is produced, is first of all an urban phenomenon poorly understood in an era of strong urbanisation. This paper focuses on urban knowledge precincts as the magnet infrastructure impacting knowledge production of cities. The paper discusses two important issues: knowledge based urban development within the paradigm of the knowledge economy; and knowledge precincts as an instrument to seed knowledge production in cities. The paper concludes with conditions for knowledge precincts as the incubators of knowledge production and innovation in Australia.

Introduction

Australian cities, like others worldwide, face the prospect of major transformation in the 21st century as the world moves towards a global information order (Castells, 2000). In this new era, already upon us, urban economies are being radically altered by dynamic processes of economic and spatial restructuring (Graham and Marvin, 1996). In advanced economies ‘knowledge based urban development’ (KBUD) has become an important mechanism for the development of cities. It is extensively seen as a potentially beneficial set of instruments, which may improve the welfare and competitiveness of cities (Yigitcanlar, 2007).

Sydney and Melbourne have long been linked, one way or another, to the global system. Brisbane’s international links are more recent. Nevertheless, as the metropolitan heart of Queensland it has recently adopted a ‘Smart State Strategy’ (Queensland Government, 2005), Brisbane is part of the competition to become Australia’s first globally recognised knowledge city. Perth and Adelaide also want to reap the benefits of such recognition would bring.

The competition is more than domestic. The five major cities of Australia are in a global battle with other urban conglomerations for knowledge based development, investment and talent. KBUD plays a significant role for Australian cities to be successful in this tough global competition. Especially knowledge precinct developments across urban Australia provides a strong potential for these cities by producing codified and tacit knowledge, supporting the shift towards the knowledge economy and boosting economic-social-human capitals within their (sub)urban settings.

This paper aims to analyse the context of KBUD within the paradigm of the knowledge economy and the planning practice. Knowledge precincts are discussed as an instrument to seed knowledge production in cities. The final section of the paper explores the conditions for knowledge production and knowledge precincts in Australia.

Knowledge economy and knowledge based urban development

In the course of history knowledge has always been a vital resource for creating and sustaining a strong economy, society and culture. However neo-classical economic thought that recognised only three factors of production: ‘land, labour and capital’, only considered ‘knowledge, creativity, education, and intellectual capacity’ as secondary, if not incidental, parameters of production (Li et al., 1998). Knowledge and creativity was assumed to be either embedded in labour or just one of numerous categories of capital. During the last quarter of the 20th Century, however, it has become apparent that knowledge in and of itself is sufficiently important for production, and the new growth theory and the new economic geography recognised ‘knowledge’ as the fourth factor of production (Romer, 1990).

During the last two decades a global, knowledge-based, and technology-driven economy has emerged, so called ‘knowledge economy’ also variously known as ‘knowledge-based economy’, ‘new economy’, and ‘creative economy’ (Baum et al., 2006). In this new economy knowledge, also including creativity as a tacit knowledge form, related activities have become central for creating employment and wealth, and sustaining economic growth (Ofori, 2003). Such economy creates, distributes, and uses knowledge to generate value and gives rise to “a network society, where the opportunity and capability to access and join knowledge and
learning intensive relations determines the socio-economic position of individuals and firms" (Clarke, 2001:189). Rapid advances in technology during the last two decades established the infrastructure that enables the knowledge economy to scale up. The main novelty of the knowledge economy consisted of the need to manage an intangible asset that, in contrast to material resources, does not depreciate through use but rather becomes more valuable the more it is used (Laszlo and Laszlo, 2006). The sustenance of the economic activities, in the knowledge economy, requires a constant renewal of human and organisational capacities and creating conducive environments for creativity, innovation, learning, and change to thrive (Knight, 1995). The literature consistently reports that in the 21st Century, sustainable economic growth and urban development is highly associated with knowledge economies (Metcalfe and Ramlogan, 2005; OECD, 1999, 2001a, 2001b).

