

State of the State: 2017 Environmental Sensing

Technology, Business and Social
Trends Shaping the Queensland
Economy



Chair in
Digital Economy.

Acknowledgments

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This report was prepared by the Chair in Digital Economy based at QUT. The Chair investigates, stimulates and educates to help organizations and individuals thrive in the digital economy.

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Contents

Introduction.....	4
Research limitations	5
Key insights from the literature.....	6
Disruptive potential of technologies to impact business and industry: 'D' curve	11
Technology horizon: present and future use of technologies ..	12
Technology challenges in your business	13
Pace of technological change relative to business	14
Business trends	16
Social trends that shape life, business, and economy.....	19
Government support to cope with challenges in the digital economy	21
Sectoral Case Studies.....	23
QLD beef industry	25
QLD education and training industry	26
QLD FinTech industry	27
QLD healthcare and social assistance industry.....	28
QLD manufacturing industry	29
QLD spatial industry	30
QLD veterinary services.....	31
Business profile	34
Appendix A.....	35

Report Highlights

Approximately 50%
of businesses believe that technology
is moving at a faster pace than
businesses can comprehend 

Businesses have highlighted
“cost of technology investment” and
“aligning IT processes to business process”
as top technology challenges

+53%
of businesses identify
“data and analytics”
as a top business trend

+48%
of businesses agree that technology is
shaping the society norms and values

Introduction

Disruption is fundamentally reshaping the way a traditional business, government or individual works [1]. Disruptive information technologies, such as business intelligence, cloud, big data and analytics continue to evolve as they combine with the Internet of Things (IoT) and other catalyzing platforms. Other trends in technology, such as augmented reality, blockchain, advanced robotics, virtual reality, 3D printing, drones, machine learning and many others are rapidly accelerating [2].

Additionally, some fundamental forces are constantly driving and facilitating changes in business and economy. These include globalization, climate change and the environment, the innovation economy, urbanisation, connected living, crowd funding and so forth [2]. Overall, these emerging trends are reshaping and dramatically transforming the way we live and work [3]. While new opportunities are emerging, new trends may also cause a threat as they require changing the current way of doing business, which might impact profitability [4].

Nevertheless, there are many great examples of successful integration of new trends in technology, business and society with existing business activities to realize new opportunities as well as to catalyse changes in the related markets, industries and sectors. Understanding the key trends is, therefore, the first step of sensing the business environment and integrating them in the business.

This research project involved investigating key trends – technology, business and social – relevant to small and medium enterprises (SMEs) in Queensland. It also explored the key challenges businesses face and what kinds of government support could be provided to cope with the advances in the digital economy. SMEs (those hiring less than 200 people) represent about 99.7% of the businesses, with a share of 70% of total employment in Australia. They are the most important source of innovation in the economy and key driver of future economic growth [5]. Researchers and practitioners argue that the technology adoption rates in smaller sized businesses is weak [6]. Our goal is to create awareness towards the emerging trends and examine policy options to cope with challenges in the digital future.

Study Method

In late 2016, the Queensland Government Department of Science, Information Technology and Innovation (DSITI) engaged the Chair in Digital Economy (the Chair) based at Queensland University of Technology (QUT) to perform environmental scanning on the emerging trends which are expected to impact SMEs. An extensive literature review was undertaken and survey instruments were developed for technology, business and social trends. The instruments also included aspects of challenges to cope with the trends and were piloted extensively with domain expert researchers at QUT, industry representatives and businesses during February to March 2017. An online survey was then conducted targeting Queensland-based businesses. Given below are further details on the research process.

Research problem

There is a lack of research on the technology, business and societal trends in the SME context. Secondly, there is a lack of research in Australian and Queensland contexts. Existing research describes environmental scanning as a necessary precondition to strategy formulation by firms, as understanding the external environment helps firms to develop their responses and to secure or improve future position. This research will provide helpful input in this regard.

Review of literature

An extensive literature review was conducted to get insight into the emerging technology, business and social trends and to shape the questions to be asked to the businesses. A brief result from the literature survey is presented in the later part of this section.

