Knowledge-based urban development processes of an emerging knowledge city: Brisbane, Australia

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Abstract:
In the global knowledge economy, to attract and retain knowledge-intensive industries and workers, cities produce various development strategies. Such strategising is an important development mechanism for cities to complete their transformation into knowledge cities. This paper discusses the critical connections between knowledge city foundations and integrated knowledge-based urban development strategies, and scrutinises Brisbane's strategies in attracting and retaining investment and talent. The paper introduces a knowledge-based urban development assessment framework and uses this framework to provide a clearer understanding of Brisbane's knowledge-based development processes and knowledge city transformation experience. The assessment framework particularly focuses on examining Brisbane's four development processes, institutional, economic, socio-cultural and urban development, in detail. The findings reveal that although Brisbane is still in early stages of its transformation into a fully-fledged knowledge city, global orientation and achievements of Brisbane in strategising knowledge-based urban development are noteworthy.

Introduction

As the world moves towards a global information order, shaped by the growth of technology and the knowledge economy (Castells, 2000; Slabbert, 2006; Metaxiotis et al., 2010), many cities worldwide face the prospect of major metropolitan transformation. In the knowledge era, knowledge-based economies deliver prosperity and growth through the development of competitive strengths in knowledge and technology intensive sectors. Consequently, urban regions are being radically altered by dynamic processes of economic and spatial restructuring, where by the replacement of physical commodity production with more abstract forms of production has paradoxically reinforced the importance of central places and led to the formation of 'knowledge cities' (KCs) (Carrillo, 2006). KC can be seen as an overall guiding concept for geographical entities, as it focuses on knowledge

creation, and includes other knowledge zones such as 'knowledge precincts', 'knowledge corridors', knowledge villages', and 'knowledge regions' (Dvir and Pasher, 2004). Consequently, KCs are incubators of knowledge and culture, as they form a rich and dynamic blend of theory and practice within their boundaries, and are driven by knowledge workers through strong knowledge production (Work Foundation, 2002; Yigitcanlar et al., 2008b). Knowledge-based urban development (KBUD) therefore, is a development approach that aims to make cities compatible with the knowledge economy and achieve KC status. KBUD mechanisms are delineated at several levels: international, national, regional, and local, and offer citizens opportunities to foster knowledge creation, knowledge exchange, and innovation by providing enabling conditions for cities in global competition (Ergazakis et al., 2004). These conditions include such things as knowledge infrastructure (e.g. universities, research and development institutes); technological infrastructure (e.g. information and communication technologies); connections to the global economy (e.g. international companies and finance institutions); and concentrations of well-educated and creative people (e.g. knowledge and creative workers) (Van Winden and Berg, 2004; Carrillo, 2006).

Brisbane city and Australia as a whole are currently transitioning from a natural resource-based economy to a global knowledge economy, whereby the successful development of knowledge and technology intensive sectors will be the basis for innovative capacity, global competitiveness and growth of the region. In recent years, Brisbane has adopted a number of KC policies and urban development strategies that target knowledge-based development, and which function as important mechanisms for expanding the various knowledge economies of the city. Consequently, the question 'whether introduced KBUD strategies are adequate enough to transform Brisbane into a KC' deserves a profound investigation. To address this important question, the research presented in this paper develops an analysis framework of KBUD, and examines Brisbane's strengths and weaknesses in light of this framework. The case study scrutinizes Brisbane's capacity to grow globally competitive and to sustain knowledge-based growth into the future, and suggests a number of areas that may warrant increased strategic focus.

Knowledge city formation and knowledge-based urban development processes
As economies become increasingly knowledge-based, the nature of urban, city-development changes because activities in the knowledge sector require conditions and environments different from those required by commodity-based manufacturing activities in the production sector (Knight, 1995). An economy, environment and socio-cultural base strong in knowledge are the keys for transforming a city into a KC and recent and growing literature indicate that KBUD is a powerful strategy for the economic growth and post-industrial development required by cities to participate in the knowledge economy (Carrillo, 2006; Van Winden et al., 2007; Yigitcanlar et al., 2007). Principally, it is a strategic management approach applicable to purposeful human organizations and important for cities trying to achieve a KC status (Carrillo, 2002; Yigitcanlar, 2009). The primary goal of KBUD is a KC purposefully designed to encourage the production and circulation of abstract work, whereby KBUD can be regarded as the program to nourish the transformation of cities into KCs, and the renewal of their economies as

knowledge economies (Cheng et al., 2004; Yigitcanlar et al., 2008c). KBUD promises a secure economy within a human setting, delivered through institutional, economic, socio-cultural, and urban development.