The ongoing transformation of advanced economies from manufacturing to services and knowledge-based activities has important implications for cities and for the organisation of economic activities. Although historically the production of commodities involved combinations of manufacturing, service and knowledge functions. (Daniel and Bryson, 2002). During the last couple of decades the accelerating speed of knowledge production played a critical role particularly in the development of high-technology products (e.g. computer and software technology, pharmaceutical and bio-technology, aerospace and aviation technology). With the dawn of the knowledge economy, firms have increasingly used technology as their prime source of competitive advantage, while the economic wealth of cities is increasingly tied to their technological competence (Martin et al., 2001).

The increasing interconnectedness of the world economy, as part of the ongoing process of globalisation, depends on technology that has become, in itself, key to corporate success and national/local growth (Velibeyoglu, 2001). Such technology imposes a sort of globalisation imperative on the place of its adoption, an almost irresistible drive to be part of international growth (Arogyaswamy and Koziol, 2005). Similarly since the end of the 1980s, the development of knowledge economy, globalisation, and international competitive pressure has increased the importance of creativity and innovation in local economies, as well as national economies (Camagni, 1995; Feldman, 1994; Malmberg, 1997; Porter, 1990; Ritsila, 1999; Storper, 1995). Simultaneously, globalisation is increasing distinct local differences arising from local capabilities and environments (Baum, 2003; Hu et al., 2005).

New developments in globalisation and communications technology have prompted countries and cities to focus their competitive strategies on improving innovation. This shift has increased the value of knowledge-based activity in such economies (Hu et al., 2005). Knowledge-based production, however, generally clusters in areas with a rich base of scientific knowledge related to specific industries (Baptista, 1996). This spatial imperative has tended to polarise such high growth activity in a limited number of, dominantly urban, areas of the world.

Proximity helps generate and transfer knowledge more effectively. Although under some conditions knowledge-intensive industries do take place outside urban regions (e.g. high-tech mining industry, high-tech farming, tropical science and eco-tourism). Generally speaking new knowledge-based activities tend to cluster in specific urban geographic localities, such as vibrant metropolitan areas, particularly to benefit from the cluster of other knowledge-intensive industries and knowledge workers of these creative urban regions (Audretsch, 1998). The proximity among companies created by such clusters is also essential to stimulate company learning, creating compatible knowledge spill-over effects and establishing a positive feedback among various local agents (Hu et al., 2005). Cluster development, in sum, is built around advanced technological infrastructure and mature networks of innovation between people and organisations. According to Buckley and Mini (2000) a city’s knowledge economy is the economic wealth and well being that results from the effective investment in people and ideas that create an environment where information, creativity, goods and services are produced and exchanged, drawing on best practices. It requires a skilled labour force, up-to-date knowledge, effective use of technology, and broad city resources that foster a productive urban economy. In this process, communication, good governance and partnerships are developed with all major stakeholders.

Emerging from analysis of the cities’ knowledge economy, there has been recognition of creativity as one of the major forces behind knowledge production (Corey and Wilson, 2006). Landry (2000), Florida (2005) and Henderson (2005) directed planners and urban administrators to think about the environmental and cultural assets of the cities and communities as economic resources. Corey and Wilson (2006) underlined the important role of information and communication technologies in developing a knowledge economy and
sustainable urban development (for discussions on sustainable cities and knowledge economy see Wheeler and Beatley, 2004; Curwell et al., 2005).

Atkinson (2001:1) emphasised on the new economic realities, many driven by technology, that are shaping the economic potential and form of cities:

- High-tech industry (e.g. information and communication technology, bio-technology, nano-technology, finance) is growing quickly relative to other parts of the economy and it is driving overall metropolitan growth rates;
- High-tech industry tends to cluster mostly in metropolitan regions;
- Attracting and retaining talent is a critical factor to a region’s success;
- Within metropolitan regions, high-tech development remains, for the most part, an (sub)urban phenomenon;
- High-tech products and services are transforming the rest of the economy, putting a greater share of the metropolitan and urban economy ‘in play’.