Development and testing of the survey questionnaire

Based on the review of literature, questions for an online survey were developed focusing on the emerging trends, challenges and barriers SMEs face to cope with the changes and their business

performance as well as what government could do to support businesses to cope with the challenges. The survey instruments were tested rigorously with five companies before launching to participants. Appendix 1 provides the questionnaire for the survey.

Implementation of the online survey

The online survey tool KeySurvey was used to conduct the survey. Because there are no known public databases which provide details of the owners/managers of firms, the survey was administered through the QUT's Chair in Digital Economy and Department of Science, Innovation and Information Technology (DSITI) websites. Social media channels, such as, Twitter and LinkedIn were used to encourage businesses to participate in the survey. Owners/managers of 51 companies in Queensland participated the survey.

Analysis and presentation of results

The survey data were downloaded in an Excel spread sheet and analyzed by means of descriptive statistics.

Research limitations

There are a number of limitations to this study.

The first limitation is the small sample size. This is due to difficulties with identifying or accessing email addresses of the owners/executives of Queensland firms. We recommend a more detailed and larger study to provide more conclusive findings.

The second limitation is that we cannot conclude any interaction between technology business and social trends, that is, technological changes causing other trends to occur or vice versa. A qualitative type of study would be required in order to test causality.

The third limitation of this study rests on the data collection through an online process. There might be biases inherent in the data collection process due to lack of Internet access and/or experience

with electronic surveys. There might be concerns over possible security or confidentiality issues.

Key insights from the literature

Recent literature has provided insight on disruptive technology, business and social trends. Below is a list of key literature and their mentioning on the trends:

Technology trends

On the technology trends the reviewed literature are:

- Deep Shift Technology Tipping Points and Societal Impact [7].
- Disruptive technologies: Advances That Will Transform Life, Business and the Global Economy [8].
- Focusing on the Fundamentals Enterprise IT trends and Investments 2014, [9].
- ICT Trends 2020: Main Trends for Information and Communication Technologies (ICT) and Their Implications for E-Leadership Skills [10]
- OECD Science, Technology and Innovation Outlook 2016[2].
- Tech Breakthrough Megatrends [11]
- Tech Trends 2016 Innovating in the Digital era [12]
- Technology Vision 2017 [13]
- The Digital Revolution: What's on the Horizon? [14].
- The Upside of Disruption: Megatrends Shaping 2016 and Beyond[15].
- Top 10 Emerging Technologies of 2016 [16].

The most prevalent and disruptive technology trends common in existing literature are:

- Internet of Things (IoT)
- Artificial Intelligence and Automation of Knowledge Work
- Big Data/ Advanced Data Analytics
- Cloud Technology
- Autonomous & Semi-Autonomous Vehicles
- Robotics

Other disruptive technologies mentioned in the literature include augmented reality, Blockchain, virtual reality, advance materials and nanotechnology, energy storage, renewable energy, advanced oil and gas exploitation and recovery, drones and next-gen genomics. Appendix A provides some definitions of these technologies.

Business and social trends

We have reviewed the following literature to understand business and social trends:

- OECD Science, Technology and Innovation Outlook 2016 [2].
- Our Future World: Global Megatrends Report [17]
- The Upside of Disruption: Megatrends Shaping 2016 and beyond [15]

According to the literature above, the most prevalent and disruptive of these business and social trends include (alphabetically):

- Awesome Ageing
- Climate Change and Environment
- Globalisation
- Increased Connectivity
- Innovation Economics
- Great Expectations
- Urbanisation

Other dominant trends include, digital immersion, Generation Y, gig economy, healthy living, women in power and so forth.

The Queensland Economy

With a Gross State Product (GSP) of 314.5 billion in the 2015 – 16 financial year, Queensland is the third largest economy in Australia. The Queensland economy is primarily built upon mining, agriculture, tourism and financial services.

Aided by a strong export portfolio of coal, metals, meat and sugar; the economy experienced a period of robust economic growth during 1992 – 2008 (17 consecutive years) (Figure 1). The pace of economic growth was disrupted significantly following the Global Financial Crisis in 2008 – 09.

Population growth, though historically steady at 2%, has declined moderately in recent years (Figure 2). The relative change of these two factors led to a decline in the growth of income per capita in recent years – recovery of this remains a key challenge for the government in the coming years.