Institutional development is essential to orchestrate KBUD and bring together all of the key actors and sources, in order to organize and facilitate necessary knowledge-intensive activities and plan strategically for KC formation (Yigitcanlar, 2009). Economic development codifies technical knowledge for the innovation of products and services, market knowledge for understanding changes in consumer choices, 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). Socio-cultural development indicates the intention to increase the skills and knowledge of residents as a means for individual and community development (Gonzalez et. al., 2005). Urban development builds a strong spatial network relationship between urban development clusters, and in this sense, knowledge precincts play a significant role in the spatial formation and delivery of citywide KBUD strategies (Yigitcanlar et al., 2008d). Combined, institutional, economic, socio-cultural, and urban development shapes the development domains of the KBUD: institutional, economy, society, and built and natural environment. For the successful knowledge-based and sustainable development of a city, sustainability capacity and organizational capacity are central to these four development domains (Figure 1).
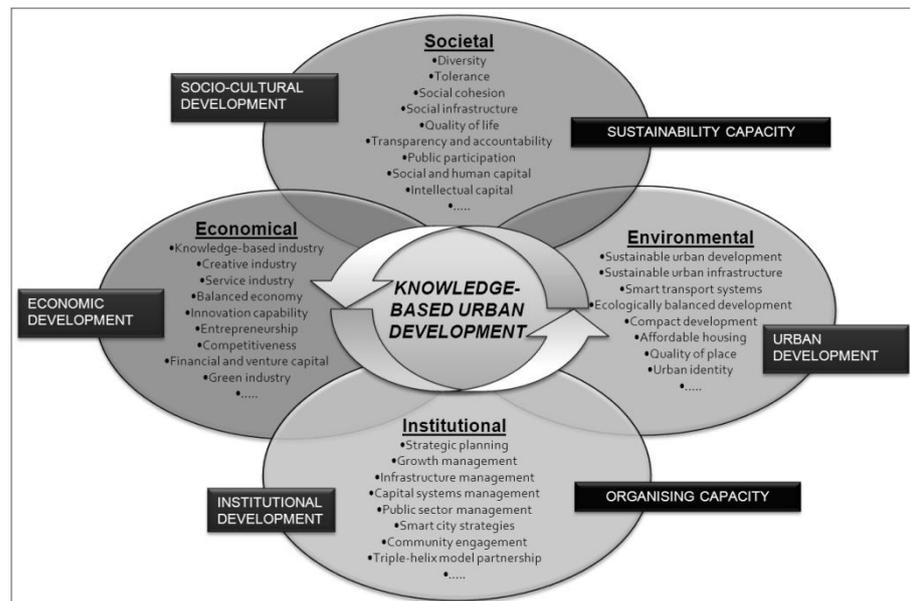
Figure 1. *Development domains of KBUD*

The globalization of the world has been a dialectical process; as the tyranny of distance, eroded, economic networks of production and consumption were constituted at a global scale, and simultaneously, spatial proximity remained an important factor in KBUD. In this way, organizational and institutional proximity, although mediated by technology (i.e. information and communication technologies), are dependent on personal contact and the medium of tacit knowledge. Consequently, as these remain closely associated with spatial proximity, clustering of knowledge production in cities is essential for fostering innovation and wealth creation (Baum et al., 2007).

Therefore, the social benefits of KBUD extend beyond aggregate economic growth. To extend the possibility of KBUD in different social environments 'capital development systems' should be secured in a network of connections anchored at federal, state and local governments, community, sector, household, and individual levels (Carrillo, 2002). Creating 'networking' opportunities among these groups and levels has a positive influence on the KBUD mechanisms. For instance, the environmental actions derived from community and individual levels (i.e. attitudes) influence both the state and local governments (i.e. policies). The next section of this paper scrutinizes Brisbane's transformation to KC by examining the city's strengths and weaknesses in light of the development domains identified in the analysis framework.