To date, the structuring of most of the cities has proceeded organically: in essence, as a dependent and derivative effect of global market forces. Urban and regional planning has responded slowly, and sometimes not at all, to the challenges and the opportunities of the global knowledge city. Almost a decade into the new century the economic success of the knowledge-intensive development policies in a number of cities and nations have led urbanists to think of whether similar policies could be applicable for the knowledge-based planning of urban regions. In recent years urban planning has consolidated its interest in the paradigm of post-modern social production under the rubric of KBUD (Carrillo, 2004). The concept of KBUD has started to gain acceptance among urban scholars. Parallel to this recognition, KBUD has become an emerging area of research interest which links interests of planners, economists, geographers and other social scientists. Despite this growing interest KBUD still remains in its infancy (see Yigitcanlar et al., 2007a).

Planning sees KBUD as a new form of urban development for the 21st century that could, potentially, bring both economic prosperity and sustainable socio-spatial order to the contemporary city. The goal of KBUD is a knowledge city purposefully designed to encourage the production and circulation of abstract work (Cheng et al., 2004). KBUD can be regarded as a vision/strategy to nourish the transformation and renewal of cities into knowledge cities and their economies into knowledge economies (Yigitcanlar, 2005). It is not about the strict government control on the development, rather it is the initiation and provision of the knowledge incubation environment (e.g. incentives, knowledge and urban infrastructures, quality of life) jointly by public-private-academia for entrepreneurs (e.g. knowledge-enterprises, knowledge workers, artists).

KBUD is a powerful strategy for economic growth and the post-industrial development of cities and nations to participate in the knowledge economy (see Yigitcanlar et al., 2007a). It is a strategic management approach, applicable to purposeful human organisations in general (Carillo, 2002). Relatively recent and growing literature indicates that KBUD has two purposes: The first one is, it is a, urban and economic, development strategy that codifies technical knowledge for the innovation of products and services, market knowledge for understanding changes in consumer choices and tastes, financial knowledge to measure the inputs and outputs of production and development processes, and human knowledge in the form of skills and creativity, within an economic model (Lever, 2002). The later one is that, it indicates the intention to increase the skills and knowledge of residents as a means for individual and social development (Gonzalez et al., 2005). KBUD policies includes: developing and adopting the state of art technologies, distributing instrumental capital, developing human capital, and developing capital systems (Carrillo, 2002; Yigitcanlar et al., 2007a).

Knowledge precincts as the incubators of knowledge production in KBUD

The successful development of ‘Silicon Valley’ in the US was based mainly on a knowledge network that encompassed both regional learning institutions (Stanford University and the universities of Northern California) and for profit industry research teams. Innovations produced in the knowledge network were adopted and developed economically by proximate industries operating in an environment of flexible development (Castells and Hall, 1994: Saxenian, 1994). Silicon Valley has inspired KBUD around the world in the belief it is a royal road to competitive advantage and economic development (Ku et al., 2005). Such successful KBUD policy implementation in the US (e.g. Silicon Valley and DNA Valley) has exposed that ‘creative urban regions’ can be built by promoting knowledge-based and high-tech precinct developments (see Yigitcanlar et al., 2007b). Since 1970s the establishment of knowledge precincts as part of a strategy to develop new engines of growth and creative urban regions has become widespread (see Koh et al., 2005).
The term knowledge precinct not only distinguishes the functional activity in an area but, more important, is correctly used to refer an area where agglomeration of technological activities has positive externality (i.e. structural) benefits for individuals and firms located in the precinct (Westhead et al., 2000; Chan and Lau, 2005). The International Association of Science Parks defines a knowledge precinct as “an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community, by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge base institutions.” In pursuit of these objectives a knowledge precinct promotes and manages the flow of knowledge and technology amongst universities, research and development (R&D) institutions, companies and markets, as well as facilitating the creation and growth of innovation based companies through incubation and spin-off processes, and providing other value-added services such as high quality space (including living and recreation areas) and facilities (IASP, 2001).

