Knowledge Intensive Services

Growing Queensland’s knowledge intensive services sector through science, research and innovation

Office of the Queensland Chief Scientist
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For further information please contact Dr Debra Venables in the Office of the Queensland Chief Scientist (debra.venables@chiefscientist.qld.gov.au)
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Growing Queensland’s knowledge intensive services sector through science, research and innovation

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1. Executive Summary

"Today's knowledge economies are increasingly services oriented."

"Services are … anything you can't put in a box and ship."

Services industries – industries other than goods-producing industries – are critical to Australian prosperity. The Australian services sector is responsible for the employment of around 85% of all working Australians and is the largest contributor to the Australian economy: more than 80% of Australian businesses are services business; the services sector accounts for approximately 70% of Gross Domestic Product (GDP) and 73% of industry gross value add. While the manufacturing and agriculture sectors have been in decline – and the direct contribution of the mining sector is under threat – the value of the services sector to the Australian economy has grown steadily over the past 20 years.

Hence, there are huge opportunities in Queensland to use services to enhance existing industries and take advantage of niche opportunities where we have a competitive advantage, such as infrastructure and resource services, urban services (design, planning, construction and engineering), environmental services, education and ICT services.

Knowledge intensive services or KIS – advanced services that use more R&D, more technology and more highly skilled workers – are critical to growing Queensland’s knowledge based economy. The high value jobs of today (doctors, nurses, engineers, science professionals, teachers, IT professionals), and of the future, are driving the knowledge intensive services sector.

Science and technology are fundamental to the success of many advanced services, by providing the product, platform or knowledge to develop or deliver the service. Yet, even today we find that the role and value of science and innovation in the knowledge intensive services sector is greatly undervalued and misunderstood.

Continued global expansion of the knowledge based economy, combined with increased economic globalisation, is also raising the importance of knowledge intensive services activities in contributing to innovation.

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2 John Harvey, IBM.

3 http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/1301.0Main+Features332012


6 http://servicesaustralia.co/about/

Challenges

- The contribution of knowledge intensive services industries to the national (and global) economy is often undervalued.
- Despite their significance to the Australian economy, services jobs are often seen as low skilled, low value jobs. Many services jobs are, but they are also the jobs under threat from computerisation, technology and automation. However, this stereotypical view of services jobs does not take into account many jobs in knowledge intensive industries, which will be resilient to digital and technological disruption (see Opportunities).
- Our understanding of what innovation means in the (knowledge intensive) services sector, what it can deliver and what innovation looks like for service focussed industries is often not well understood.
- The link between the (knowledge intensive) services sector and academia is not robust, although there are pockets of excellence in Queensland and Australia.
- The nature of the workforce in Australia is predicted to change dramatically over the next 20 years, with around 44% of all jobs at risk of disappearing, or being significantly impacted by disruptive digital technologies. We are redefining the workforce of the future, training people for jobs that don’t yet exist or for jobs that won’t exist in 10 to 20 years time.
- The threat to Queensland’s knowledge intensive services industries – typically technologically rich environments – from cyber-attack is significant and the consequent costs substantial.

Opportunities

- Leveraging the State’s science and technology, research and innovation capacity will facilitate growth in services – and in particular knowledge intensive services – in Queensland, and in the businesses and industries they serve.
- The services sector and associated supply chains are now operating on an increasingly international scale.
- Knowledge intensive service industries will be at the centre of the workforce of the future:
  - creating jobs and industries that require high levels of social intelligence, technical ability and creativity
  - supporting other industries to adapt to the impact of emerging highly disruptive technologies and business practices.
- Queensland is well placed to:
  - exploit the rising demand from Asia for high-value services, spurred on by the burgeoning Asian middle class
  - leverage the State’s expertise in tropical and sub-tropical design (building, urban and environmental design), environmental science and management, agriculture and medicine (amongst others), particularly given the rapid population and economic growth in the tropics.

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8 Future-proofing Australia’s workforce by growing skills in science, technology, engineering and maths (STEM).
continue to develop service delivery capability into Queensland’s geographically disperse populations
– develop Queensland’s capabilities in cyber risk management – identifying risks and protecting data
– manage how the State delivers and exploits the ‘big data’ phenomenon.

Where to from here?

• Importantly, the role of science, research and innovation in driving growth of the knowledge intensive services sector has been identified as a Queensland Science and Research Priority going forward.
• Informed by this research paper, Government should identify tangible actions which will impact upon the growth of the knowledge intensive services sector in the State. This could be achieved through the work of the Advance Queensland Expert Panel or other appropriate vehicle. Possible actions could include:
  – consider the potential for ‘affirmative action’ with respect to research and development investment into this field, for example:
    ◦ giving consideration to sound investment principles, consider making investment in knowledge intensive services focussed start-ups a priority for the Queensland Government’s Business Development Fund
  – build the brand of knowledge intensive services in Queensland, raising the profile and understanding of the industry and its contributions to the State’s economic growth both within Government and across the community, business and research sector
    ◦ possible vehicles for this include: websites, stakeholder networks, embedding in Government policy and dialogue
    ◦ this could include, in the first instance, mapping and profiling successful knowledge intensive services businesses in Queensland as potential role models for future expansion of this sector
  – identify existing industry development strategies for knowledge intensive services sub-sectors and how Government can leverage these
  – identify innovation and collaboration poor sub-sectors of the knowledge intensive services industry and create opportunities for engagement with the research/academic community.

• The findings of this research paper should inform any whole of Government strategy to support the growth of the knowledge economy including export growth, and knowledge based jobs in Queensland.
2. Fast Facts

- The services sector employs around 85% of all working Australians.  
- More than 80% of Australian businesses are services business. 
- The services sector accounts for 73% of industry gross value add. 
- Australia's largest services exports are delivered by: 
  - education services $14.5 billion 
  - recreational travel services $12.6 billion 
  - business travel services $4.2 billion 
  - professional services $4.1 billion 
  - technical and other business services (e.g. architectural, engineering, surveying and scientific services) $3.5 billion. 
- In 2014, the direct export of Australian services overseas was valued at $60 billion, representing 18.4% of total exports. 
- However, it is estimated that services are responsible for 41% of the total value-added to Australian export earnings (direct services exports and the value added by services supplied to other export industries). 
- Knowledge intensive services exports (KISE) account for 57% of all services exports in Australia. 
- In 2013-14, the value of Queensland KISE was $4.38 billion, representing 45.4% of all Queensland services exports and 13.3% of the national KISE total. 
- Education services were Queensland’s largest KISE in 2013-14 ($2.4 billion or 55.5% of the total KISE). 
- Since 2004, KISE from Australia grew by 87%. 
- Since 2004, KISE from Queensland grew in value by $2.7 billion or 154%. 