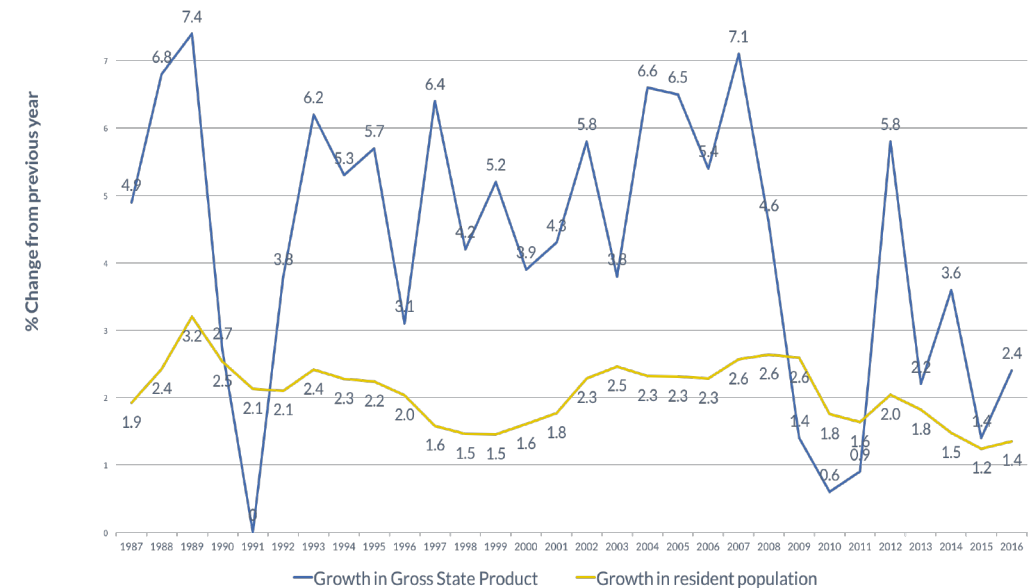


Figure 1: Growth in Gross State Product and resident population in Queensland (1987-2016) Source: Cat no 3101.0 Australian Demographic Statistics and Cat no 5220.0 Australian National Accounts: State Accounts. Australian Bureau of Statistics.

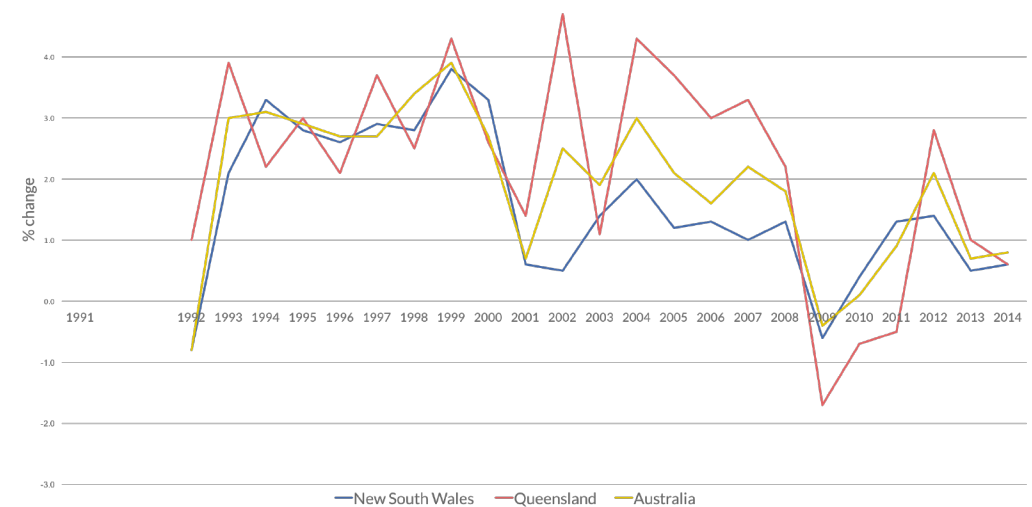


Figure 2: Per capita income growth in Queensland, New South Wales and Australia. Source: Cat no 5220.0 Australian National Accounts: State Accounts. Australian Bureau of Statistics.