While there are many different types of knowledge precincts, a knowledge precinct generally provides both support and an environment of technology transfer that nurtures the start-up, incubation, and development of innovation-led, high-growth, knowledge based businesses. Most knowledge precincts have formal and operational links with institutions such as universities and research organisations. Although knowledge precincts strive to focus R&D and innovation in its area, the types of R&D conducted in a science and technology and the sectors they focus can vary widely. Overall, however, by attracting new firms knowledge precincts can create substantial agglomerative effects for the urban economy (Koh et al., 2005).

Different countries have used different design, management and technological foci for their knowledge precincts. For example, in South-East Asia urban planners took more active role in knowledge precinct development than North American and European planners (i.e. One-North development in Singapore). Additionally the states and cities aspiring to be strategic foci, or knowledge hubs, have required considerable government funds for their knowledge precinct initiatives (e.g. Hong Kong’s ‘Teleport’, Singapore’s ‘Intelligent Island’ and Malaysia’s ‘Multimedia Super Corridor’) (Brooker, 2005). The knowledge precinct projects in Europe and the US, in contrast, tend to require less government funding and are often organised and financed by public private partnerships. These public private partnerships have been formed with varying levels of public authority and both large multinational companies and small and medium enterprises.

The technological foci of knowledge precincts can vary as widely as its financial ownership and organisation (Koh et al., 2005). Some knowledge precincts are structured around basic research (e.g. the Cambridge Science Park), some concentrate on applied research (e.g. the Singapore Science Park), others focus on the further development of more traditional manufacturing activities, either within the park itself or in its vicinity (e.g. the Hsinchu Technology District in Taiwan), while yet others aim to develop a knowledge community precinct that contains all work, residential, education and recreation areas within the same development (e.g. One-North in Singapore).

Despite their differences, in terms of urban planning and design, contemporary knowledge precinct initiatives have the following aspects in common: (a) they have technology enterprises (e.g. Nokia in Helsinki Digital Village), knowledge workers, R&D and educational institutions; (b) they provide living facilities that promote creativity, cater for emerging lifestyle choices, and celebrate the experience of ‘place’; (c) they are guided and managed by partnerships between governments, real estate developers, educational or research institutions, and technology and business companies (MIT, 2005). According to Felsenstein (1994), knowledge precincts were generally established with two primary objectives in mind. The first objective of a knowledge precinct is to be a seedbed and an enclave for technology, and to play an incubator role, nurturing the development and growth of new, small, high-tech firms, facilitating the transfer of university know-how to tenant companies, encouraging the development of faculty-based spin-offs and stimulating the development of innovative products and processes. The second objective is to act as a catalyst for regional economic development or revitalisation and to promote economic growth. Conceptually knowledge precincts do not foster innovation for itself but applied innovation – innovative/knowledge production.

The role of government in this process is changing as industry relies more and more on academic research for generating marketable innovation and economic growth. This is especially true for science based technologies such as artificial intelligence or biotechnology (Etzkowitz, 1993). Knowledge has become a capitalised good, an intangible, valuable asset for many companies. The more the line between basic and applied research is blurred, in many countries (i.e. Australia) the more publicly funded research institutes and universities become the source of commercially exploitable knowledge. As the quality of knowledge has changed, its mode of production has changed in step.
As Gibbons et al. (1994) have pointed out the ‘new production of knowledge’ rather than a linear model, comprises the interaction of many disciplines and actors within a network of mutual reactions and feedback. The new mode of knowledge production challenges the traditional notion of innovation as the outcome of successive inputs linked in a chain of development. It requires, amongst other things, a re-examination of the trilateral relationships between academic institutions, government and industry. The triple-helix model suggests innovation is a spiral movement that captures multiple reciprocal relationships among institutional sectors (public, private and academic) not abstractly but in the very (multiple stages of) capitalisation of knowledge itself. As a consequence institutions are changed in their very production of knowledge (Etzkowitz and Leydesdorff, 1997). The emergence of research centres in universities provides a good example. The triple-helix model challenges the concept of innovation as a thing that can be produced in isolation. It conceives of research and innovation as not existing in the realm of a firm/institution but as subsisting in the interrelationships between actors of the triple-helix: academia, state and industry (Giesecke, 2000; Turpin & Martinez-Fernandez, 2006). Instead of a fourth actor in the production of knowledge base of cities, the model sees the public as an embedded actor in three sectors. However the citizens of Barcelona have proved that wrong by more than 1.6 million people working actively for the ‘city of knowledge’ campaign of the Barcelona city (see Yigitcanlar, 2007).