12 Education-related travel services: Exports of education services delivered either offshore (by the internet, correspondence or Australian professionals travelling overseas) or onshore (by foreign students entering Australia for the purpose of study). Primarily, these services include tuition fees and the living expenses of foreign students studying in Australia. For the purposes of reporting, the Australian Bureau of Statistics refer to these as “Education-related travel services”. 
3. Introduction

3.1. Services sector

The services sector covers economic activities that provide products and services that are, in general, intangible and that cannot be traded separately from their production.

Figure 1: The highly heterogeneous services ecosystem

In 2006, the Australian Services Roundtable produced the following definition of services: “Services deliver help, utility or care, an experience, information or other intellectual content. The majority of the value of that activity is intangible rather than residing in any physical product.”

The broader services sector is a highly heterogeneous system and one that is often misunderstood. In particular, the contribution of the services sector to the national and global economy is often undervalued. A wide variety of businesses and public agencies provide services across a range of activities and sectors, including health, banking/finance, transport and logistics, education, tourism, communications, creative industries, retail/hospitality, accommodation, property and business support.

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3.1.1. Value of the services sector to the economy

The services sector is a major contributor to the global economy. In 2014, services accounted for more than two thirds of GDP in most Organisation for Economic Cooperation and Development (OECD) countries.\(^{18}\) (Figure 2)

Figure 2: Contribution of services to nominal GDP of OECD nations (2014)\(^{19}\)

![Contribution of services to nominal GDP of OECD nations](image)

In Australia, the services sector is the largest contributor to the Australian economy. Services businesses are responsible for the employment of more than 85% of all working Australians (Figure 3), more than 80% of Australian businesses are services business,\(^{20}\) and the services sector accounts for 73% of industry gross value add (Figure 4).\(^{21,22}\)


\(^{22}\) Gross value added measures the contribution to the economy of each individual producer, industry or sector.
**Figure 3:** Contribution to the economy – Australians employed by industry (May 2015)\(^{23}\)

**Figure 4:** Contribution to the economy – measuring Gross Value Added by industry (2013-14)\(^{24}\)

\(^{*}\) Ownership of dwellings

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While the manufacturing sector has been contracting for a number of years and the direct contribution of the mining sector is currently under threat, the absolute value of the services sector to the Australian economy ($ millions) has grown steadily and continually for over 20 years. (Figure 5) In fact, the Australian services sector grew by an average of 3.5% per annum between 1991 and 2014, compared with non-services industries which have grown at an average of 2.5% per annum.25

**Figure 5:** Growth in the direct value of key industry sectors (measuring total factor income) – 1991 to 2014

When broken down by industry sub-sectors, the four fastest growing industries were all services industries, with information media and telecommunications having the fastest growth at 5.1%, while financial and insurance services, and professional, scientific and technical services grew at 5.0% per annum over the same period.26 (Figure 6)

Hence, the relative contribution of the services sector to the Australian economy (% contribution to GDP) has remained consistently strong over the past 20 years, even during the resources boom and despite the focus of governments on support for the traditional sectors of agriculture and mining. (Figure 7)

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Figure 6: Contribution to the Australian GDP of key industry sectors – 1994 and 2014²⁷,²⁸

![Figure 6: Contribution to the Australian GDP of key industry sectors – 1994 and 2014](chart6.png)

Services average: 3.5% per annum

Figure 7: Contribution to the Australian GDP of key industry sectors – 1994 and 2014²⁷

![Figure 7: Contribution to the Australian GDP of key industry sectors – 1994 and 2014](chart7.png)

= Agriculture  ▪ Mining  ▪ Manufacturing  ● Services  = Other*

*Ownership of Dwellings

This growth has been driven in large part by strong domestic consumption of services. The share of household budget expended on services is now at 65% (up from 52% in 1984).\(^{29}\) (Figure 8)

**Figure 8:** Goods and services consumption (% of total consumption)\(^{30}\)

Business expenditure on services has also increased, possibly linked to the increase in outsourcing by businesses of “non-core” functions to specialist (often knowledge intensive) service industries.\(^{31}\) Therefore, services have comprised a significant proportion of the Australian economy over the medium term and will continue to grow in importance with future economic growth.

**Export earnings**

Services are also a significant component of the export income for many of the world’s top exporting economies. In 2012, global services exports were valued at $4.4 trillion or 19.4% of the world’s total exports.\(^{32}\)

Comparably, Australia’s international trade in (export of) services is of significant value to the economy. The direct export of services overseas is valued at $60 billion or 18.4% of total exports.\(^{33}\)

Despite Australia’s trade reliance on the agriculture and resources sector, the contribution of Australia’s services industry to the global economy is growing as demonstrated by the country’s steady growth in international trade in services. (Figure 9) In fact, in 2015 the

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Reserve Bank of Australia noted that for the first time in over 10 years the export of Australian services was set to overtake that of iron ore.\textsuperscript{34}

**Figure 9: International trade in services ($ millions)\textsuperscript{35}**

The OECD evaluates the role of services in global value chains by reviewing the extent to which exports of manufactured goods depend on inputs from various service activities. In 2009, they found that approximately a third of the value of OECD exports of manufactured goods could be attributed to services, a significant rise since 1995.\textsuperscript{36}

While not directly comparable, this is consistent with the findings of a recent report from Pricewaterhouse Coopers, ANZ Bank and Asialink Business. The report estimates that services are responsible for 41\% of all Australian export earnings – around $112 billion in value – when measured in terms of total value-added (direct service exports and the value added by services supplied to other export industries). This contribution compares with 37\% for mining and 23\% for agriculture/manufacturing.\textsuperscript{37} The report also estimates sales of services by foreign affiliates of Australian companies were $138 billion in 2013. The contribution that this makes back to the Australian economy through jobs and income is substantial.


\textsuperscript{36} OECD. Measuring Trade in Value-added. May 2013. \url{www.oecd.org/sti/ind/TIVA%20flyer%20FINAL.pdf}.

3.2. Knowledge intensive services

The knowledge intensive service sector – a subset of the broader services sector – includes a range of services with varying degrees of knowledge intensity.  

Knowledge intensive services can be divided into market services – such as post and telecommunications, finance and insurance, business services (excluding property services), computer system design, professional, scientific and technical services – and non-market services including health and education.

The professional, scientific and technical services sub-sector incorporates firms providing services such as scientific research, architecture, engineering design and consultancy, specialist design, law, accounting, advertising, market research, and management consultancy. (See Appendix 1)

In 2007, the Queensland Government’s Smart State Report on the services sector noted the following characteristics of knowledge intensive services:

- knowledge intensive services are very high value services, provided by private sector businesses and commercial public sector organisations that use knowledge and technology to drive their business
- these businesses engage in more R&D, use higher technology and employ more highly skilled workers compared to other types of service businesses
- knowledge intensive services are tradeable in that they are able to be exported to other countries and other states, and/or can substitute for imports from other countries and other states
- knowledge intensive services are recognised as providing a significant amount of innovation in modern developed economies, and in traditional and emerging industries.

