



***STIMULATING INNOVATION IN WESTERN AUSTRALIA:
LAYING THE FOUNDATIONS***

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1. Executive Summary

Innovation is central to competitiveness and productivity in the State economy for both traditional and emerging economic sectors and has underpinned WA's remarkable economic growth. However, in recent years the State's innovation performance has lagged by comparison with other States and this decline is even more concerning when placed in an international context where Australia has relatively low levels of innovation efficiency and collaboration between research and industry.

This report reflects TIAC's desire to see a culture of innovation* in WA to support economic diversity and growth. Its aim is to assist the West Australian State Government (WA Government) in addressing the key questions: "*What do we need to do, and where should we focus our resources and attention to stimulate innovation in business, government and community sectors?*" Knowledge will be essential in developing strategies, knowledge of the competencies** that exist and are growing in Western Australia, the sectors the competencies support, cross sectoral linkages and where there is existing concentrations of industry providing a foundation for a cluster.

The recommendations guide and inform development of innovation policy responses aimed at strengthening and diversifying the State's economy. TIAC believes that clusters of increasing innovative capability are one of the most effective environments for innovation to be sparked, driven and converted to improved productivity, new commercial assets and increased economic value. Innovation can and does happen in isolation, but the successful outcome can face greater challenges. Collaboration, cooperation and support will drive greater success.

TIAC considers that a more nuanced understanding of WA's current innovation system and its constituent networks and clusters is needed before effective policies are developed. In this document TIAC offers suggestions for achieving this outcome.

Innovation networks and clusters may range from members of a single incubator to a mature industry cluster (Australian Marine Complex, Henderson) and we need to understand their systems, linkages and the underlying competencies to assist innovation. For example, how can clusters be organised more effectively to speed up the rate at which ideas flow through the economy and transfer between sectors? What regulatory environment will facilitate cluster growth and accelerate the rate at which innovation moves through 'concept-to-commercialisation' stages? The role of individual and small team innovators outside of recognised clusters must also be assessed.

TIAC's recommendations provide suggestions to better understand the WA innovation system. At their core is a proposal that the WA Government, in partnership with organisations from industry and technology, start-ups and institutional research, initiates spatial analysis to identify, classify and map the wide range of innovation networks and clusters (both physical and virtual) within the metropolitan and regional areas. A second stage to the project could seek to identify gaps, impediments, keys to success, and the different types of "proximity" that can optimise competitive advantage through innovative practise.

* Innovation is defined as: '*improvements in technology, products, services or business operations that lead to a distinct competitive advantage or productivity gain*'²¹

** TIAC recognises both functional (skill and discipline-based) and generic competencies as components of competitive advantage; in the context of the WA economy: "*A Generic Competency is an adaptable and transferable package of enabling capacities, skills and technologies that extend across, contribute to, and enhance the competitive advantage of some, or all, of the key economic sectors in WA.*"

2. Recommendations

Research and specific knowledge is required to develop an effective policy response to stimulate innovation in WA. Policies should strengthen what currently works and stimulate the creation of new networks and clusters of innovation in WA, with the overall objective of diversifying and strengthening the State's economy. TIAC therefore recommends the following actions:

1. That the WA Government fosters a culture of innovation by making policy and strategies based on knowledge of the competencies with a critical mass in the state and by "Promoting Western Australia's Best". Stimulating innovation by providing examples of existing innovation that meet national and international market demands. The WA government also needs to contextualise failure as a learning experience.
2. Knowledge of the complex relationship between competencies and industry is essential. That the WA Government initiates a project to identify, classify and map the wide range of networks and clusters (both physical and virtual) within the WA innovation scene with the aim to:
 - Gain an overarching view of the current WA innovation landscape, its components, complexities, gaps and needs.
 - Determine its relationship to the existing commercial and industry infrastructure, as well as identify previously unrecognised clusters.
 - Understand interactions and linkages at different scales within the innovation system, e.g., between co-located organisations, between clusters within WA and across state and national boundaries, and between individual entrepreneurs.
 - Identify the factors that lead to successful innovation and the current impediments to success, and make appropriate amendments to increase opportunities.
3. That the WA Government identifies policy mechanisms and regulatory changes needed to enhance innovation, such as the need to:
 - Unlock private capital and attract venture capital**, so WA becomes a preferred home for early stage investment and venture capital activity.
 - Improve cluster linkages across WA's large spatial divides based on inter-related competencies and supporting Regional Blueprints.
 - Attract talented global entrepreneurs to relocate (or return) to WA***.
 - Encourage stronger commercial engagement between university research, investors, industry (large and SME's) and government.*
4. That this work be undertaken with several partner organisations (e.g. from industry and technology, start-ups and institutional research) to increase the likelihood of success, and to recognise the benefits it will afford to non-government organisations.
5. That the WA Government give increased attention to the competencies and STEM skills required in a forward looking economy creating sustainable long term employment and jobs.
6. That the WA Government identifies its role in stimulating an environment of increased entrepreneurial activity based on the knowledge gained through the project.

These recommendations are contextualised below by a discussion on performance indicators for innovation, value-adding and entrepreneurship, and a summary of current thinking on policy to facilitate innovation, before a final comment on the WA innovation system itself. The appendices provide related data and examples of innovative companies, including the products and services they deliver.

** (e.g., tax treatments/advantages, changes to bankruptcy laws)

*** For example, some of the estimated 20,000 members of 'Aussie Silicon Valley Mafia'^{3, 12}.

* Large gaps exist; some suggesting that universities have 'limited role in business innovation'¹⁸, and others that 'WA researchers have entrepreneurial DNA but limited ideas on how to access money or develop a business'²⁴.

Introduction

A central tenet of TIAC has always been that a culture of innovation is the key to growing prosperity and economic diversity. What is clear to TIAC is that while innovation has underpinned economic growth in the past, in recent years Western Australia's performance against other states has lagged. International comparisons, which highlight Australia's low levels of innovation efficiency and collaboration between research and industry, only heighten TIAC's concerns (e.g. DIIS 2015 Report¹⁰).

For Western Australia's long term success, innovation is not an added extra, it is an essential ingredient. It is a mindset that should be at the heart of all enterprise undertaken in the State – it is the quest for *'how can we do this better?'* and *"how can we be more competitive?"*

The aim of this report is to assist the West Australian State Government (WA Government) in developing appropriate policy responses to stimulate innovation, thereby strengthening and diversifying the State's economy²⁵. Whilst such policy commitments should seek to complement national initiatives, they must be tailored to the specific needs of the State, and take account of successful innovation in WA, the generic competencies that exist in Western Australia, the very unequal nature of the Australian start-up industry, and WA's current standing. The key questions for the WA Government are: *"What do we need to do, and where should we focus our resources and attention to stimulate innovation in business, government and community sectors?"*

Australian research produces 3% to 4% of the new global knowledge (WA Chief Scientist²⁰) and WA is a strong contributor (see Appendix 1). However, WA's innovation performance is much lower than other states, as measured by:

- entrepreneurship (e.g., start-up numbers in Appendix 2),
- value-add sales (e.g., manufacturing and services exports in Appendix 3),
- innovation (e.g., patent application numbers in Appendix 4).