Other changes include major demographic shifts towards the increase in elder populations relative to other age groups, with the ratio projected to rise in the future in Australia (Figure 3). While these changes pose greater challenges for the government in terms of greater demand for age pensions and health-care spending, the ageing population is an asset as elders provide a wealth of skills, knowledge, wisdom and mentorship[17]. The digital economy will be able to provide a great opportunity to embrace digital life and contribute productively to the economy.

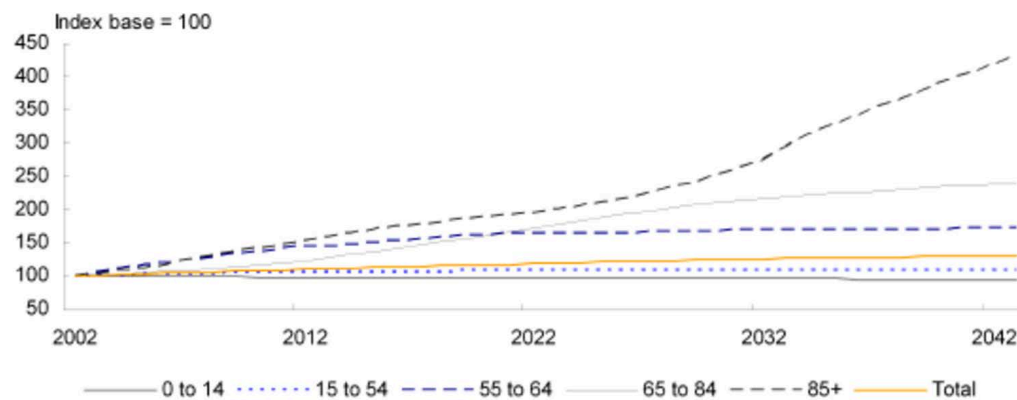
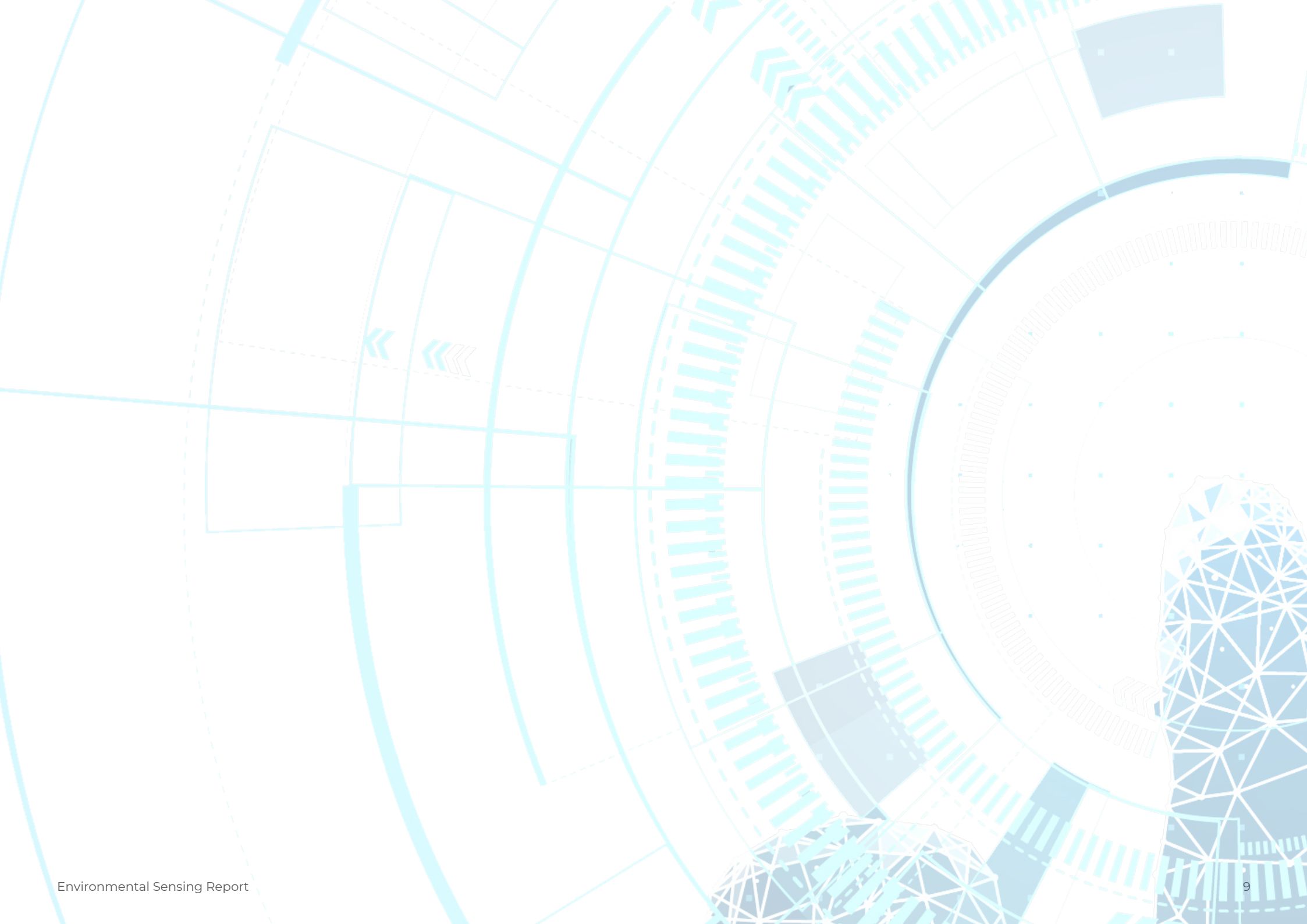