In summary knowledge precincts play an important role in knowledge production, which strengthens the KBUD of cities where academic institutions, government, industry and the public (both workers and residents) are the key actors of such development.

Considerations for knowledge precinct developments in Australia

Australia is a vast continent with over two-thirds of its land of a remote or rural nature. Population concentrates in a few large metropolitan regions (Sydney, Melbourne, Brisbane, Perth and Adelaide). The geography of knowledge follows population concentrations both in dense metropolitan regions and in regional centres. There are also some notable examples in remote areas such as the Desert Knowledge Cooperative Research Centre, based in Alice Springs and covering most of Western Australia and the Northern Territory and the CSIRO’s research concentrations in Narrabri, Northern New South Wales, at the Australia Telescope National Facility and the Australian Cotton Research Institute (ACRI). The highly urbanised form of our regions and the notable coastal urban growth together with the demands for a knowledge economy sets up questions about the organisation or reorganisation of knowledge and its effects in our regions. In Australia, it is often important for firms and organisations to locate close to universities, research institutes, co-operative research centres (CRCs) or the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to maximise their access to information concerning products and services developed by local knowledge intensive institutions. This is also important for knowledge institutions so that the knowledge they generate is used and transformed in new knowledge. The equation is not easy because most knowledge travels through networks and, in fact, some knowledge producers might be more close to users at the other end of the planet than to those next door within the same building or precinct. This means that geographic proximity does not automatically imply that the different parts of the local/regional innovation system will generate, share, transform and adopt knowledge. Strategic planning and policy measures might be needed to ensure that knowledge circulates through the urban system, creating new opportunities for players that otherwise would not have access to specialised information, skills or technology. An example of isolated systems in closer proximity is mining sites in remote communities. Mining sites are innovation intensive locations where service providers and staff of the mining company built new capabilities day to day. Despite this high concentration of knowledge and problem solving skills little of these innovation processes are leaked to the businesses and organisations of the hosting towns. In the long-term the disconnection of these two innovation systems leaves the mining town in a weak position to face the future beyond mining operations resulting, in most cases, on shrinkage of population and economic prosperity (Martinez-Fernandez & Wu, 2007).

There have been early considerations of the existence of ‘knowledge hubs’ in Australia as the organisation of knowledge within a certain space (TIAC, 2002). This may be defined as an ensemble of knowledge intensive organisations located in both public and private sectors. Some are research-intensive knowledge producers, such as research institutes or universities. Others are demanding knowledge users, including firms but also service providers such as hospitals or airports either from the public or the private sector (Marceau et al., 2005; Turpin and Martinez-Fernandez, 2006). Public sectors organisations can be today sophisticated centres of knowledge and therefore need to be considered as part of a knowledge system where both private and public sector are present. The intensity of the knowledge produced and transmitted makes the hub a ‘system of activities’ and while the boundaries are not limited at the geographical level, the organisation at the core of the hub does need to be in geographic proximity (Acs, 2003). For example in the case of North
Ryde in Sydney there is both a strong presence of public research institutions with Macquarie University and the CSIRO and also a concentration of ICT companies (Searle and Pritchard, 2004).