This low performance, and the limited focus on innovation and entrepreneurial activity outside of *'mining, petroleum and traditionally farming'* (Premier Colin Barnett²⁰), have led to an announcement on increased funding to support innovation in the 12 May 2016 State Budget. However, further work is now required to generate policies that will cost-effectively facilitate an innovation environment. As noted by the Premier: *'the Government has not thought through its policy or done enough in [innovation]'*²⁰. As a first step, the Minister for Innovation has announced a summit on 28th July, 2016, to obtain input from the broader community including industry, researchers, innovators and investors into developing a strategy to address innovation needs in Western Australia.

Whilst this summit is a necessary measure, TIAC believes that an appropriate WA Government response also requires taking stock of the State's industrial innovation framework, understanding its unique innovation ecosystem, and considering its latent potential*. The State's Science Priorities provide a context for this consideration. However, optimizing this potential depends on the underlying generic competencies, efficient linking and clustering of the synergistic interactions (both physical and virtual) that drive innovation. TIAC considers that a more nuanced understanding of WA's existing competencies and current innovation system is needed before effective policies are developed, it therefore recommends that current networks and clusters** of innovation within the State be identified and assessed, with gaps considered, to ensure informed leadership from the WA Government.

* This assessment needs to be wide ranging, and include industry, WA Government entities, not-for-profit organisations and other sectors of the State's economy.

** Clusters are defined as: *'groups of individuals or businesses which find mutual economic benefit in collaborating or organising across either virtual or physical space into a synergistic sub-system within the broader economic environment.'*

Successful clusters develop a critical mass in capability and activity. They are a honey-pot where initial market potential attracts capital, identifies supply chain potential, and leads to collaboration partners. Given the risks associated with innovation and commercialisation, supporting growing clusters is a prudent government investment strategy that is more likely to result in a reasonable proportion of viable enterprise successes that contribute long term economic benefits.

Ad-hoc innovative ideas are also developed by individuals and private businesses and there is a need to consider how to identify, support and grow these disparate individuals and where appropriate connect them with clusters and industries for greater impact.

3. Innovation, Value-adding and Entrepreneurship

An innovative economy requires a culture that encourages questions, new ideas, experiments and failure as part of an ongoing business, government and community conversation. Such a culture thrives in a stimulating, positive, can-do environment informed by both successes and failures. The aim of an innovative culture is to grow single, seemingly insignificant innovations into marketable, high impact commodities or services. It is also about taking those innovations and transferring the concepts across disparate industry sectors.

Innovation, value-adding and entrepreneurship have become important measures of global competitiveness and productivity in advanced economies. They are the hallmarks of prosperous and specialised industry sectors. They are also the basis of new economic activity, such as those markets carved out by disruptive digital and internet technologies²². In WA, there has been successful international marketing of locally developed advanced knowledge based services; just two such examples are in mining software and warship design.

Global market integration and diminishing trade barriers (through free trade agreements and recently, the World Trade Organisation) are intensifying global competition. With relaxation of these impediments come opportunities and threats, including likely impacts on Australian agriculture and manufacturing from the approaching Trans-Pacific Partnership.

Successful innovation is often a complex process involving singular or collective actions by stakeholders* that require interdisciplinary competencies, supporting infrastructure and systems**. Translating basic and applied research into commercial opportunities advances our productivity. In WA, this translation will be helped by innovation policy informed by the unique factors of its economic landscape.

Three key factors are:

1. Western Australia's location in the same time zone as the rest of Asia;
2. The urban, economic and political centrality of Perth compared to the rest of the State; and
3. The State's high reliance on mineral and energy wealth with relatively low value-add sectors.

Innovation is often linked to the IT start-up community however the economic importance of minerals, energy and agriculture in WA has resulted in high levels of specialisation, entrepreneurship and innovation in these sectors. These features lead to a research and development profile that differs from other states and Australia overall (Appendix 5). A concentration in certain sectors has served WA well and underpinned its historic growth, but the inherent vulnerabilities become apparent when low demand for commodities is coupled with high output capacity and embedded high capital expansion cost structure.

* Such as: government, venture capitalists, R&D institutes, education institutes, skilled and creative human capital, industry.

** Such as: transport, regulation, school education, governance and trade facilitation.

These conditions now prevail. Current weak demand for major mineral and energy commodities over the medium term and Australia's high cost structure threaten the State's economy. Increased productivity and diversification into internationally competitive high value products and services are urgently needed.

This situation requires broadening innovation, value-adding and entrepreneurship to other areas of the economy and encouraging transfer of established skills through supportive policies, regulations, incentives and information. Increased attention should also be given to two youth-related matters:

- Increasing the level of engagement of WA school students with STEM subjects given the importance of competencies for future job opportunities; and
- High levels of youth unemployment that needs to be addressed by skilling youth with appropriate generic competencies.

TIAC drew attention to these issues in its 2014 report, *Optimising STEM education in WA Schools*, and helped influence development of the practical solutions proposed in the 2015 STEM-WA Proposal: *STEM Education, Innovation and Youth Unemployment: Rising to the Challenge*.

4. Informing Innovation Policy

Australian innovation policy has followed global trends. It has moved from large-scale construction of technology parks to a more 'bottom-up' model of knowledge-intensive local clusters⁵⁰ linked to a broader national innovation ethos^{4-11, 49}.

The Commonwealth Department of Industry's Innovation System Reports note the importance of 'a culture of innovation'⁷ being about 'people'⁶. However, the conversation to date has been generally framed by the narrow notion that innovation occurs at the nexus of research and industry. This view disadvantages less dense economies, particularly if government innovation packages favour locations of dense industry clusters⁵⁴.

In contrast, the 2015 Department of Industry National Innovation Report includes the *individual* as an entrepreneur who 'mobilise[s] ideas, people and resources to act on business opportunities...[and whose] activities – wreaking disruption and creative destruction – can affect the economy in ways which lead to employment growth, new products and services, as well as different ways of doing things'⁹. This report reflects a global shift in thinking away from the one-size-fits-all 1960s/70s science park and 1990s clusters co-location principles¹⁹, which have not facilitated collaboration or co-learning, or fostered start-ups to any greater degree than other locations (e.g., Malaysia SuperCorridor⁴⁵⁻⁴⁸). Instead, different types of proximity* are being viewed as fundamental to unlocking local and regional competitive advantage** and innovation.

Put simply, innovation is driven by people, their competencies and their interaction with certain technologies or new discoveries; it is not just about the tools used or the sector they are in. Economic development policy must therefore encompass all urban, rural and remote innovators and help them overcome any barriers to innovative success. An open-economy approach is crucial in fostering innovation, given the unpredictable nature of knowing exactly where innovation knowledge should go, who should use it, how it should be applied and the optimal time for implementation.

* Such as through organizational-shared knowledge or labour social relations.

** Such as based on various governance, industry, spatial units and labour advantages.

5. Western Australian Innovation System

In recent years, there has been a growing understanding that innovation needs strategic assistance. However, without a clear understanding of how innovation occurs across WA, it has been difficult to formulate workable policies.

At a recent COAG² meeting, the need to abandon a ‘one size fits all’ approach was demonstrated by its formal commitment to find ‘new ways to apply competition policy in regional and remote Australia.’ COAG effectively endorsed the need to better understand the range of economic environments operating at State and National levels.