Brisbane's knowledge city transformation and knowledge-based urban development processes
With a reasonably strong knowledge and technological development; growth in competitive industries and efficiencies in the services sector; rapid processes of adjustment to ICT's; and the increasing implementation potential of KBUD; Australia rates above the OECD average for most of the indicators of success for knowledge-driven economies (McKeon and Lee, 2001; Yigitcanlar 2008c). Brisbane is the capital city of the state of Queensland, in which economic growth has exceeded that for Australia over most of the last decade, and Australia itself, has been acclaimed as one of the fastest growing economies in the OECD. By standard economic measures, Brisbane is an outstanding performer, driven by strong population growth and high export performance (Andrews, 2006). The city has emerging strengths in a number of dynamic new sectors that will drive the city's capacity to sustain and advance growth into the future. Biotechnology and biosciences, aviation and aerospace and information and communications technologies (ICT) are examples of development opportunities, which have the potential to diversify Brisbane's economy into the higher value activities required to be competitive in the global marketplace (Andrews, 2006). The following sections discuss the regions institutional, economic, socio-cultural, built and natural environment KBUD processes, and examines Brisbane's capacity to become a KC.

Institutional development processes
It is broadly agreed that there are fundamental strengths in Brisbane's economy, which have allowed it to accommodate a rapid population growth whilst sustaining high growth in income and output per capita, in recent years. However, in the context of the knowledge era, the future economic performance of Brisbane will be dependent upon its capacity to produce and disseminate knowledge and innovation. As the geography of knowledge producers and users is an important factor in the development of urban economies, strategic planning instruments offer much guidance for the continued attraction of talent and investment, and overall success of KBUD. Van Winden et al. (2007) suggest that 'organizing capacity' or the quality of governance processes across various hierarchal levels, have a significant impact on the KBUD efforts of an urban region. In Queensland, the Smart State Council and the Department of Infrastructure and Planning developed the 'Smart State Strategy', to drive growth and economic development across the state and particularly in the Brisbane Metropolitan area (Rayner, 2006). Broadly, the strategy aims to increase competitive access to physical inputs, effective market processes, and advantageous business and cultural

environments (SEQRP, 2005; Smart State Council, 2007). Specifically the strategy endorses eight central themes: (a) Skilling the state with training and science education; (b) Using knowledge to drive economic growth; (c) Managing the knowledge economy; (d) Building scientific and research facilities; (e) Commercializing discoveries and innovations; (f) Harnessing smart science for the environment; (g) Government agencies to drive research and innovation; and (h) Strategic partnerships with private and academic sectors (Queensland Government, 2004). Overall, the political imperative of the strategy is within its capacity to transform the region from a natural-resources base to the knowledge economy, recognizing knowledge, science, technology, research, education, and innovation as key drivers of economic growth.

Although still in its infancy, the 'Smart State Strategy's' dominant KBUD focus, demonstrates a strong potential to achieve the diversification of economic activities required to sustain regional income and employment growth into the future. Purposely the strategy sanctions an alignment of strategic planning and growth management at the regional level, with local administrative practices, in an effort to advance KBUD. In accordance with the strategy, Brisbane has adopted a ten year 'Smart City Strategy' (2007), which aims to transform the city into a KC. An opportunity of the 'Smart City Strategy' is that it offers Brisbane a more intense urban development focused knowledge-based development perspective, than the overarching statewide strategy could provide. Explicitly the strategy develops KBUD policies that address the following activities: economic development (economic fundamentals of industry efficiency, capital infrastructure, fiscal environment, and innovation), human and social development (education and training, knowledge society skills, culturally diversification), and sustainable urban development (formation of knowledge clusters, networked infrastructures). Importantly, the operation of 'Smart State' and 'Smart City' initiatives from one administrative centre for each, promotes overall integration of various local and statewide initiatives, and promotes capital systems management in combination with community engagement practices. As a result, Brisbane and the Queensland region as a whole are considered to be well integrated in terms of service delivery, the infrastructure for which is underpinned by the regional telecommunications plans, and where by social integration is addressed through various e-governance initiatives. Overall, the strengths of this institutional structure are largely contributed to constructive State and Local Government collaboration, within a clear policy framework and with well-resourced staff (Odendaal, 2003).