Figure 3: Population Growth Indices in Australia by age group

Source: Australian Treasury https://demographics.treasury.gov.au/content/download/australias_demographic_challenges/html/adc-04.asp

Other challenges, such as climate change and globalization, continue to influence business and the economy. With the unprecedented growth in Internet technology, the world has become more connected and people are moving at a faster pace to communicate with each other and obtain information. All economic agents (citizens, businesses and governments) are moving to a connected virtual world to access and deliver services, reduce market failure and exploit business opportunities.

Technological changes are shaping society and its norms and values (referred to as digital immersion). On the other hand, growing demand and expectations are putting pressure on resources, leading to a greater level of calls to produce more from less (innovation economics) [17]. We can therefore expect very challenging years for the Queensland and Australian economies ahead.





TECHNOLOGY TRENDS AND CHALLENGES

Disruptive potential of technologies to impact business and industry: 'D' curve

'Disruptive technology' is technology which has the potential to transform life, business and the economy. However, the extent of disruption differs widely between different technologies. This is shown in the figure below, which indicates the differential potentials of technologies to impact Queensland businesses and industries in the next 12 to 24 months. We plot this as a disruptive 'D' curve (Figure 4).

In our survey, the disruptive potentials of any specific technology (e.g. 3D printing) were measured on six-point Likert scale (Very high potential, High Potential, Moderate Potential, Low Potential, Very Low Potential and Not Sure). Respondents were asked to rate the disruptive potentials for various technologies. Based on the overall response for these different types of technologies, a potential disruptive score was developed. According to the disruptive 'D' curve in Figure 4, the top most disruptive (very high and high) technology is found to be 'business intelligence', which is given a score of 100. Other technologies were scored relative to business intelligence. Following business intelligence, the other most potentially disruptive technologies are: cloud based solutions, high-speed wireless INTERNET, digital technology platforms, artificial intelligence, Internet of Things (IoT), open data infrastructure and intelligent apps and others as presented in the disruptive "D" curve figure.

Why do some technologies qualify as more disruptive than others? This depends on the particular context in which a business operates. For example, in the small business environment, the choice of 'business intelligence' as most potential technology makes sense as most business executives in this environment have just started to understand the power of data and its potential use in strategic

decision-making [18]. Clearly, this trend reflects the new ways of making business decisions and improving business performance. Similarly, cloud computing is thought to be hugely disruptive due to its potential to displace traditional in-house storage of information. The survey results indicate the availability of 'high speed wireless Internet technology' as a potential disruptive technology. Whilst Telstra has recently launched a new 4G high-speed network, having a reliable and high-speed Internet connectivity remains a key issue for small businesses in Queensland[19, 20]. The Quarter 3, 2016 State of the Internet Report ranked Australia 50th for its average Internet connection speeds and found that almost a quarter of the country's population still receives less than half of the national average speed (9.6 Mbps) [20]..