The WA economy can be viewed essentially as a network of industry, competencies and community clusters connected via the movement of people and ideas across the entire State. These clusters may range from the members of a single incubator to a mature industry cluster (such as the Australian Marine Complex, Henderson.) Appendix 5 identifies possible WA cluster typologies. We need to better understand this system of clusters and their underlying interdisciplinary competencies if we are to assist innovation.

We should contemplate how clusters might be organised more efficiently and effectively to speed up the rate at which ideas flow through the economy*. In addition, we need to identify an appropriate regulatory environment that facilitates cluster growth and accelerates the rate at which innovation moves through ‘concept-to-commercialisation’ stages. However, these assessments should also seek to identify the role and needs of individuals and small teams of innovators operating independently of incubators and other identifiable clusters.

A concise appraisal of this situation would help to close our current knowledge gap about the dynamics of the WA innovation landscape. It will also assist in identifying the best role that the WA Government policy can play in building world-class innovation from within existing sectors that have comparative advantage and from new sectors. The appraisal would also inform strategic planning between the WA Government, industry, and research and educational institutions.

Appendices 6 to 10 present examples of data sources that would enable appraisal of the diversity of clusters and linkage assets within the WA innovation system and their impact on innovation in WA. It should be noted that report only seeks to provide examples of what could be possible. The data sources focus on the Metropolitan Region and its concentration of WA Government services, research and development, education and skills infrastructure, industry and population compared to the rest of the State. There is a critical need for complementary information about regional WA. An integrated assessment of these data sets will paint a powerful picture of corporate strategic advantage, industry clustering and inter-cluster linkages across the State and reveal crucial information about:

- The composition of and reasons for clusters (e.g., skilled labour, similar or complementary businesses, access to markets);
- Innovation and cluster success factors and what is needed to optimise success;
- Impediments to success (including skill deficits and regulations);
- Cluster and linkage alignments with other strategic centres (e.g., Perth and Peel @ 3.5M, priority economic and urban areas, data centres, and regional areas corresponding to industry priority areas of the WA Science Statement and Regional Blueprints);
- The level of innovation outside of identified clusters;
- The degree of public access to innovation infrastructure;
- Inter and intra-cluster dynamics and competencies facilitating innovative activity, and WA’s preparedness for The Internet of Things¹; and,
- Over-arching misconceptions regarding innovation in regional WA (see Appendix 9 for patent activity in regional WA).

* This includes understanding the impact of strategic data centre location and The Internet of Things¹

Advocating a state-wide approach to informing strategic WA Government policy and funding choices follows a rising trend in spatial analysis by business^{**} and governments^{***}. It also leverages improvements in mapping technologies where multiple modes of data (such as labour, commuting, or corporate networks) are layered to form integrated networks. This approach will enable different 'systems' to be viewed in the context of each other over large spatial divides, including regional areas.

A state-wide approach will lead to effective decision making about where investment growth and policies should be directed for most effective impact. It will also result in improvements being carefully evaluated and monitored. Furthermore, making such information public will allow business and other organisations to make informed strategic and investment decisions, capitalising on current WA industrial and technological capacities.

In conclusion, TIAC argues that the WA Government should initiate comprehensive mapping of the WA innovation system, its clusters and linkages and their positive attributes. This initiative would inform and optimise the new policies, regulations and incentives needed to further stimulate innovation, with the aim of strengthening and diversifying the economy.

TIAC also recommends that this work be undertaken with several partner organisations to ensure a more comprehensive outcome.

^{**} For example, Walgreens uses geographically based analytics to inform consumer choices and strategic business investment decisions⁴³.

^{***} Harvard University and the US Economic Development Administration have engaged in a cluster mapping project to 'understand and shape the competitive landscape for a wide range of industries...[and] to make strategic investments, recruit new companies, and lay the groundwork for new industries'⁴⁴. New South Wales State Government similarly maps research intense locations⁴².

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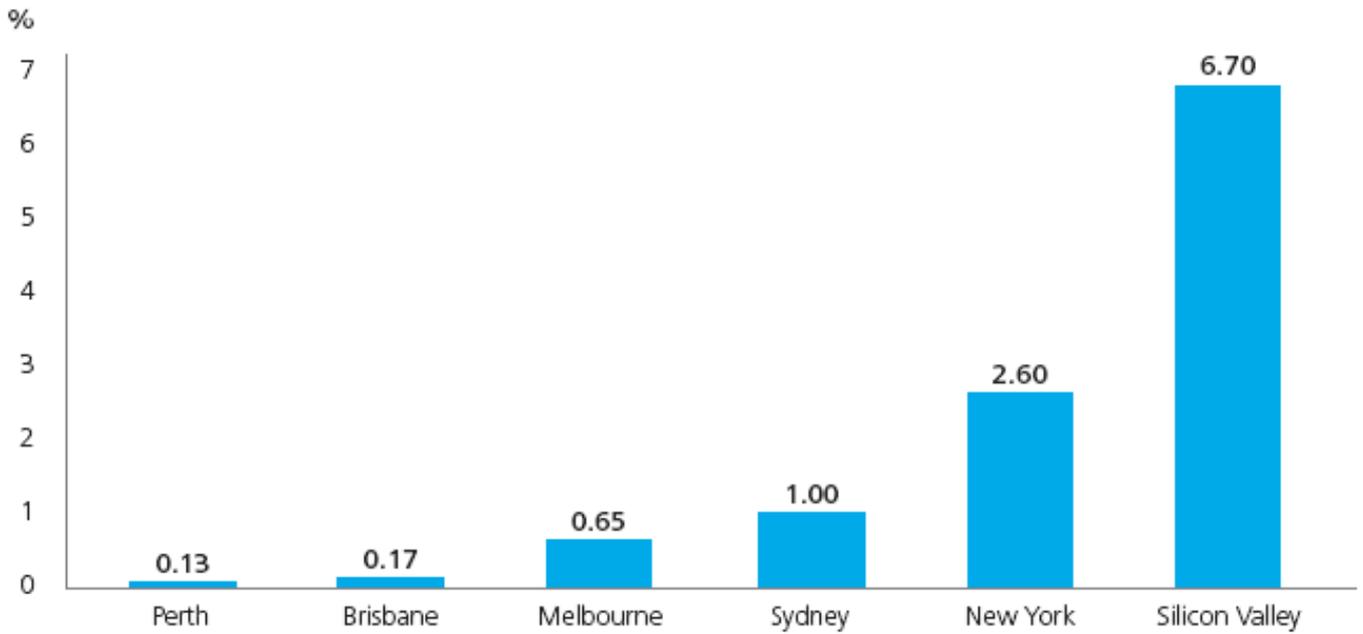
APPENDIX 1: Some examples of Western Australian Innovations

- ✓ Fastbrick Robotics – first robot bricklayer in the world poised to disrupt the construction industry.
- ✓ Austal Limited– global shipbuilding company which grew from small crayboat industry in the 1970s. Biggest shipbuilder in the AsiaPacific and one of the biggest in the world. Supplies US Navy, Australian Navy, and defence and luxury vessels for various other nations.
- ✓ Remote Operations Centre (ROC) – remotely operating activities in Rio Tinto mine sites at a distance of 1,500 kms, changing the face of mining and the way it is done.
- ✓ SEQTA – the world’s first fully integrated learning management system managing all aspects of teaching and learning.
- ✓ Scanalyse – Curtin researchers created 3D laser technology measuring 10 million points or more in 30 mins to map the internal wear of crushers and grinders. Acquired by Finnish mining giant Outotec.
- ✓ Track'em - cloud-based asset tracking and management software using barcode, GPS and radio frequency identification technologies to track and manage assets, equipment and construction materials.
- ✓ HepaFat-Scan - A non-invasive technology that enables magnetic resonance imaging scanners to measure the concentration of fat in the human liver.
- ✓ Ion transport membrane – developed by Curtin researchers to separate oxygen from air, which is commercially valuable due to its superior performance in the production of pure oxygen and the chemical storage of renewable energy.
- ✓ Duchenne Muscular Dystrophy Therapy – developed by UWA researchers targeting the genetic disorder that affects boys and results in muscle degeneration and eventual death.
- ✓ Intium Energy - A prototype roller sensor that has the potential to predict failure of rollers in bulk haulage conveyor belts, timely changes avoid unscheduled stoppages or catastrophic belt damage.