The contribution of knowledge intensive services to the broader (general) services sector is growing. Knowledge intensive services jobs account for 56% of services jobs in Australia, while jobs growth in knowledge intensive services in Australia has been around 52% over the past 20 years, compared with 45% in services in general. Meanwhile, knowledge intensive services exports (KISE) in Australia grew by 87% over the past decade, with Queensland’s growth in KISE at 154% for the same period.

Jobs in the knowledge intensive services are diverse and require widely varying amounts of technical skill and expertise. Workers in the knowledge intensive services can include:

- accountants
- market researchers
- architects
- recruitment consultants
- lawyers
- financial management professionals
- advertising executives
- scientists (researchers and those providing technical services, such as water testing)
- regulatory compliance professionals
- engineers.

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Case Study: Queensland Rural Telehealth Services

For a long time Queensland has been leading the delivery of cutting edge health services to rural and regional populations. In 1928, the Royal Flying Doctor Service was established in Cloncurry, bringing a revolutionary health care service for the people of inland Australia.

While in 2013, Queensland Health established the Rural Telehealth Service to ensure Queenslanders had access to high-quality healthcare regardless of where they lived.

This service uses information technology, including email, telephone correspondence and teleconferencing to deliver reliable health care and information to rural and remote Queensland communities who were previously unable to access these services. This formal integration of telehealth across Queensland’s Health and Hospital Services delivers better patient outcomes by improving their access to healthcare, reducing travel and inconvenience for patients, carers and health professionals, and providing a support and education network for health professionals.

With funding of $30.9 million over four years, the Queensland Rural Telehealth Service is the largest managed telehealth network in Australia. More than 2000 videoconferencing systems are deployed in more than 200 hospitals and community facilities deliver advice and care across 40 clinical specialities and sub-specialities.

The Rural Telehealth Service is supported by strongly integrated research expertise. The University of Queensland Centre for Online Health leads the world in telehealth publications and citations and ensures research capability is embedded within the clinical service environment. Their research focusses on clinical telemedicine and on developing useful and sustainable (feasible, efficacious, effective, economically viable) telehealth services for patients and service providers. In addition, the leading Queensland-based Australian e-Health Research Centre works collaboratively with clinicians and other service providers to improve the quality and safety of services and treatments for patients and clinicians by applying digital technologies to healthcare innovation.

Some specialist services such as paediatrics have been operating in the telehealth space for more than a decade.

3.2.1. Why is the knowledge intensive services sector a priority for Queensland?

Knowledge intensive services are key to the growth of the knowledge based economy in the State. Advanced economies are increasingly focussed on the importance and value of the knowledge based economy and knowledge based jobs to drive economic growth and competitiveness, and on the role of innovation as a key contributor to the economy.

Research from the OECD shows innovation accounts for at least 62% of Australia’s productivity growth over the longer term,\(^{40}\) and that future growth must increasingly be

innovation-induced. However, evidence indicates that productivity growth in Queensland\textsuperscript{41} and Australia\textsuperscript{42} is declining and declining productivity will erode Queensland’s competitiveness and prosperity. Therefore, Queensland must focus on designing, developing and commercialising globally relevant products, services and processes to maintain a competitive edge. In particular, the broader services sector has consistently been a significant contributor to economic growth in Australia.

**Case Study: Mining Equipment and Technology Services**

The Australian Mining Equipment and Technology Services (METS) sector generates over $90 million in gross annual revenue, exports more than $15 billion worth of products and services internationally, and invests $4 billion in R&D.\textsuperscript{43}

Queensland is a hub for world-leading R&D to support the mining industry, with particular expertise in mining engineering, equipment manufacturing, mine management and commodity transport. It is also home to many of Australia’s innovative, globally competitive METS enterprises, such as Deswick mining consultants.

Deswick offers mine planning software coupled with innovative mining engineering and geological services. The company’s fully integrated software platform eliminates the need for up to eight separate software packages and provides mining planning tools through a flagship 3D spatial database. These tools and services are used to develop mine plans on a diverse range of mining sites worldwide.

The mining/METS industry in Queensland and across Australia is facing a number of challenges driven by increased regulation of safety and environmental management, resource depletion and the need to produce more for less.

Innovative solutions to these challenges can be found throughout the State with institutes such as the Sustainable Minerals Institute, Cooperative Research Centre for Mining and the Queensland Centre for Advanced Technologies working closely with industry.

Meanwhile, developing nations are becoming increasingly skilled with significant capacity to grow their services industries, which will result in increasing services exports to Australia. Given our population size, our ability to be competitive across the board is limited. Queensland needs to diversify its economy and industry base to drive growth in new industries and to future-proof the long-term economic growth of traditional industries, which


will continue to be important to the State. Knowledge intensive services firms can be great enablers of innovation in both traditional sectors of value to Queensland such as agriculture and resources, and in emerging sectors such as mining and engineering technologies and services, cleaner and renewable energy technologies development (including industrial biotechnology), and smarter transport.

Knowledge intensive services firms are frequently lead users or producers of new technologies and critical to developing new solutions (or adapting to) disruptive digital technologies, infrastructure and business models.

Growth in services, especially knowledge intensive services, also contributes significantly to high-value job creation in mature economies. As globalisation continues to create new competitive pressures and opportunities for many Queensland firms, knowledge intensive service industries will be vital to job creation and innovation, and will be key components of the workforce of the future.

3.2.2. The impact of the knowledge intensive services sector on economic growth

“Knowledge intensive services sectors’ share of an economy can be seen as a proxy for an economy’s capacity to absorb new knowledge from international sources, and to generate new knowledge locally, driving innovation and growth.”

Strong employment growth is expected in the services sector in Australia (and the world) over the next 10 to 20 years. Knowledge intensive services are already a critical contributor to productivity, economic growth and competitive advantage in Queensland and Australia, and the State will benefit significantly from aligning itself with the growing importance of services in the global economy.

Jobs

In 2011, services account for over 70% of employment – on average – in OECD countries. Employment in the services sector in Australia is also strong, with around 85% of all jobs in Australia and Queensland being services jobs. Knowledge intensives services make a significant contribution to overall employment in Australia and Queensland, accounting for

around 55% of services jobs in Australia and Queensland, and over 45% of total employment. The OECD gives separate consideration to knowledge intensive market services (versus non-market services), which includes post and telecommunication, financial and insurance, and professional, scientific and technical services. In Australia, jobs in the knowledge intensive market services represented around 13% of all employment in 2011 (12% in Queensland). This is compares with the OECD average of 12% in 2011. (Figure 10)

**Figure 10:** Jobs in the knowledge intensive ‘market services’ as a percentage of total employment (2011)

The services sector, and in particular knowledge intensive services, is a key factor in jobs growth in the world’s technologically advanced economies. By way of example, total employment in the European Union grew by 1.4% annually in the five years between 2002 and 2007. By contrast, knowledge intensive services jobs grew by 3.8.