Cities have also been analysed in terms of knowledge concentrations and this has form the bases of important policy documents such as the Sydney Metropolitan Strategy (DPNR, 2005) where pockets of knowledge were identified across the Greater Sydney Region. Organisations identified include university campuses, CSIRO units, hospital and medical research units and CRCs’ headquarters. There are clear concentrations of knowledge producing institutions in the eastern and central suburbs of Sydney and in Ryde (see Figure 1).

Figure 1: Sydney’s Knowledge Hub locations (DPNR, 2005: 20)

Figure 1 above shows the organisation of knowledge in Australia’s most global city (Melbourne and Brisbane would follow similar patterns) where the central business district acts as a magnet attracting knowledge workers and knowledge institutions. For example, and as can be see in Figure 1 few knowledge institutions are located in the far west side of the Sydney corridor despite the growing population in Western Sydney and therefore this creates a disadvantage in accessing knowledge to both a significant part of the population and to important contributing industries to the state of NSW and the nation\(^1\). Traditional macro-economic strategies such as fiscal and labour force policies and international trade are important but perhaps it can be argued that if the geography of knowledge producers and users matters for the development of our cities and for the attraction of talent then knowledge strategies need to be linked to the development and planning priorities in the local area or region so that support policies can be more effectively designed.

The analysis of ‘knowledge hubs’ and their elements and processes still in its early infancy and to extract lessons and conclusions that can be replicated into small scale ‘knowledge precincts’ needs further exploration. The Australian knowledge precinct policy dates back to early 1980s (Joseph, 1997). Technology Precinct Bentley WA, La Trobe Research and Development Park, Ballarat Technology Park VIC, The Australian Technology Park NSW, Brisbane Technology Park QLD, Tasmanian Technopark, Adelaide University Research Park SA are among the better known of the 20 plus knowledge precincts in Australia. There is not, however, a clear understanding of what a ‘knowledge precinct’ actually needs to include generating those highly innovative knowledge flows and innovation outputs produced by the famous Silicon Valley. On one hand is the issue of having high-tech designed buildings in closed precincts where the

\(^1\) Western Sydney is the third largest economy in Australia and the most important manufacturing hub in NSW.
separation from the rest of the suburb is evident through gates and security enforcement. On the other hand, is the open urban space where the ‘living space’ is integrated with the working space (a model similar to the old European university cities such as Salamanca or Cambridge where scientist, students and business ‘walk into each other’s spaces’). Both concepts imply a very different planning system and the strategies for residential and commercial development and land use would also be very different.

A guide to the development of knowledge precincts in Australia needs to consider the three main functions of knowledge: generation (e.g., research); transmission (e.g., graduates), and transfer (e.g., commercialisation / industry application) of knowledge. The way these three elements are combined is dictated by the talent involved and the environments where this talent results in innovation 2 Western Sydney is the third largest economy in Australia and a global manufacturing hub activity and commercialisation. Three elements can be targeted: type of knowledge workers to be attracted, type of industries rich on knowledge intensive service activities (KISA) and type of knowledge based occupations of major revenue in terms of knowledge. A possible typology is presented in the table below.