APPENDIX 2: Australia States Start-up Comparison

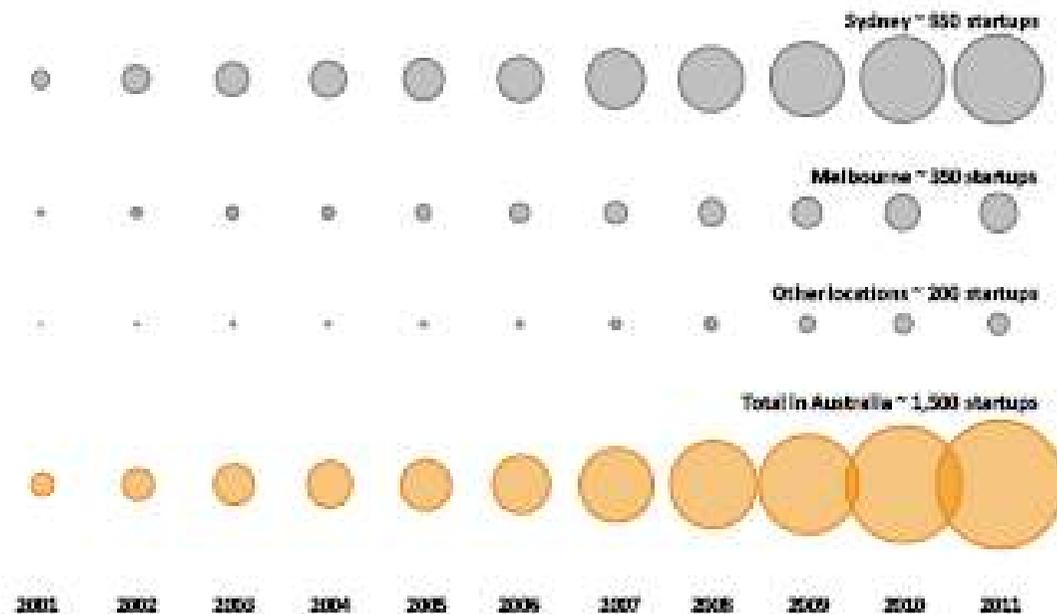
Figure 1: Relative Size of Startup Eco-Systems, Base is Sydney (1)

Relative size of startup hubs



Source: Morle et al. (2012)

Figure 2: Location of today's tech start-ups



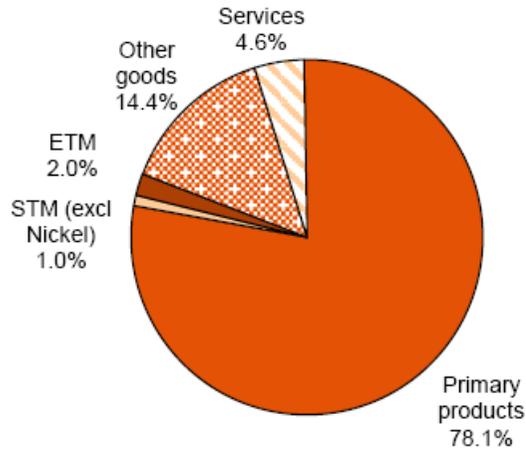
Bubble size = total number of startups active in each year that are still active as at 1 Jan 2013

Source: PWC (2013)

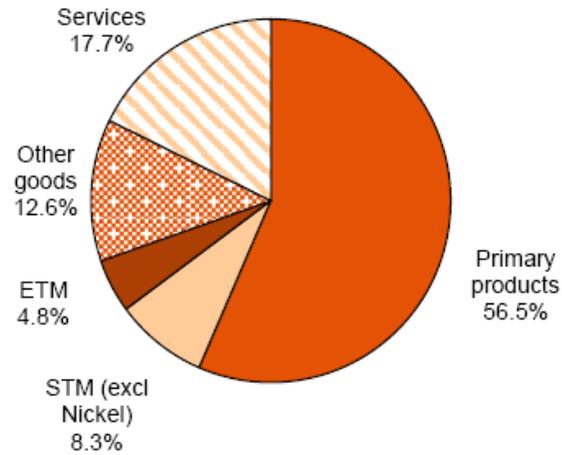
APPENDIX 3: Australia States Trade Export Comparison

Where STM is Simply Transformed Manufacturing and ETM is Elaborately Transformed Manufacturing