Jobs growth in the services sector in Australia is also encouraging. This is particularly evident in the knowledge intensive services. In fact, jobs in the knowledge intensive services industries have grown significantly in recent decades, outstripping growth in the broader services sector or overall jobs growth, both in Australia and Queensland. (Figure 11)

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53 Where we have defined KIS as including: information media and telecommunications, financial and insurance services, professional/scientific/technical services, education and training, healthcare and social assistance, arts and recreation services, other services. Note, the industry categories used by the ABS when measuring labour market activity are not consistent with those used to measure trade in services. We have made the decision to acknowledge these industries as KIS. For comparison, OECD classifications are not fully consistent with the ABS. OECD considers KI market services to include post and telecommunications, financial and insurance services, and business activities. The OECD also recognises non-market KI services, including education, health and social work, other business activities (excluding property services).
Jobs in the knowledge intensive services industries have grown by 52% in Australia over the past 20 years and by an impressive 77% in Queensland. This compares with 45% growth in jobs in the broader services sector and 33% growth in jobs overall in the same period in Australia. Meanwhile in Queensland, overall jobs growth was 46%, compared with 58% growth in the services sector.

Employment in the professional services in particular has been significant of late, growing by 10.6% in 2014 compared with 1.4% in economic growth for Australia broadly. In fact, the long term growth in jobs in this sector has been 4.1% over the past ten years, the highest growth of any major industry sector other than resources/mining.55

**Export Earnings**

Australia, the US and Europe together account for more than two-thirds of worldwide exports by knowledge intensive services firms.56,57 In Australia, knowledge intensive services exports (KISE) accounted for around 56% of all services exports in 2013-14 and were 44% of all services exports in Queensland, to a value of $4.3 billion. (Table 1)
Table 1: Knowledge intensive services exports (KISE) 2013-14*

<table>
<thead>
<tr>
<th>Category</th>
<th>Australia</th>
<th>Queensland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total exports $m\textsuperscript{58}</td>
<td>332,433</td>
<td>54,573</td>
</tr>
<tr>
<td>Total services exports $m\textsuperscript{59}</td>
<td>57,381</td>
<td>9,651</td>
</tr>
<tr>
<td>KISE $m\textsuperscript{59}</td>
<td>32,859</td>
<td>4,383</td>
</tr>
<tr>
<td>Services as % of total exports</td>
<td>17%</td>
<td>18%</td>
</tr>
<tr>
<td>KISE as % of total exports</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>KISE as % of services exports</td>
<td>57%</td>
<td>45%</td>
</tr>
</tbody>
</table>

* Knowledge intensive services exports (KISE) as defined by Trade and Investment Queensland (TIQ) and Queensland Government Statistician’s Office (QGSO).

This disparity between the relative contribution of Queensland and Australia’s KISE to total services exports is largely due to the disproportionate influence of tourism – and in particular, recreational travel services (a service industry that is not knowledge intensive) – on the Queensland services industry. In 2013-14, 24% of all Australian services exports were due to recreational travel services. By comparison, recreational travel services accounted for 33% of all Queensland services exports.\textsuperscript{60}

While Queensland’s international trade in the broader services sector, as a proportion of Australia’s total trade in services, has been virtually unchanged over the past decade, Queensland has experienced high growth in knowledge intensive services exports. Over the past ten years, knowledge intensive services exports from Queensland have grown in value by $2.7 billion or 154\%. (Figure 12) This is the fastest growth in the country, far outstripping Victoria which grew their knowledge intensive services exports by 96% or NSW by 65\% over the same period. The total knowledge intensive services exports from Australia in that time grew by 87\%. Queensland’s growth in KISE is also more than three times the rate of growth for total services exports in the same period. This suggests an opportunity to nurture long term growth of the wider knowledge based economy in the state, underpinned by the knowledge intensive services sector.

\textsuperscript{58} ABS 5368.0 - International Trade in Goods and Services, Australia, Dec 2014. 


TIQ: Trade and Investment Queensland

QGSO: Queensland Government Statistician’s Office

Within the knowledge intensive services industries in Queensland, education services (education-related travel services)\textsuperscript{62} were the state’s largest KISE in 2013-14. Valued at $2.4 billion, they represent 57.1% of all Queensland KISE.

However, the value of exports from education services has fallen in recent years. By contrast, Queensland exports of financial services and construction services grew strongly in the three years to 2013-14 and represent a significant share of the national knowledge intensive services exports for these services.

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\textsuperscript{61} ABS ‘International Trade in Services by Country, by State and by Detailed Services Category, Financial Year, 2013-14’, cat. no. 5368055003. Provided by Queensland Treasury and Trade

\textsuperscript{62} Exports of education services can be delivered either offshore (by the internet, correspondence or Australian professionals travelling overseas) or onshore (by foreign students entering Australia for the purpose of study). Primarily, these services include tuition fees and the living expenses of foreign students studying in Australia. For the purposes of reporting, the Australian Bureau of Statistics refer to these as “\textit{Education-related travel services}”.
4. The Role of Science, Research and Innovation

“...modern economies are both service economies and economies of innovation. Paradoxically, they are not regarded as economies of innovation in services....it is as if services and innovation were two parallel universes that co-exist in blissful ignorance of each other.”

“Services include some of the most innovative and highest performing sectors of recent years.”

Services have a major role to play in the innovation ecosystem, as innovation active firms or by enabling innovation in client organisations.

As noted earlier, knowledge intensive services are important drivers of innovation in the traditional sectors, such as mining, agriculture or manufacturing, where knowledge intensive services firms can deliver innovative solutions to the financial, technological, and transport and logistics challenges (amongst others) facing these industries.

Hence, science, technology and research can drive services innovation in two ways:

- **Innovation in service industries** – where innovation is applied to an industry regarded as service based or innovation results in a new-service based industry. This innovation can be driven internally or rely on external capabilities or technologies to support or stimulate innovation e.g. Dell’s IdeaStorm, which allows users to go online to vote on ideas for new products, features or customer services.

- **Innovation through services** – where the application of a service results in innovation in a non-service based (client) organisation/business/industry e.g. smart manufacturing platforms that integrate information technology, metrics, modelling and simulation driven by plant sensor data to enable manufacturing to run with real-time flexibility, optimising efficiencies throughout the entire production process.