At the metropolitan level, Brisbane's efforts in institutional development processes of KBUD are based around quadruple-helix model partnerships, for the overall integration of various local and statewide KBUD initiatives (Odendaal, 2003). Local Government incentives for knowledge sharing in the form of budget allocations for the creation of communities of practice (Brisbane City Council, 2009) facilitate the creation of formal and informal networks for knowledge sharing amongst various knowledge agents. These knowledge agents include innovative businesses, organizations, universities and research centres, with the advantages of these public–private–academic partnerships found to be in the resulting dynamic co-operations that facilitate successful KBUD. Brisbane's local administration for example, works with State Government in providing training in schools; with universities in providing training, and skill development; with the information technology

businesses in providing infrastructure; and with knowledge-intensive industry providing services and employment. In addition, local government networks with other state agencies such as State Education in providing various initiatives and online training, and works with Federal and State government in the development of local e-government (Odendaal, 2003). Local e-governance initiatives in Brisbane are proving successful in achieving KBUD through the development of capital systems to obtain a positive value balance among stakeholders and involve interest groups in the decision-making process as active actors. In general, Brisbane's institutional development processes for KBUD are strengthened by high-level investment in research, capital systems development, technology diffusion and the commercialization of ideas. Brisbane for example, receives the highest per capita State Government investment in R&D in Australia, and is home to a growing number of 'world-class' research institutes. Furthermore, many of these institutions are based at University of Queensland (UQ), which has emerged as a leader in achieving commercial outcomes from research. However, these strengths are predominately located in the public sector with Brisbane's business expenditure on R&D (BERD) low as compared with Australia's other capital cities. Therefore, it suggests that the institutional linkages between the venture capital, government and business sectors; need to be reinforced and appropriately configured to support the growth of the emerging knowledge-intensive sectors.

Overall, Brisbane's synergistic administrative environment combined with the regions strong local economy and lifestyle options, results in great potential to attract more knowledge-intensive industry and workers, which in turn further supports the KBUD of the city and the region. The development of KBUD strategies in concert with the relevant authorities is important in providing for knowledge production and the augmentation of the knowledge economy, which requires relevant governing institutions capable of orchestrating KBUD and equipped to handle the planning and the creation of the necessary spatial arrangements for the development of the knowledge economy and the concomitant KBUDs. Queensland's 'Smart State Strategy' together with Brisbane's 'Smart City Strategy', are the major statutory driving forces behind the KBUD of Brisbane, and when combined the KBUD initiatives have strong pushing power in positioning Queensland's economy as a knowledge economy and in transforming Brisbane into a KC. Until recently however, the region was lacking in the institutional linkages that could bring the key actors and sources together to foster knowledge-intensive activities. Although, newly formed incubator and commercialisation organisations, now serve to support the establishment of networking, interactions and partnerships with other KCs, more administrative effort is required to facilitate the strategic planning of Brisbane's KC transformation.

Economic development processes
In the late 1990s, Queensland started to develop extensive innovation engines; these centred on nine universities and research agencies, the majority of which are located in metropolitan Brisbane and the South-East Queensland region. The development was focused on emerging capabilities in niche knowledge-intensive areas such as biotechnology and biosciences, information and communications technologies (ICT), and eco-tourism, as well as continuing the region's competitiveness in food and agribusiness, aviation and aerospace, mining, marine, and environmental technology industries. However, and until the formation of the 'Smart State' council, there was a lack of coordination of development and insufficient recognition

of these sectors' potential to generate wealth for the region. Moreover, there was insufficient public leadership and investment to boost the necessary knowledge infrastructure required for the transformation of the region's economy, to the knowledge economy. Until the release of the 'Smart State Strategy' together with the 'Smart City Strategy', Brisbane lacked the necessary strategic platform from which to mobilize knowledge processes and convert ideas to tangible results. Therefore, another positive feature of these strategies is seen to be in their emphasis on building the 'brand' by expanding on the strengths, successes, and global recognition of Queensland. Specifically, these strategies emphasize Smart sector strategies to grow skills and innovation projects in priority industry sectors, and Smart ICT to grow the region's ICT industry and exports (Queensland Government, 2005). Although, aimed at incremental as opposed to radical innovation development, these initiatives have the potential to increase technology adoption and diffusion, so that the region can maintain its competitiveness and lift productivity growth over the long term.