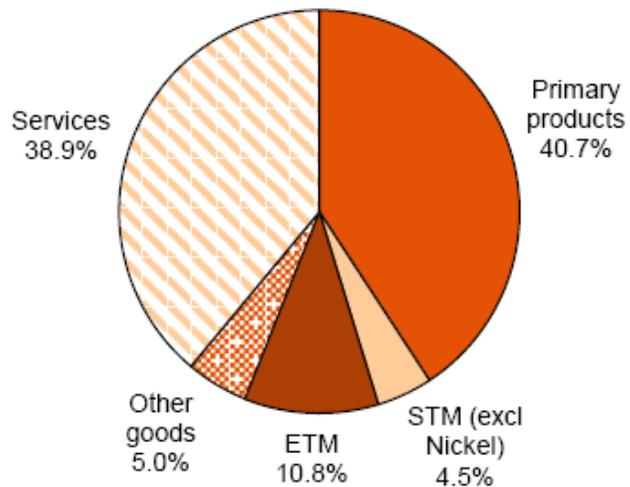
Western Australia's exports



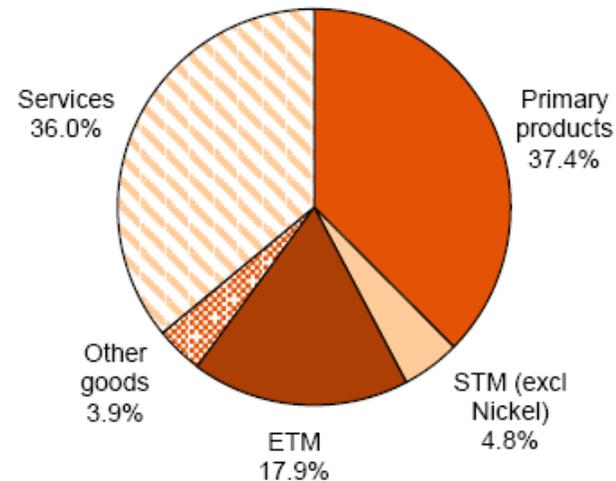
Queensland's exports



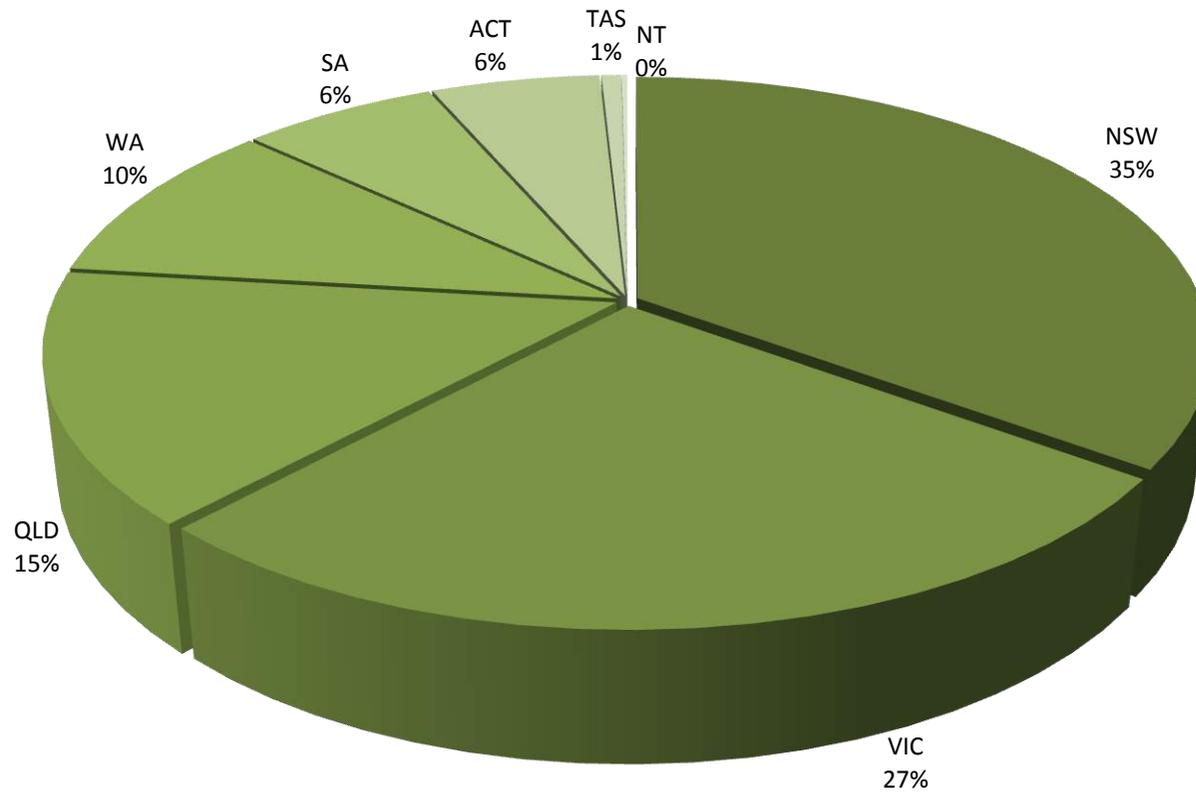
New South Wales' exports



Victoria's exports



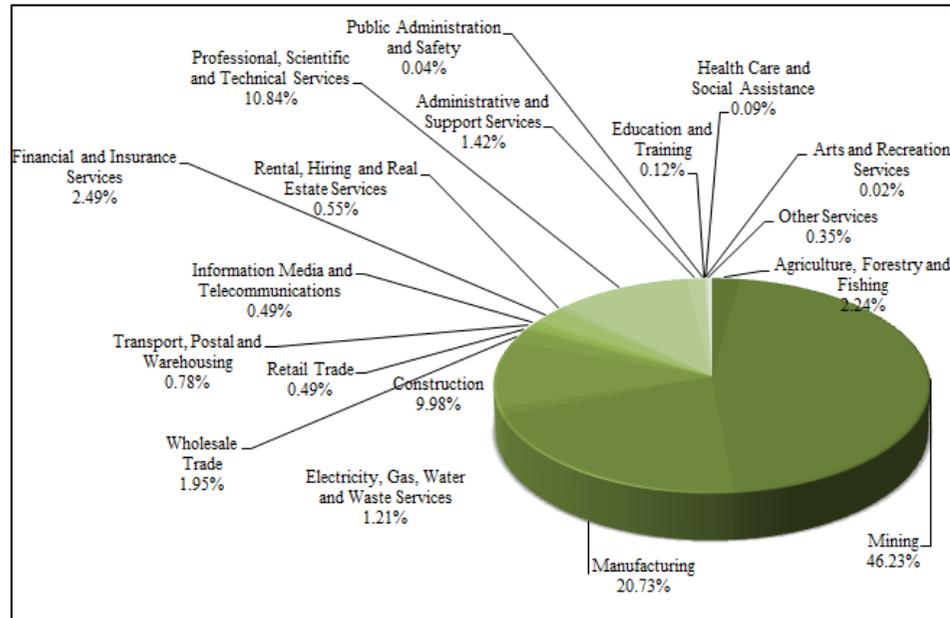
APPENDIX 4: Australia States Portion of Summed Patent Application Total, 1975-2013



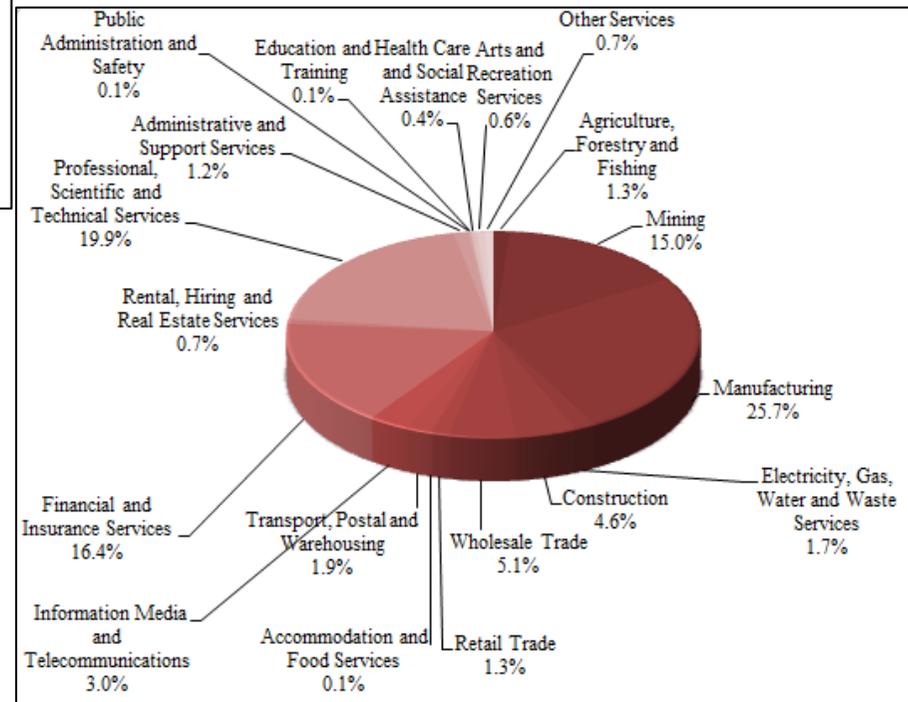
Source: OECD (2014)