To this end, service innovation can take a number of forms, for example, adoption or development of new technology or products/infrastructure, new ways of delivering a service, and new business processes.

However, the nature and application of science and research to innovation in the knowledge intensive services sector is often poorly understood, a serious deficiency given this growing global services revolution. This was confirmed in the 2009 report from The Royal Society in the United Kingdom (UK), which found (following a review of recent policy studies and literature reviews) that there is a poor understanding of services innovation and how to measure it effectively. The report noted that there were a number of reasons for this lack of clarity, including:

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• the diversity of the services sector
• rapid growth in the sector
• the fact that the output of services is not a concrete/tangible product and therefore, not easily visible to those outside the process
• low academic interest in services innovation, compared with R&D and innovation in the manufacturing sector
• a lack of understanding or appreciation for services innovation by governments/policy makers.

In fact, the contribution of science, research and innovation to the services sector is often hidden from view. This is a serious problem for the sector. The increasing internationalisation of the services marketplace and the rapidly changing nature of the knowledge based economy – driven in large part by disruptive digital technologies, infrastructure and processes – means that services firms, and in particular knowledge intensive services firms, are more dependent upon investments in science and research to remain competitive in the globalised marketplace.

The way services firms innovate is often in contrast to the way we view and value innovation through research and development in traditional sectors. However, R&D is likely to play a larger role in innovation in knowledge intensive services industries, in comparison to the broader services sector.

The global marketplace also poses innovation challenges for the services sector in Australia. Much as the Australian manufacturing industry is being increasingly driven offshore by cheaper labour and production costs, the services industry is not immune to such drivers. Innovation led by science and research will be key to addressing these challenges, adding increased value to Australian knowledge intensive services firms.

Digital disruption is also a driver of innovation in the services sector, challenging and changing the way services are delivered, consumed and the way businesses operate internally. In recent years, disruptive digital technologies have drastically changed the nature of the services (and knowledge intensive services) sector and of service delivery. If we are to maintain and improve the competitiveness and profitability of Queensland’s knowledge intensive services businesses in this environment, defend existing market share and grow new markets, then the application of science, research and innovation will be critical. Growing our knowledge intensive services through science, research and innovation will influence not only Queensland’s future position in the world market, but also our ability to deliver effective, state-of-the-art domestic services.
Case Study: WOTIF

The Wotif Group is an internationally recognised leader in the online travel services industry and a true Queensland success story.

The company was established in Brisbane in 2000 as a specialist online accommodation service, and now operates in 13 countries on five continents, servicing 510,000 properties globally from over 23,500 accommodation providers. The company was listed on the ASX in 2006 and the Wotif Group were recently acquired by the Expedia Group for AUD$703 million.

Central to the success of Wotif was the company’s disruptive business model of real-time online management of rates and accommodation delivered entirely through an online model. Wotif’s digital channel is integrated to the organisation’s accommodation suppliers and seamlessly connects suppliers and customers together through a low cost commission-based model. Although this is now regarded as an industry benchmark – allowing for very low cost delivery of real time services – it was a highly innovative model when first launched.

This culture of innovation has continued to support the company’s success over the past 15 years. The company has a dedicated team focussed on technology innovation and R&D (future product development), to ensure the company’s service delivery stays relevant and grows with the developments in digital technologies and in the way services are delivered and consumed. Today the Wotif Group is one of the most recognised brands in travel throughout the Asia-Pacific region.
5. The Knowledge Intensive Services Industry in Queensland

5.1. Challenges and opportunities for Queensland

Supporting a sustainable competitive advantage for the knowledge intensive services sector in Queensland can be achieved by identifying high-value, knowledge intensive services with global markets. As we have noted, growth in services, especially knowledge intensive services, contributes significantly to high-value, knowledge based job creation in mature economies, compared with growth in capital-intensive manufacturing and primary industries.

The application of science, research and innovation to our knowledge intensive services sector will contribute significantly to this growth in high-value knowledge based jobs, drive productivity improvements, and provide the opportunity for Queensland to capitalise on our strengths and expertise - particularly where they relate to the challenges associated with a tropical/sub-tropical environment and a highly regionalised population in the State.

Where science, research and innovation can drive growth in high value jobs, productivity and economic output in a knowledge intensive services industry, the following will be important in identifying and developing successful, sustainable and innovative science and research-led knowledge intensive services opportunities in the state, where:67,68

- we have domain knowledge, access to R&D talent and an appropriate skills-base
- the opportunity is not easily replicable and is unique to Queensland
- the opportunity exists to deliver personalised services or personalise the delivery of services
- we are either already ahead of the game or are likely to get ahead of the game
- a strong, high-value global market opportunity exists
- there is exportability.

Examples of potential areas that meet these criteria for Queensland include:

- health service delivery including telehealth and health delivery to remote communities
- solutions to delivery of education services in remote communities
- design and management of infrastructure in tropical and subtropical climates
- sustainably exploiting our resources e.g. minerals, oceans, agriculture
- environmental challenges/services e.g. water, bushfires, coastal/marine – the Great Barrier Reef, desert, particularly those unique to sub-tropical and tropical locales
- transport and logistics services e.g. in sparse geographies, telemetry, drones, spatial intelligence.

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However, the knowledge intensive services industries face sizeable challenges from the rapidly changing nature of services markets, the globalisation of the services marketplace and the competition pressures that entails, the disruptive nature of advances in digital technology and infrastructure and the demands of consumers for increasingly personalised/tailored services and products. Reports also suggest that services organisations are poorly connected to the academic sector\(^{69}\) and this poses challenges for science, research and innovation led growth in the knowledge intensive services.

The Australian Government has identified that despite producing excellent research, Australia’s ability to translate publicly funded research into commercial outcomes lags behind comparable countries.\(^{70}\) To address this issue, it is proposed to identify further opportunities to enhance collaboration between researchers and industry.

### Case Study: RedEye Apps

First of its kind technology, RedEye Apps delivers a cloud-based and purpose built solution for managing the versions of engineering drawings, making them centrally accessible and easy to share. RedEye identified a genuine gap in the market and the technology was the first of its kind in the world, attracting strong interest from mining, oil and gas, power and water industries around the globe.

The RedEye App enables engineering drawings and documents to be digitised, uploaded on a cloud, edited, approved, stored securely and used – anywhere and anytime.

The ability of RedEye technology to manage these assets, ensuring the most up-to-date versions of drawings are being used and are accessible and secure, improves productivity and safety, reduces risk and provides real and significant cost savings for large infrastructure projects around the world. RedEye estimates savings of up to six per cent of project costs simply by ensuring that the right versions of engineering drawings are being used.