### Table 1: A guide to urban/regional knowledge for knowledge precincts (Martinez-Fernandez and Sharpe, 2007)

<table>
<thead>
<tr>
<th>Knowledge Workers</th>
<th>Rich KISA Environments</th>
<th>Knowledge-Based Occupations</th>
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<tbody>
<tr>
<td>Information &amp; Communication ICT</td>
<td>Business Services</td>
<td>Engineering &amp; Building</td>
</tr>
<tr>
<td>Business &amp; Financial Services</td>
<td>Banking</td>
<td>Scientific</td>
</tr>
<tr>
<td>Managers (general &amp; specialists)</td>
<td>Finance</td>
<td>Business &amp; Information</td>
</tr>
<tr>
<td>Technical Workers</td>
<td>Insurance</td>
<td>Craft &amp; Trades</td>
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<tr>
<td>Scientists</td>
<td>Marketing</td>
<td>General Management</td>
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<tr>
<td>Engineers</td>
<td>Education</td>
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<td>Health</td>
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Building physical infrastructure with state of the art offices surrounded of research centres or industry incubators is not sufficient to foster knowledge and commercial innovations unless a functional understanding of the dynamics of knowledge (generation, transmission and transfer) forms part of the equation. For example, universities today are magnets of specialised knowledge and much knowledge migrates with the scientific and research staff of universities; this alone is a strategic tool for policy aimed at bringing knowledge into a city or region as supporting scientific workers and facilitating their participation in urban and regional networks would facilitate the circulation of knowledge. It is then necessary to ensure that this knowledge mix, match and expands through participation in networks. Policy makers also need to be aware of the science and technology conditions operating in our world today. There is an increasing competition from other regions to attract scientists and industry talent; knowledge carriers are often targeted by other players to move institutions and knowledge bases. There is also a danger on focusing on a particular type of technology or picking a winning knowledge base occupation. For instance government regulations in favouring certain knowledge fields can hamper other forms of new knowledge resulting on decline in knowledge attraction and, maybe, urging scientists to emigrate. Policies oriented to strengthen innovation systems therefore need to look not just at supporting the ‘flavour of the month’ but also knowledge that might be more basic, fundamental and from which commercialisation outcomes might not be clear at the present moment.

At the firm level, the literature shows positive effects of designing knowledge rich environments on innovation activity of services industries which are reorganising themselves into ‘networks of production’ where they use formal and informal services from the private and public sector to boost their innovation outcomes (Martinez-Fernandez and Miles, 2006; Martinez-Fernandez and Martinez Solano, 2006; OECD, 2006). The data suggest that the network space of the firm has a significant role to play in their learning and innovation processes, and that this role might be more significant than the role attributed to transactions with knowledge intensive business services (KIBS) and research and technology organisations (RTOs). These studies suggest that service firms are proactive organisations in the search of knowledge, that they overcome market barriers due to their small size or revenue through the use of network sources of expertise closely related to their services, and that knowledge is co-produced from both formal and informal sources leading to change and innovation. The behaviour of the participating big firms in searching for knowledge is somehow different because big firms rely more in inter-departmental knowledge or they have an internal R&D department. Results of the studies also indicate that in order to build firm capabilities for innovation, knowledge management needs to differentiate formal and informal processes of co-production of knowledge, as these different types of knowledge require specific strategies for their selection, acquisition, integration and final adoption within the firm. Thus, in theory, knowledge precincts may well represent an ideal seed environment for knowledge production. In summary, planning and commercial strategies can certainly be structured to
directly enhance the relevance of knowledge produced in a certain space but the conditions for high intensity of knowledge traffic are much more complicated than, for instance, the strategic use of land. A different set of skills are needed to develop knowledge networks where ideas can be trialled and discussed. Government policies, also at the local level, have a critical role to play in fostering the conditions where intellectual vitality is made up of intensive collaboration networks that attracts and retain knowledge carriers (agents, firms and workers). In part this responds to the view that local institutions, businesses and organisations are partners in fostering local development and are part of the local innovation system where they are embedded.

Conclusions
Urban areas in Australia can and should pursue knowledge based development. Succeeding in such development will raise standards of living in the region and expand economic opportunity for residents. However, more questions than answers are raised at the moment about what constitute KBUD and whether this imply the attraction of knowledge institutions and knowledge workers to lifestyle choices or it is about the way we design our working places and spaces.

The ways and forms and conditions of knowledge precincts also still need to be clarified through, for example, case studies where a systematic investigation of hard and soft features including urban design, physical infrastructure, design for KISA interactions and innovation infrastructure can be undertaken. Perhaps the primary question to answer is if knowledge precincts can successfully overcome the tyranny of the distance of Australia and forge connection that go beyond the boundaries of the ‘precinct’.

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