APPENDIX 5: Business Research and Experimental Development

Western Australia (2013-14)



Australia (2013-14)



Source: ABS (2015)

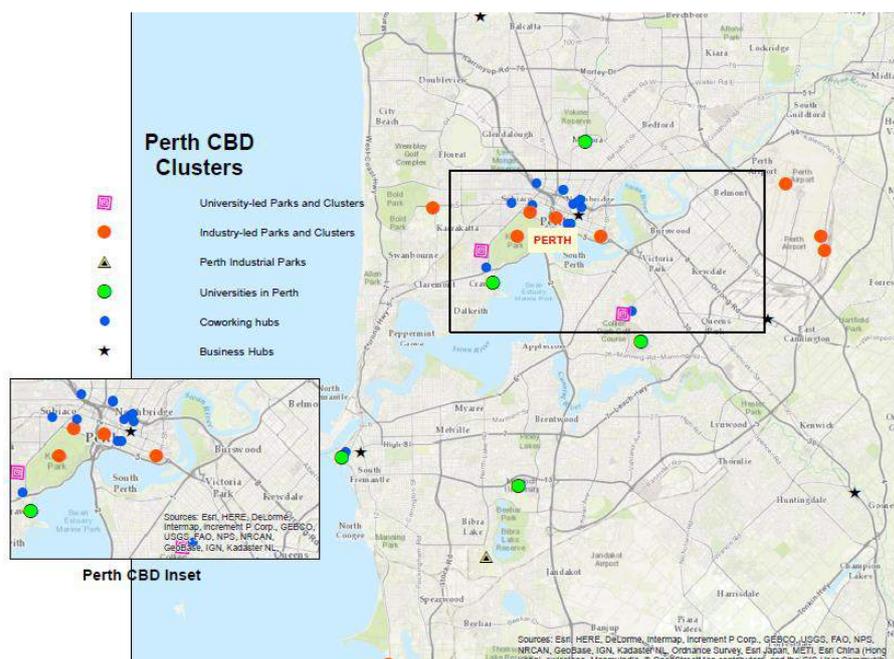
APPENDIX 6: Mapping Cluster and Linkage Assets of Innovation System

A key element of the project is to map the cluster and linkage assets of the WA innovation system. Whilst it is possible to generate rudimentary maps of known clusters (see map below), understanding how these relate to or interact with WA State Government priority infrastructure (such as strategic centres, regional towns or regionally-based science infrastructure) will require targeted investigation to inform future government investment and policy formation appropriately.

Possible Cluster Asset Typology

- University-science parks being geographic clusters of organisation anchored by a university. They aim to increase industry-university collaboration and engage in innovation and knowledge development.
- Learning Precincts being geographic clusters of primarily higher education institutions (academic and skills based). They aim to enhance regional education and skills, as well as attract industry and engage in innovative activity.
- Industry-science parks being geographic clusters of organisations anchored by major corporations whose business models are highly driven by innovation and knowledge development.
- Start-up co-working communities being discrete and concentrated clusters of member individuals or start-up companies having access to co-working space. They aim to provide a range of services and opportunities for small business collaboration in the innovation or design space.
- Business incubators being discrete and concentrated clusters member individuals or start-up companies providing access to business incubation services, such as co-working spaces, business advice. They are not necessarily focussed on innovation or design.
- Industrial - manufacturing parks being specially zoned parks providing medium to large commercial lots for a variety of small to medium manufacturing activity.
- Industrial – commercial parks being specially zoned parks providing medium size commercial lots for a variety of commercially focused business, this may include design-based business as well as customer sales.
- Commercial and business precincts being geographic mixed-use (commercial and residential) land-use in key strategic centres as defined by Directions 2031. They may include a range of large-small business, restaurants, cafes, residential, universities, R&D institutes, co-working spaces, business incubator, government offices, etc.
- Virtual clusters being networks of individuals or companies which do not have a particular geography, but which engage across the community for a particular purpose. They aim to increase innovative output or knowledge development.
- Temporary clusters being networks of individuals which temporarily come together for common reason focused around advanced consumer services or the transfer of knowledge.

The following identifies discrete clusters in the Perth CBD and immediate surrounds, but gives limited understanding of intra and inter cluster interactions given that co-location cannot be conflated with connectivity.



Possible Cluster Linking Assets

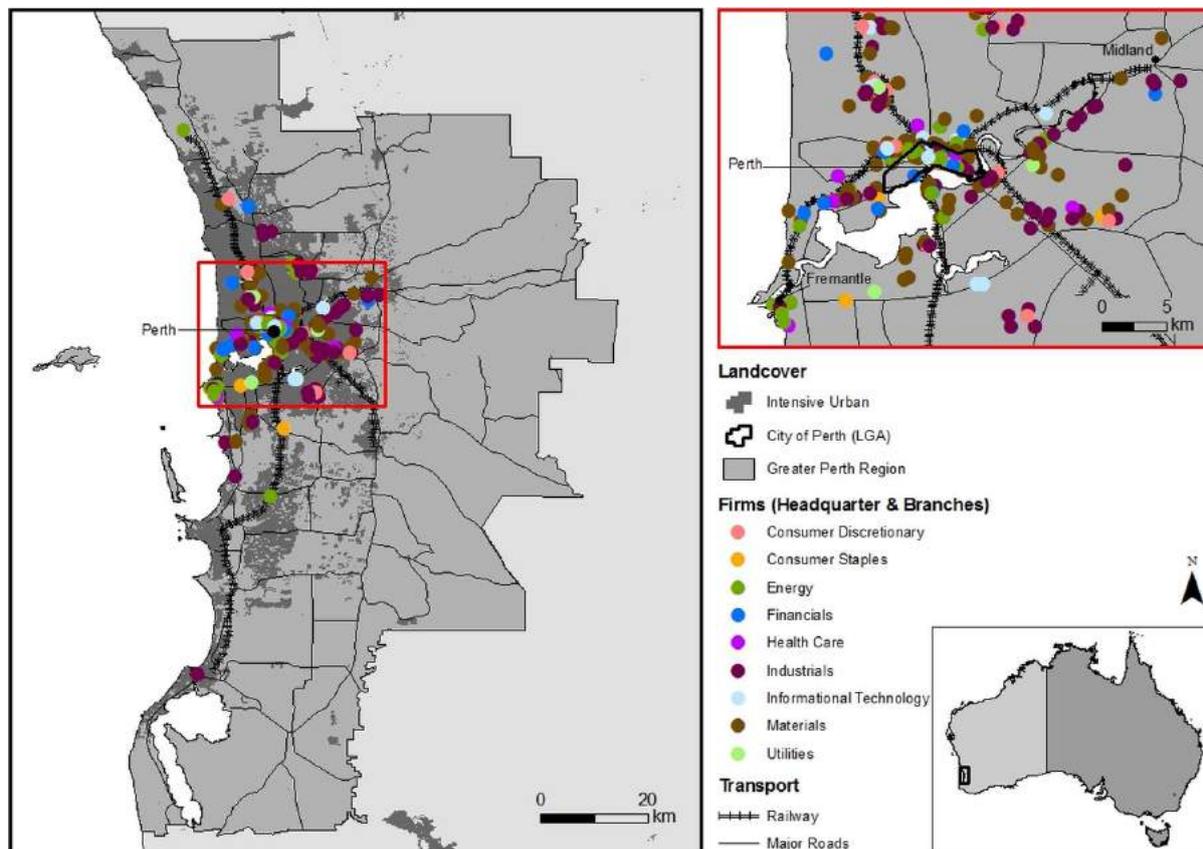
This section outlines what might link clusters and businesses across Perth Metropolitan Region. Linkages are defined by their capacity to facilitate flows of knowledge and ideas through individual mobility and connectivity, increasing the economic productivity of knowledge and innovation. Understanding this aspect will be particularly critical for regional WA where communities are less connected to the overarching system as well as not having a critical mass of industry and population traditionally associated with innovation.