Since the Brisbane based start-up company was founded in 2011 by former engineer Randall Makin and current RedEye CEO and digital entrepreneur Wayne Gerard, RedEye has expanded significantly. RedEye was commercialised in late 2012, securing BHP Billiton’s Peak Downs Mine as its first client, and opened its first international office in June 2014.

The company currently employs around 20 people in Australia and now has international offices in Houston and Palo Alto, USA.

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5.1.1. Understanding and measurement

In section 3 we discussed the lack of understanding, by many, of knowledge intensive services, what they deliver now, how science, research and innovation impact on these services and the long term role of knowledge intensive services in delivering economic benefits through jobs of the future. This lack of understanding is a challenge for the State and for policy makers looking to grow the knowledge based economy in Queensland.

However, better understanding of the value that can be derived from – and the risks facing – the knowledge intensive services sector could be achieved through better measurement. Currently, the outputs of the knowledge intensive services industries and the impact of innovation on the sector are not well captured by traditional metrics at the state or national level. We have seen a decline in recent years in the availability of science and innovation statistics and disaggregated state-level (Queensland specific) statistics from the Australian Bureau of Statistics.

Better and more comprehensive data on the knowledge intensive services industry and on innovation in the sector, or innovation in general, will facilitate greater appreciation and awareness of the knowledge intensive services industry and its role in the knowledge based economy. This data will also facilitate a greater appreciation and awareness of its value to the academic sector where there is closer collaboration with knowledge intensive services firms, and the potential economic, social and environmental benefits the knowledge intensive services industry can deliver going forward.

5.1.2. Queensland’s unique environment

Queensland is well place to leverage the challenges and opportunities associated with our position as a developed community in the tropics/sub-tropics and the State’s geographically disperse population.

*Tropics*

Currently the tropics are home to 40% of the world’s population, with around 99% of people in the tropics live in ‘developing’ nations. The tropics are undergoing rapid population and economic growth. By 2050, the tropics will be home to more than 50% of the world’s population and 60% of the world’s children under 10.71

Not surprisingly, this growth is occurring primarily in urban environments. Concurrent with this rapid population growth, tropical nations are also experiencing significant economic growth – although it is important to note that more than two thirds of the world’s poorest people live in the tropics. None the less, the growth of tropical cities is driving increasing demand for services, including knowledge intensive services, particularly those catering to the needs of tropical environments and populations, and those that meet the needs of developing nations.

These factors all present an enormous opportunity for Queensland to develop our delivery of knowledge intensive services into the region, as well as exporting services capability

including training opportunities, in the areas of tropical design (building, urban and environmental), environmental science and management, agriculture and medicine.

**Disperse population**

Queensland is home to Australia’s most geographically disperse population. This presents unique challenges and opportunities for the delivery of knowledge intensive services into the State’s highly regionalised population: both in development of new service delivery mechanisms e.g. telehealth solutions, and of new service industries that cater specifically to the challenges of rural and remote communities.

5.1.3. **Globalisation**

The knowledge intensive services industries and their associated supply chains are now operating on an increasingly international scale where success is measured in the international marketplace. This has been in large part enabled by the expansion in digital technologies and infrastructures e.g. cloud computing, remote sensing technologies, and the consequent interconnectedness they bring.

Despite the global nature of the market for knowledge intensive services, there is also increasing client demand for niche and personalised services which can be delivered globally.

This poses enormous opportunities for the knowledge intensive services in Queensland, with an almost limitless marketplace to tap into, however it also has significant challenges. Cybersecurity and competition from overseas firms that can deliver services more cheaply and can be responsive to customer needs in real time (time zones and labour costs) are threats to Queensland’s knowledge intensive services firms operating internationally. Science, research and innovation have a substantial role to play in addressing these challenges.

5.1.4. **Asia**

Tapping into the growing demand for high-value (often knowledge intensive) services in rapidly growing economies in the Asian region is a significant opportunity and challenge for the knowledge intensive services industries in the State.

As it stands, by 2030 the services sector is set to be Australia’s top export into the Asian market, according to a recent report. This will be driven primarily by Asia’s burgeoning middle class, which is expected to grow from around 500 million in 2014 to 3.2 billion in 2030.

Australian service exports to China have been increasing for more than ten years, with Australia currently exporting $6.7 billion worth of services to China, with the largest being

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travel services (including education-related).\textsuperscript{74} In fact, China is the largest market for Australian education services ($4 billion in 2014).\textsuperscript{75} However, we are also seeing substantial growth in Chinese demand for Australian business services.

This sort of growth – and consumer demand for sophisticated services and advanced technologies – from our near neighbours represents an exceptional opportunity for Queensland’s knowledge intensive services industries. This opportunity has also been recently recognised in the Brisbane City Council’s \textit{Brisbane 2022 New World City Action Plan} which has identified knowledge based and corporate services as a priority sector for Brisbane, particularly when it comes to exporting capabilities in that sector into the Asia-Pacific marketplace.

5.1.5. Cybersecurity

The move towards centralisation of business functions in large public and private sector organisations, the global nature of many sectors and their supply chains, and the rapid pace of change in digital technology mean companies are increasingly exposed to cyber-attack. The threat to Queensland companies from cyber-attack can be very costly. The average cost of a data breach per company in Australia was around $2.8 million in 2014,\textsuperscript{76} and the data indicates that the threat and associated costs are rising. In fact, the direct cost of cybercrime to Australia in 2014 was estimated to be more than $1 billion.\textsuperscript{77}

Cybersecurity risk management is now a priority for businesses across all sectors, with health, finance and the resources sector (remote data management and remote operation) key sectors at risk. In a 2013 survey, Ernst and Young found that 41\% of the respondents from the mining and metals industries had experienced an increase in external threats to their information systems over the past 12 months, with 28\% experiencing an increase in internal vulnerabilities over the same period.\textsuperscript{78}

The often technologically rich nature of knowledge intensive services firms, and the global nature of the services marketplace exposes such companies to significant risk from cyber-attack. Science, research and innovation can help such firms adapt internally or develop solutions that enable cybersecurity in other organisations.

5.1.6. Big data

We live in an increasingly digital age where 90\% of today’s data was created in the last two years.\textsuperscript{79} ‘Big data’ – data sets so large and complex that they are difficult to process using traditional data processing applications – is an increasingly complex universal problem.