As KBUD requires an economic model to regulate the advancement of technical, market, financial and human knowledge required for KC formation, Brisbane's 'Smart City Strategy' focuses on creating high value-added products using research, technology, and brainpower. In a KC, private and the public sectors value knowledge, spend money on supporting its discovery and dissemination, and ultimately, harness it to create goods and services (Carrillo, 2006). Therefore, strong financial support is fundamental for successful KBUD in Brisbane, and financial support is required for research, innovative business and entrepreneurship. From various government resources, Brisbane city administration has created a number of programmes for the promotion of new ideas. As a result, Brisbane has experienced higher out performance and increasing rates of labour force employed in knowledge intensive sectors, and accordingly they comprise a growing share of the city's annual turnover (Brisbane City Council, 2009). In addition, increased funding has facilitated the growth in the numbers of research centres and institutes, and companies with a R&D component, operating in Brisbane. Overall, it is expected that this feature of KBUD will contribute to an immediate increase in the quality and degree of knowledge diffusion through research results, and over the long term contribute to an increase in hi-tech and knowledge intensive exports.

Within Brisbane, the active involvement of the private sector in the organization of knowledge production is essential to its transformation to KC. A positive business climate is the breeding ground for the development of entrepreneurial spirit and competitiveness. Furthermore, the positive promotion of knowledge entrepreneurship is a vital aspect of successful KBUD strategies. Brisbane's 'Smart City Strategy' is improving the local administrative together with the business environment to create an exemplary entrepreneurial climate and an open, flexible interface between government and business. For example, Brisbane's 'Green Heart' program administered through Council's website, provides a high quality of information and knowledge, in addition to a number of actions and measures to support environmental sustainability, and offers financial and venture capital for investments in Green Industry sectors. Embedded within the strategy, Brisbane's KBUD initiatives affirm the city's commitment towards achieving flexibility through facilitating responsiveness to changing needs and demands, while providing the basic capital infrastructure and sound fiscal environment that enables future needs and demands to be

accommodated. Nevertheless, in its current state, Brisbane does not have the proliferation of multinational regional headquarters in the city, which would translate into knowledge-based employment growth (Searle and Pritchard, 2008), and therefore further significant investment in its business environment is required if it is to become a globally vibrant city.

Socio-cultural development processes

Brisbane's 'Smart City Strategy' refers to the terms 'knowledge' and 'creativity' as vital sources for attracting investment and talent, and retaining high-level intellectual human capital, which drive the economic vitality of the city. It is understood that socio-cultural development processes in Brisbane are essential to incubate creativity to ensure economic growth, urban development, and socio-cultural and psychological wellbeing of its residents. Cultural resources are embodied in people's creativity, and Landry (2000) highlights that KCs aim to create the conditions for people to think, plan, and act creatively. Within the context of Brisbane, this means providing an enabling environment that facilitates exchange of ideas, and the possibility to turn these ideas into products, services, and innovative solutions to urban problems. Before the introduction of the strategy, Brisbane was already working towards the same direction, and had a creativity strategy, Creative City: Brisbane City Council's Cultural Strategy 2003-2008, as part of the statutory plan and strategic vision for the city. The former strategy recognized not only the importance of creativity and creative industries, but also urban development and renewal, ecological balance and sustainability, and social and cultural capital development. The strategy aimed at transforming Brisbane to a 'city of ideas' with the venues and audiences to attract world-class festivals and events, and also to be a city of excitement where energy, life and vitality create a sense of cultural confidence (Brisbane City, 2003). Combined with the initiatives of the current strategy, Brisbane is well positioned to promote interest in history, culture and the arts and attract the high-level human capital required within a KC.

Additional KC foundations include quality of life and place, urban diversity and tolerance, accessibility and connectivity, and social equity. Quality of life and place within Brisbane's 'Smart City Strategy' are expressed not only by the level of public service (e.g. health, education) but also by the conservation and development of the cultural, aesthetic and ecological values that give Brisbane its character to attract knowledge workers. Within Brisbane, urban diversity and tolerance is expressed in a cosmopolite atmosphere, wherein open channels for communication and knowledge exchange are reinforced by increasing participation in the public affairs by all social groups. In recent years, high levels of international growth have contributed to the enhancement of the multi-ethnic character of Brisbane and thus linked to a citywide improvement in immigrants and minorities' living conditions. Therefore, another strong feature of the strategy is that accessibility and connectivity link to social cohesion. The strategy emphasises seamless links to other knowledge centres by the networks of good international and regional transport and information technology infrastructure. Overall, the strategy serves to provide Brisbane with the necessary conditions required to expand public and citizenry access to information, education and training.