- Virtual linkages being flows which are independent of geography but allow the movement of ideas using ICT, such as social media, or the Internet.
- Human movement being the physical movement of human capital between clusters and regions. A result would be increased connectivity and the social capital of a place, such as through labour commuting or the social movements of community members. Appendix 8 demonstrates this concept via the commuting networks of Perth and Peel Metropolitan.
- Transport infrastructure being the port (air and sea), road and rail connecting infrastructure between clusters, communities and the rest of the world.
- Amenity being community assets attracting and fostering social capital (including labour), such as public open space, natural amenity, universities, etc.
- Technology transfer organisations being specific entities set up to bridge institutional and organisation divides for the cross-fertilisation of knowledge. They enable research to better match industry needs and industry to better commercialise or utilise research output. They are often attached to science or university precincts, or specially established as not-for-profit organisations to promote collaboration in specific regions.
- Data Centres being the physical location of critical ICT infrastructure for organisation data storage, processing and dissemination. The provision of a secure centralised

facility is the essential backbone for ensuring efficiency in State productivity and innovation, as well as facilitating our global integration with The Internet of Things¹.

APPENDIX 7: Strategic Location of 2013 ASX-listed Perth headquarters (707) and offices (180), by industry sector

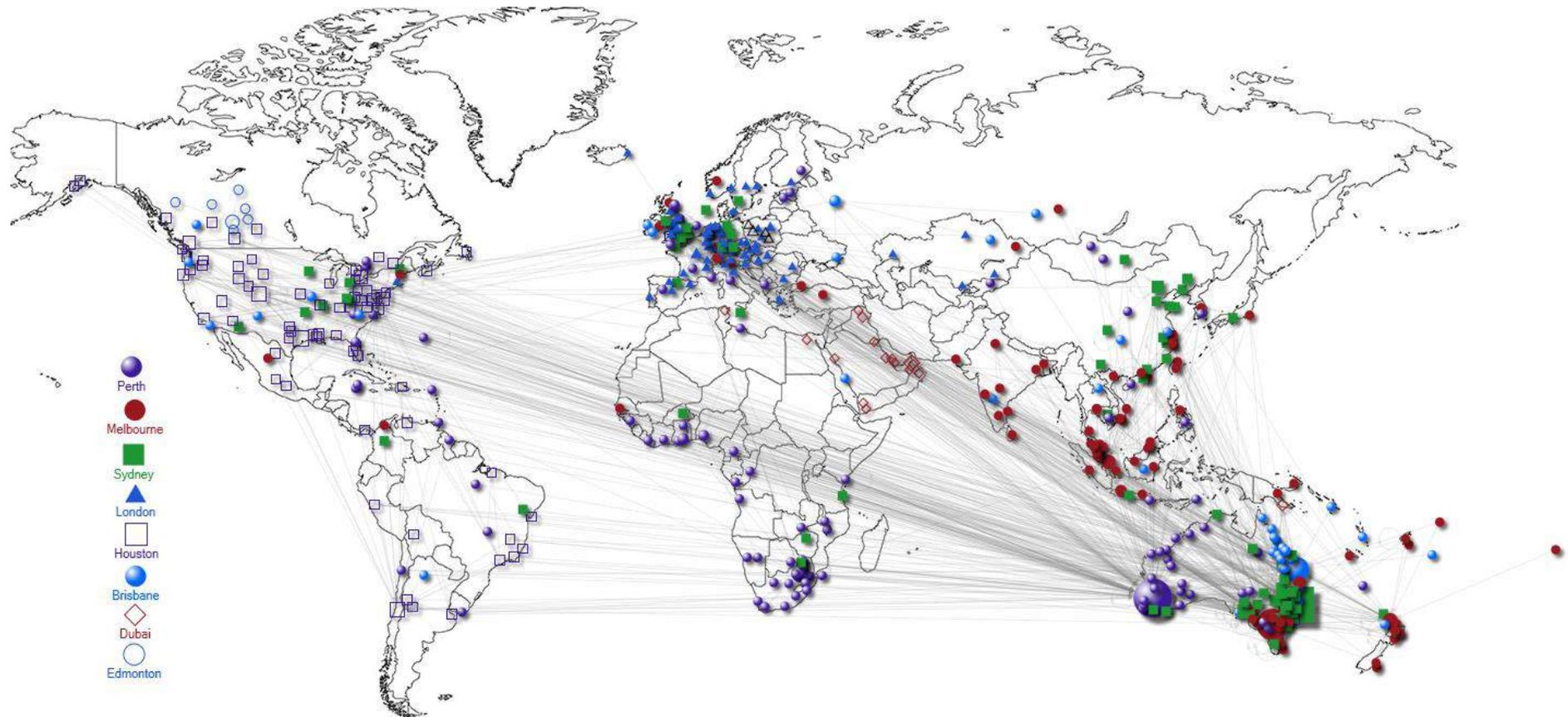
The map illustrates the strategic location of 2013 ASX-listed global companies by industry sector. Coupled with other business data, it can provide insight into the commercial attraction of specific locations and the competitive advantages of specific industry configurations.



Source: Martinus, K. (The University of Western Australia) and Sigler, T. (The University of Queensland).

APPENDIX 8: Strategic Global Location of 2013 ASX-listed headquarters (1839) and offices (4647), by city clusters