\textsuperscript{75} ANZ Opportunity China: The ChAFTA and implications for Australian Businesses. ANZ. March 2015. \url{https://bluenotes.anz.com/media/320138/CHAFTA_2.pdf}


\textsuperscript{77} \url{https://www.pm.gov.au/media/2014-11-27/cyber-security-review-0}

\textsuperscript{78} \url{http://www.ey.com/GL/en/Industries/Mining---Metals/EY-Cyber-hacking-and-information-security-in-mining}

Big data and data science are producing new insights and opportunities for Queensland and Australia. The global big data technology and services market (public cloud services spending) is expected to grow from US$6 billion in 2011 to US$24 billion in 2016.\textsuperscript{80}

However, we face a global skill shortfall which will constrain this growth. By 2018 it is predicted that the US will have 200,000 fewer skilled ‘data wranglers’ than necessary.\textsuperscript{81} To keep up with the market we must make use of the data we generate, invest in our future capability, embed research into business and develop a sensing and analysis network which integrates big data across sectors and subjects. The role of – and opportunities for – the knowledge intensive services industries in the state in managing, delivering and exploiting this data is enormous.

5.1.7. Digital disruption and the future workforce: \textsuperscript{82}

“The ‘digital revolution’ … has fundamentally changed the way many services are delivered and consumed (through the enablement of disruptive business models), as well as the internal processes of firms themselves.”\textsuperscript{83}

“… our discovery of means of economising the use of labour (is) outrunning the pace at which we can find new uses for labour.”\textsuperscript{84}

A key driver of economic success in advanced economies such as ours, is the knowledge based workforce. A knowledge based workforce is necessary if we are to capture and protect market share in new and emerging knowledge based industries and attract inward investment to support the growth of these industries.

As we have observed in recent years, the internet and e-commerce have changed the landscape of the economy as well as the jobs and value chains within it. Whole businesses and industries have been created, recreated or disappeared.

- Traditional models are vulnerable due to higher cost structures associated with bricks and mortar and inventory costs. Many large scale book stores have closed due to an inability to compete against online retailers such as Amazon. The print media struggles as content is outsourced and the cost of print increases.

- New business models have developed via the emergence of internet or cloud-based platforms, robotics and other enabling technologies. Success has been realised in employment services (Seek), property retailing (RealEstate.com, Domain), car retailing (CarSales.com), stock broking and banking, to name a few.

A recent report from PricewaterhouseCoopers suggests that over the next 20 years, around 44% or 5.1 million of all jobs in Australia are at high risk from digital disruption (being


affected by computerisation, automation and technological disruption). The economic impact of disruptive digital technologies on Queensland’s economy in 2025 is estimated to be $96 billion per annum, or roughly 24% of the projected $396 billion Gross State Product, with a direct impact from the digital technology sector of over $6 billion per year.

Similarly, according to a report by the McKinsey Global Institute there are 12 disruptive technologies that are predicted to transform life, business and the economy of the future.

Of the 12 disruptive technologies, the following ones are those most likely to impact the jobs of the future:

- mobile internet
- automation of knowledge work (intelligent software systems)
- The Internet of Things (sensors and actuators)
- cloud technology
- advanced robotics
- autonomous and near-autonomous vehicles
- next-generation genomics
- 3D printing.

Until now, we have only been able to automate routine processes. The next step is to automate non-routine cogitative tasks. Algorithms for big data are now rapidly entering domains reliant upon pattern recognition which can readily substitute for labour in a wide range of fields.

Additionally, advanced robots are gaining enhanced senses and dexterity, allowing them to perform a broader scope of manual functions.

If Goldkin and Katz are right, human labour will prevail over automation because of its ability to adopt and acquire new skills by means of education.

The fact that computers lack human biases is of great value – algorithms are free of irrational bias and their vigilance need not be interrupted by rest breaks or lapses of concentration.

This means that we need to redefine the jobs of the future, and more importantly, we are training a future workforce for jobs that don’t yet exist. The jobs most likely to survive this

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66 Meaning: a greater than 70% chance this job could be automated by technology.


disruptive environment will be those that require high levels of social intelligence, technical ability and creativity.\textsuperscript{91,92}

Knowledge based jobs with a high service element, where that service provision is based on significant value add (technically savvy, innovative, responsive, personalised) will be a key component of the workforce of the future.

5.1.8. Linking industry with science, research and innovation

The Royal Society (UK) suggests there are a number of barriers to effective engagement between the academic and knowledge intensive services. These barriers include:\textsuperscript{93}

- mismatch of expectations
- differing cultural norms
- poor understanding of services innovation in academia
- low esteem for services-related research
- poor alignment of objectives between businesses and academia.

This is not to say that interfaces and constructive engagement between public research organisations and the services sector do not exist. However, as a key driver of innovation in many industries, the science and research base could be better connected into the sector and have a closer understanding of the nature of innovation in the knowledge intensive services. This is as true for Queensland as it is for the UK, and has been identified by the Australian Government as a limitation for more effective translation of research into commercial returns.\textsuperscript{94}

5.2. Queensland’s competitive advantage

Queensland is well placed to capitalise on the growth in the knowledge intensive services sector, leveraging our strong underpinning base of R&D expertise, supporting infrastructure, tropical expertise and the market leading knowledge intensive services businesses in the state.

5.2.1. Sectoral strengths - industry

Queensland’s strengths in the knowledge intensive services sector are complemented by our capacity to tackle the challenges to service delivery inherent in a state with tropical and sub-tropical climates, and a geographically dispersed population.


\textsuperscript{92} Osborne, M. (Oxford University). Which jobs are safe, and not-so-safe? Real World Futures Forum (Queensland University of Technology). 24 March 2015.


\textsuperscript{94} Boosting the Commercial Returns from Research. Australian Government. 2014. \url{http://education.gov.au/boosting-commercial-returns-research}
Queensland also has very strong links into our south-east Asian neighbours and the demand in this region for high value, knowledge intense services is significant and growing. Knowledge intensive service industries active in Queensland include (but are not limited to):

- specialist education
- specialist medical technology and health
- digital content services
- creative services including architectural and fashion services
- design services, including urban, environmental and building design
- legal, finance, insurance, accounting, marketing and business services
- agriculture services (e.g. scientific and R&D consulting, monitoring services)
- technology and innovation in the mining/resources sector.

5.2.2. Sectoral strengths - R&D

Queensland already has a critical mass of R&D excellence with global impact, aligned to and engaged with the following knowledge intensive services industries:

- mining and equipment
- technology and services (METS)
- tele-health and health services delivery
- sub-tropical/tropical/sustainable design.

There is capacity to exploit science, research and innovation to grow other knowledge intensive services industries where there is a global market that can be addressed and emerging R&D capability and capacity including education, financial and business services, and agricultural services.