Notwithstanding, Brisbane's declining 'housing affordability' has been a significant barrier to the development of KBUD strategies in recent years (Yates et al., 2005). Social equity is a key dimension of sustainable urban

economic growth, as social tensions such as social exclusion discourage both knowledge workers and investment. Consequently, the 'Smart City Strategy' attempts to ensure that Brisbane maintains a wide range of dwelling types and sizes, which avoids gentrification, or causing exclusion of families, people on lower incomes, and people who might otherwise be marginalized. In this context, new generation urban scale knowledge precinct projects developed in Brisbane purposefully target to integrate different types of knowledge clusters, particularly the creative ones, with mixed-use living environments. However, the actual affordability of these new developments is widely regarded questionable, and this could therefore present a potential threat to Brisbane's transformation to KC. Consequently, Brisbane's optimism appears to be riding on the creative environment, which has the potential to rebrand the city as an inspiring place, one with a thriving cultural life, high quality leisure and amenities, and an international orientation with strong social and cultural diversity (Van den Berg et al., 2004). In this regard, Brisbane's drive to urban diversity and tolerance will require greater focus on creating places diverse in character and scale, which are accessible and attractive to people from all cultural and socio-economic backgrounds.

Urban development processes

Sustainability and smart use of natural resources is an integral part of Queensland's 'Smart State Strategy' and includes the following major initiatives: developing a sustainable natural resource development strategy; establishing an international water centre; and innovative research to control environmental hazards (Queensland Government, 2005). Most of the 'Smart State' initiatives target sustainable urban development that is important to both traditional and knowledge-intensive industries (State Development and Innovation, 2004) and that strengthens the global positioning of these enterprises through interrelated knowledge precinct and clusters. In an effort to support climate change adaptation for example, the 'Smart State Innovation Fund' has endorsed many projects in addition to established 'The Climate Change Centre of Excellence'. The centre launches Queensland's credentials as a national leader in driving climate change science and policy (Queensland Government, 2007). Unsurprisingly, environmental sustainability emerges as one of the key concepts in Brisbane's 'Smart City Strategy'. This concept employs precinct-wide initiatives for energy, water and waste efficiency, setting clear targets and monitoring performance, as well as regulating ecological sustainable development standards.

The idea of 'compactness' for future urban growth is a conceptual strength of the 'Smart City Strategy' as it supports a more sustainable treatment of natural assets. The strategy optimizes the use of available re-developable land, facilitating a density of living and working environments that capitalizes upon existing city centre infrastructure, offers choices of living affordability, and provides adequate open space and leisure environments. In Brisbane, urban and regional planning instruments have been used as an effective tool in planning the KBUD of the city and the metropolitan region. Brisbane's 'Metropolitan Regional Plan 2026' for example supports KBUD, through economic development initiatives that are underpinned by the 'Smart State Strategy'. The plan adopts a KBUD strategy that "identifies investment in research, development, technology diffusion and commercialization of ideas. It also includes investments in knowledge, skills, diversity, creativity and connectivity as the key mechanisms to achieve increased productivity and a better quality of life" (SEQRP, 2005: 82). Furthermore, the plan sets the

strategic direction for the future development of the Brisbane, by emphasising key KBUD projects and necessity of attracting knowledge workers as residents by providing quality of place through urban renewal schemes (Brisbane City, 2006). Combined with the 'Smart City Strategy', Brisbane's 'Metropolitan Regional Plan 2026' delivers a number of policies and guidelines, which have the potential to move Brisbane towards a KC.

As previously discussed, strengthening the knowledge base of Brisbane requires strong knowledge clustering (e.g. universities, R&D institutions, knowledge precincts), which is particularly important in the promotion of the spill-over effects found to be vital for long-term economic prosperity (Lever, 2002). The spatial nucleus of Brisbane's 'Smart City Strategy' is 'knowledge precincts' which have the potential to play a significant role in knowledge production. Brisbane's 'knowledge precincts' indicate the clustering of R&D activities, high-tech manufacturing of knowledge-intensive industrial and business sectors linked by mixed-use environments. A feature of globally competitive knowledge economies is that governments, universities, and industry work together to create knowledge precincts where generation, transfer, application, and transmission of knowledge can occur (Dvir and Pasher, 2004). In this context, Brisbane's 'Smart City Strategy' advocates knowledge precinct development in and around Brisbane, for biotechnology and biosciences, aviation and aerospace, and ICT in particular. These comprise the examples of Brisbane's strong knowledge-precinct development opportunities, which have the potential to make Brisbane a global player, especially in the Asia-Pacific region (Andrews, 2006).