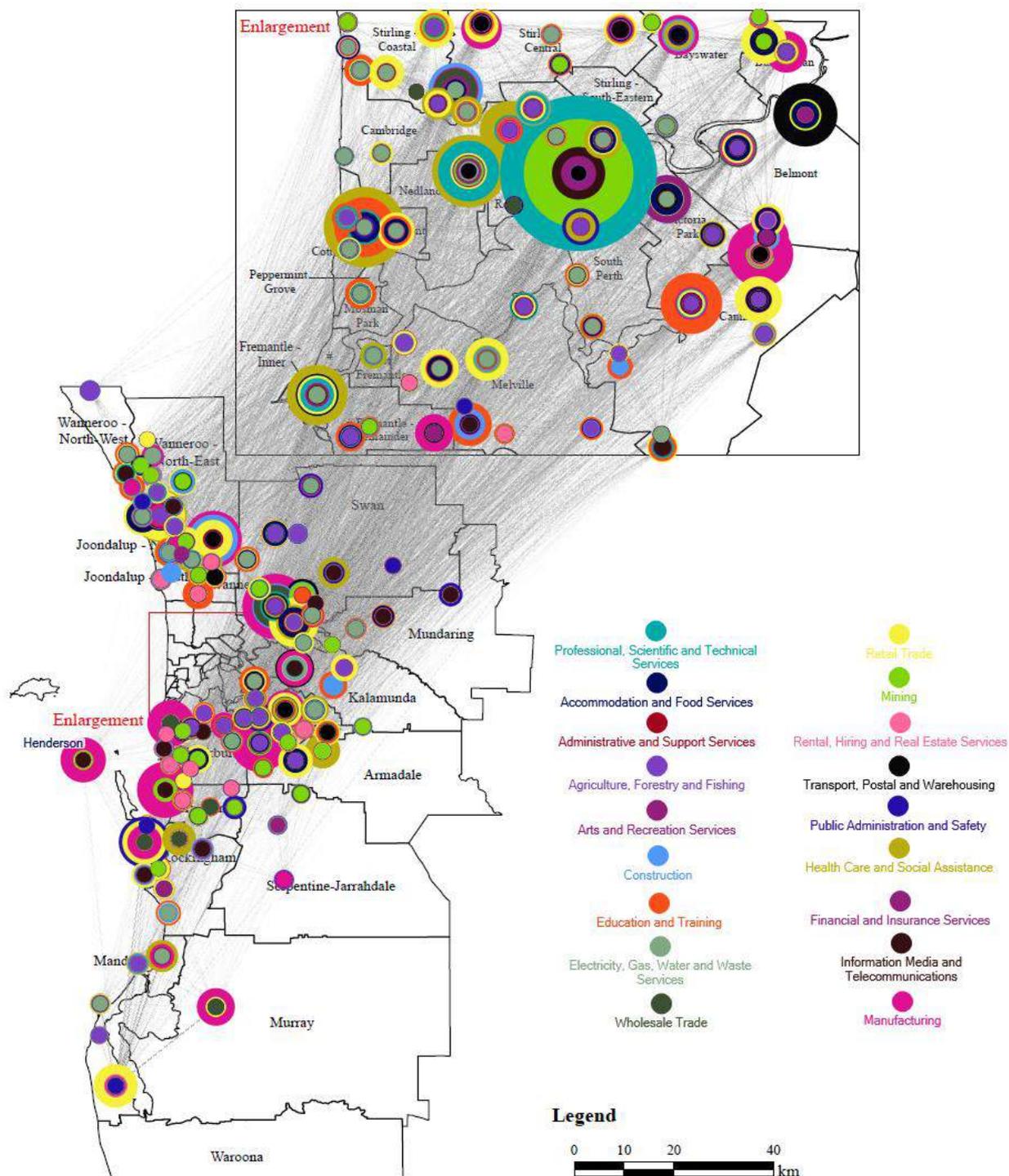
The map presents the global network extensions of the ASX-listed companies in Appendix 6. The clusters (as denoted by different colours) provide insight into the strategic global network relations of ASX-listed corporates, as well as Perth's role and regional alliances in the global economy.



Source: Martinus, K. (The University of Western Australia) and Sigler, T. (The University of Queensland).

APPENDIX 9: ABS journey-to-work (SA2) network and cluster compositions, by industry of employment

Clusters do not always correspond to commercially or industrially zoned areas, such as strategic centres. Knowledge of organically-grown clusters will emerge from an analysis of industry labour movements, which act as indirect linkages allowing ideas to flow between clusters. This feature is particularly important in regional Australia, where there is a lack of industry but large number of long distance commuters. The movement of workers might extend social or labour networks in remote or rural areas.

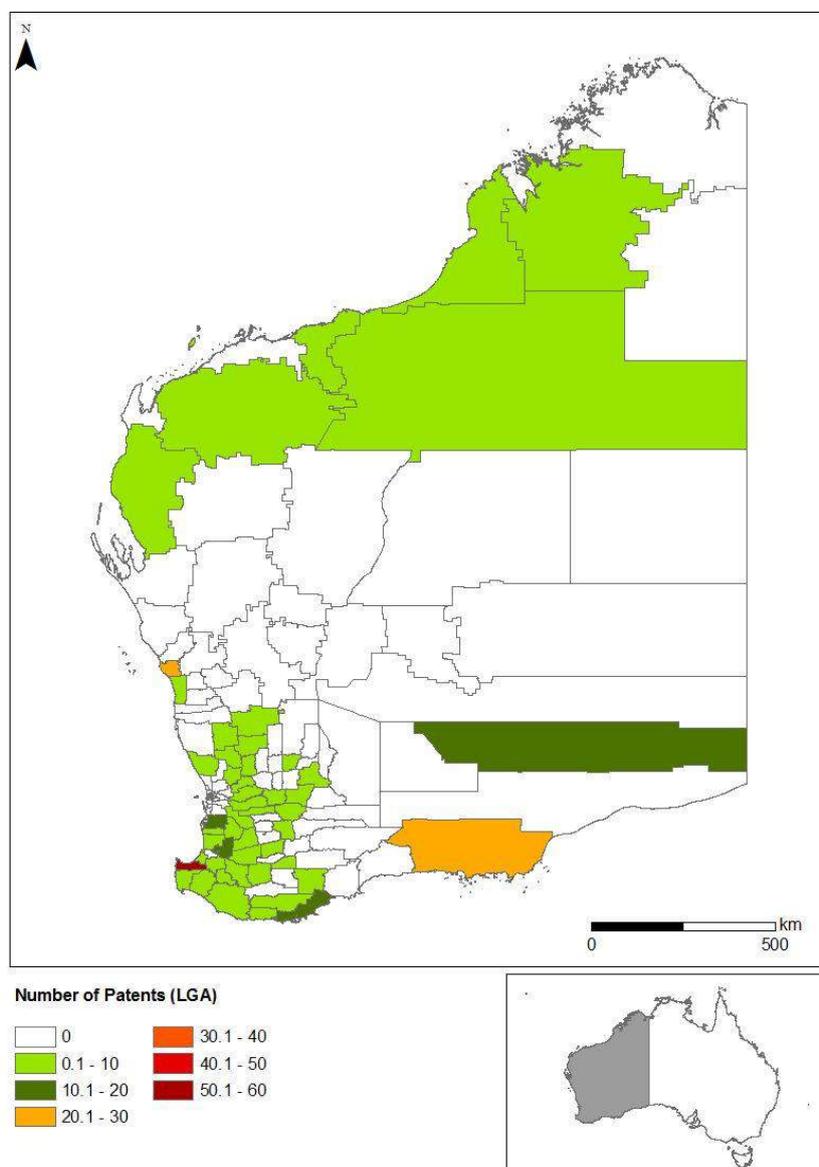


Source: Adapted from ABS (2012).

APPENDIX 10: Summed Regional Patent Applications, 1975-2013

There is an increasing regional reliance on innovation to raise productivity, remain economically viable and promote sustainability. The situation argues strongly for better understanding the regions in the broader innovation system. This will include investigating how indigenous knowledge produces better outcomes for the environment and society, for example by following the model of *Desert Knowledge Australia*, as well as how innovation supports industry development priorities of Regional Blueprints.

The below map identifies LGA propensity to innovative by summing OECD patent statistics, between 1975 and 2013. Whilst most innovation is not patented, the map provides an indication of innovative activity and potential. Advancing innovation in regional WA requires understanding how it occurs beyond populated centres. This includes firm and entrepreneurial strategies to overcome innovation barriers with a paucity of population and industry, as well as examining the 'linkage' role of long-distance commuters in the regional transfer of ideas.



Source: Adapted from OECD (2014)