Aligned with the types of knowledge intensive services businesses outlined above, the following are examples (not exhaustive) of centres of research excellence driving improvements in the productivity and/or delivery of knowledge intensive services in Queensland:

- Creative industries: The Centre for Subtropical Design, Queensland University of Technology
- Health:
  - The Australian e-Health Research Centre, Queensland University of Technology (QUT)
  - The University of Queensland (UQ) Centre for Online Health
  - Australian Research Council (ARC) Centre of Excellence for Robotic Vision, QUT
- Education: Centre for Educational Innovation and Technology (CEIT), UQ
- Resources:
  - Safety in Mines Testing and Research Station (Simtars), Queensland Government
  - Sustainable Minerals Institute, UQ
  - Queensland Centre for Advanced Technologies, CSIRO
- Environmental:
  - Ecosciences Precinct, Queensland Government and CSIRO
– Environmental Futures Research Institute, Griffith University
– Centre for Future Environments, QUT

• Agriculture:
  – The Queensland Alliance for Agriculture and Food Innovation, (QAAFI), UQ
  – Centre for Tropical Crops and Biocommodities, QUT

• ICT and digital content: NICTA (National ICT Australia).
6. Growing the Knowledge Intensive Services in Queensland through Science, Research and Innovation

6.1. Focussing investment

“Over the past 15 years, previous Queensland Governments invested in significantly raising the State’s research capacity in order to position Queensland in areas of technological opportunity linked to our existing or emerging competitive advantages.”

Growing the knowledge intensive services sector in Queensland must be underpinned by science, research and innovation if we are to identify, create and nurture the knowledge based jobs and industries of the future.

Hence, to ensure any future investments provide value for money and are well aligned with Queensland Government objectives, the Queensland Chief Scientist identifies Science and Research Priorities for the State. In doing so, the Government can ensure that future investment is focused on well-defined areas, exploits our competitive advantages, and reflects identified needs and activities the government considers important.

Next step:
Importantly, the role of science, research and innovation in driving growth of the knowledge intensive services sector has been identified as a Queensland Science and Research Priority going forward.

6.2. Overcoming challenges and barriers

Supporting a globally competitive knowledge intensive services sector in the State as part of a broader knowledge based economy could help future-proof the Queensland economy by diversifying our industry base, creating high-value, well paid knowledge based jobs, and driving export growth.

Understanding and exploiting the challenges and inherent opportunities for the Queensland knowledge intensive services sector will better position the State to leverage the substantial investments already made in the knowledge based economy in Queensland.

An overarching strategic response from Governments, industry, and the research base in the State could:

- ensure ongoing global relevance of the knowledge intensive services sector in Queensland
- address and identify emerging markets

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• exploit local strengths and expertise in a coordinated manner
• develop collaborative opportunities
• ensure that public funding is directed towards research that is aligned with current and emerging market opportunities.

Next step:
Informed by this research paper, Government should identify tangible actions which will impact upon the growth of the knowledge intensive services sector. This could be achieved through the work of the Advance Queensland Expert Panel or other appropriate vehicle.

Recommended activities might include:
• considering the potential for ‘affirmative action’ with respect to research and development investment into this field, for example:
  – giving consideration to sound investment principles, consider making investment in knowledge intensive services focussed start-ups a priority for the Queensland Government’s Business Development Fund
• build the brand of knowledge intensive services in Queensland, raising the profile and understanding of the industry and its contributions to the State’s economic growth both within Government and across the community, business and research sector
• possible vehicles for this include: websites, stakeholder networks, embedding in Government policy and dialogue
• this could include, in the first instance, mapping and profiling successful knowledge intensive services businesses in Queensland, as potential role models for future expansion of this sector
• identify existing industry development strategies for knowledge intensive services sub-sectors and how Government can leverage these
• identify innovation and collaboration poor sub-sectors of the knowledge intensive services industry and create opportunities for engagement with the research/academic community.

Next step:
The findings of this research paper should inform any whole-of-government strategy to support the growth of the knowledge economy including export growth, and knowledge based jobs in Queensland.

6.3. Skills

Furthermore, building the skills-base and attracting talent to Queensland will be fundamental drivers of the knowledge intensive services economy. Jobs in knowledge intensive services will be created wherever talent is located, and talent is found in places where people want to live. The Boston Consulting Group ranked Australia seventh globally as a place where people would choose to locate.96 The Queensland lifestyle provides a favourable locale for attracting and retaining major technological companies and skilled people.

https://www.bcgperspectives.com/content/articles/human_resources_leadership_decoding_global_talent/
The Government’s Advance Queensland initiative provides for a number of activities that will drive the development of skills and knowledge to support the knowledge based industries of today and of the future. This includes a suite of skills-based programs (scholarships, fellowships, career support for female academics in the science profession) and a review of the teaching of science, technology, engineering and mathematics (STEM) subjects, giving particular consideration to improving the links between schools and research.

6.4. Collaboration

“There is a strong link between collaboration and product/process innovation.”97,98,99,100

Fostering collaboration between universities/academia and businesses, and/or between businesses, is critical to driving innovation and productivity in the knowledge intensive services sector.

There are compounding benefits for businesses that pursue a culture of both innovation and collaboration. This is the case across a number of important business performance measures.101,102

The research and organisational priorities of businesses and academia are significantly different. However, a greater understanding by each of the other’s ‘business’ imperatives and competencies could improve collaboration and translation of research and create a closer alignment between the research agendas of academia and knowledge intensive services industries.

Again, the recently announced Advance Queensland initiative will create an environment that maximises the interactions between research and business, through programs such as the Knowledge Transfer Partnerships Program to facilitate collaboration between researchers and industries.

Appendix 1: Definitions

Knowledge intensive services are defined as education, health, postal and telecommunications, finance and insurance, and business services excluding property services (OECD Science, Technology and Industry Scoreboard 2005) where business services include scientific research, computer, legal, accounting, architectural, marketing, mining and operational leasing services (ISIC divisions 61-66, 69-75, 85 and 86. ISIC Revision 4).
Appendix 2: Queensland Science and Research Priorities

- Delivering productivity growth and jobs for Queensland by developing enhanced production technologies, tools and practices particularly in the agricultural, mining, advanced manufacturing and supporting sectors including engineering services.

- Growing our knowledge intensives services through science, research and innovation.

- Protecting our biodiversity and heritage, marine and terrestrial, with particular focus on the Great Barrier Reef.

- Natural advantage cleaner, and renewable energy technologies development (e.g. gas, solar, biofuels).

- Ensuring the sustainability of our physical and especially our digital infrastructure critical for research and - correspondingly - strategically leveraging national programs (including making use of ‘big data’).

- Building resilience and managing climate risk, through the design and development of construction technologies for extreme weather event resistance (floods, cyclones, droughts), particularly in tropical environments.

- Supporting the translation of health and biotechnology research where Queensland has a particular interest or specific expertise, such as vaccine/drug development, age-related and tropical diseases, and skin cancer.

- Improving health data management and services delivery (including telemedicine).

- Ensuring sustainable water use and delivering quality water and water security in a variable climate and in a resources-intensive economy.

- Digitally-enabled technologies, e.g. the development and application of advanced modelling, visualisation, sensing and simulation technologies, tools and practices, including robotics.