Brisbane's 'Smart City Strategy' strengthens the KBUD of Brisbane's inner core particularly by developing and integrating four super knowledge precincts. These super precincts, Woolloongabba, Bowen Hills, South Brisbane, and City West precincts, possess a remarkable range of creative, commercial, cultural, educational and research facilities to generate a strong knowledge economy for the city (Smart State Council, 2007). The KBUD of Brisbane's inner suburbs includes globally linked knowledge precincts such as Herston known for its medical research, and Kelvin Grove known for its creative industries and health. An ICT sector is developing near the CBD and adjoining neighbourhoods, with federal government representation in the iLab incubator and Information Industries Board. Substantial activity is also located around the University of Queensland with a range of research facilities, including the Institute for Molecular Bioscience and a natural resources and environmental cluster nearby. These super precincts will facilitate a new conceptualization of the inner city lifestyle for Brisbane in its journey to become a globally recognized KC. It is planned that these will bring together major commercial and residential growth, and research and knowledge development, with strong educational connections to the region's major universities. When fully developed, these precincts will comprise transit-oriented development, cultural and recreational facilities, creative industries and knowledge precincts. They will also accommodate all ingredients of a self-contained city-centre, linked to existing major health, recreational and lifestyle precincts in proximity.

The latest trend in Brisbane's orientation towards a global KC is the development of airport knowledge precincts around Brisbane International Airport. Brisbane, like other Australian hub airports, provides significant numbers of jobs, contribute substantially to Gross State Product, and are willing to attract and accommodate knowledge-intensive business and

industries. Like many major hub airport cities worldwide (i.e. Singapore's free-trade zones, Seoul Incheon's techno parks, Kuala Lumpur's high-tech corridor) Brisbane airport have already diversified its property portfolio with a variety of land use activities such as Brisbane's knowledge industry precincts. These airport precincts are among the hotspots of KBUD, and home to aviation and aerospace industries. These knowledge industry precincts are important as Brisbane aims to attract and incubate knowledge and creative industries, as they are becoming an important contributor of the global knowledge economy.

Elsewhere in the Brisbane metropolitan region, there are emerging clusters and specialist centres of research and development at key sites for: minerals and energy; pathology and bio-security; and resource industries. The ongoing development of University of Queensland campuses at regional campuses, Ipswich and Gatton will be a key factor in diversifying that area's economic activity, as well as increasing access to education and training in the Western Corridor. Urban redevelopment areas, particularly knowledge precincts such as Boggo Road at Dutton Park, provide the opportunity for mixed-use development, incorporating high value-added research, development and service industries and linkages to university research facilities. Kelvin Grove Urban Village adjunct to Queensland University of Technology campus at Kelvin Grove provides a new model for 'community knowledge precinct' development by bringing creative and knowledge-intensive industry and businesses together with a vibrant lifestyle and living opportunity. Plans for redevelopment of Queensland University of Technology's Carseldine Campus as a new knowledge precinct is another indicator of Brisbane's ambition in KBUD. Such developments and clustering effects have the potential to magnet other knowledge-intensive industries to Brisbane. Importantly new firms can be located either in close proximity or more distant to each other, and therefore Brisbane's KC transformation will in part be dependent on the government's ability to provide the easy transport accessibility, high-speed broadband, and other information and communication technologies required for the success of knowledge-intensive sectors.

Conclusion
This paper discusses the critical connections between KC foundations and integrated KBUD mechanisms in various levels. This research introduces a KBUD analysis framework that brings essential KC and KBUD concepts and practical assessment mechanisms together. This analysis revealed that the global orientation of Brisbane within the frame of regional and metropolitan level KBUD strategies is performing well, although there are a number of areas that may warrant increased strategic focus. In the context of the knowledge era, the future economic performance of Brisbane will be dependent upon its capacity to produce and disseminate knowledge and innovation. Brisbane's has emerging strengths in a number of dynamic new sectors that will drive the city's capacity to sustain and advance growth into the future. Brisbane's Biotechnology and biosciences, aviation and aerospace and information and communications technologies (ICT) are examples of development opportunities, which have the potential to diversify Brisbane's economy into the higher value activities required to be competitive in the global marketplace. Although, aimed at incremental as opposed to radical innovation development, these initiatives have the potential to increase technology adoption and diffusion, so that the region

can maintain its competitiveness and lift productivity growth over the long term.

Overall, Brisbane's synergistic administrative environment combined with the regions strong local economy and lifestyle options, results in great potential to attract more knowledge-intensive industry and workers, which in turn further supports the KBUD of the city and the region. Until recently however, the region was lacking in the institutional linkages that could bring the key actors and sources together to foster knowledge-intensive activities. However, these strengths are predominately located in the public sector, and therefore it is suggested that the institutional linkages between the venture capital, government and business sectors; need to be reinforced and appropriately configured to support the growth of the emerging knowledge-intensive sectors. Within Brisbane, the active involvement of the private sector in the organization of knowledge production is essential to its transformation to KC and consequently Brisbane must acquire the proliferation of multinational regional headquarters in the city, which would translate into knowledge-based employment growth.

Although, newly formed incubator and commercialisation organisations, now serve to support the establishment of networking, interactions and partnerships with other KCs, more administrative effort is required to facilitate the strategic planning of Brisbane's KC transformation. Significant investment in Brisbane's business environment is also required if it is to become a globally vibrant city. Overall it is anticipated that the political imperative of the 'Smart City Strategy' will provide Brisbane with the necessary funding resources required to contribute to an immediate increase in the quality and degree of knowledge diffusion through research results, and over the long term contribute to an increase in hi-tech and knowledge intensive exports.

Furthermore, it is suggested that Brisbane's drive to urban diversity and tolerance requires greater focus on creating places diverse in character and scale, which are accessible and attractive to people from all cultural and socio-economic backgrounds. Notwithstanding, Brisbane's 'Smart City Strategy' is seen to be reinforcing the KBUD of Brisbane's inner core, by providing strong knowledge-precinct development opportunities, which have the potential to make Brisbane a global player, especially in the Asia-Pacific region. These knowledge industry precincts are important as Brisbane aims to attract and incubate knowledge and creative industries, as they are becoming an important contributor of the global knowledge economy.

In consideration of these findings, it is recommended that Brisbane develop a monitoring system as a feedback and reporting tool to measure the success and failure of specific KBUD policies accurately, and which is integrated to global knowledge networks. In this regard, benchmarking with other global KC initiatives is essential. Along with Brisbane's opportunities and constraints, KBUD benchmarks and comparative analyses should take into account of specific developmental conditions of the city. Brisbane's capital systems and value structure, including all significant forms of social value, nourishes local KBUD strategies. The evaluation of Brisbane's KBUD approach based on the perception of global KCs is not a simple task, as success in other regions may not be easily replicable. Therefore, effective KBUD policies of Brisbane need to be resilient enough to capture the

advantages of national and state level industrial, intellectual, socio-economic, and urbanization characters.

Another important point is the vital need for a participatory process: the more endogenous and participatory the KBUD strategy is, the more successful the outcomes are. In such a process, the specifics of the demand side should be taken into account. The process should not be prescriptive, and should be adapted to meet the requirements of the individuals, and social and business communities. Although 'Smart State' and 'Smart City' strategies refer most of these qualities, and so far, there are some significant outcomes of the KBUD (i.e. economic prosperity, job creation, human development, and moving towards social and environmental sustainability), data limitations, make it impossible to accurately comment on how successful Brisbane's KBUD strategies are. Therefore, further in-depth research focusing on knowledge precinct development, knowledge-intensive industry sectors, and firm based analyses are necessary to find out whether introduced KBUD strategies are adequate to transform Brisbane into a KC.

Beyond the case of Brisbane, in general, KCs are complex entities, and attempts to transform cities into KC would likely result in failure unless they are guided by sound strategic visions. These strategic visions should incorporate KBUD policies for attracting and retaining knowledge workers and industries and empowering citizens as knowledge creators and innovators. Planning for KBUD of cities requires a broad intellectual team with expertise in urban development, urban studies, planning and management, socio-economic development, models of intellectual capital, knowledge management, and so on. Planning for KBUD also requires understanding the diverse spatial forms of KCs where a large number of knowledge clusters and precincts are particularly important in the promotion of the spillover effects found to be vital for long-term economic prosperity.

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