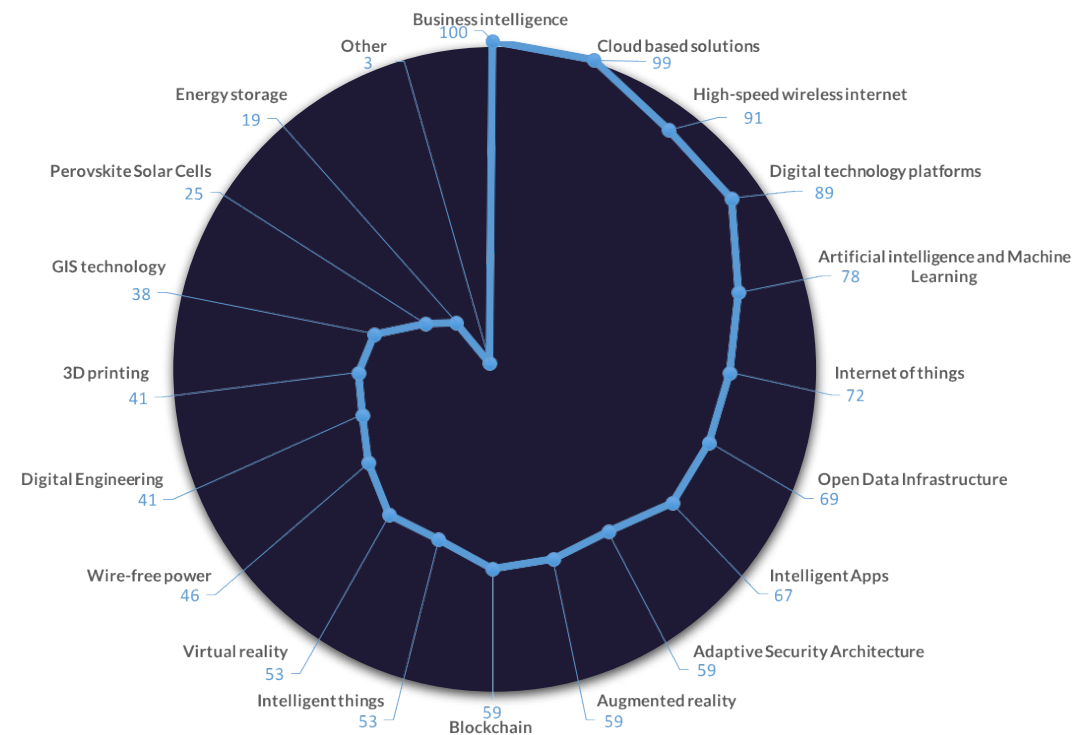


Figure 4: Disruptive 'D' curve of technologies

Technology horizon: present and future use of technologies

Survey participants were asked whether they would consider using any of these technologies in their own business. Respondents provided feedback on a five-point Likert point scale: A. Yes, already in use, B. Yes, would consider use within 1 – 2 years, C. Yes, would consider use in 3 – 5 years, D. No, not applicable to the business, E. Not sure. We refer to this technology horizon as the data provides a good understanding of present and future use of technologies in the next five years. The summary results are presented in Figure 5 below.

In Figure 5, the red bars represent the present use of technologies. The yellow and red bars represent the possible use of a technology

in next 1-2 years and 3-5 year, respectively. The number within a specific colour of a bar represents the percentage of total responses for each technology. Note, the total numbers in a bar do not add to 100, but the gap represents the Likert point scale D and E as described above.

According the Figure 5, the five most-used technologies at present are, cloud based solutions, digital technology platform, high-speed wireless Internet, business intelligence and intelligent apps. The five highest potential use of technologies in the next two years are business intelligence, adaptive security architecture, augmented reality, open data infrastructure, artificial intelligence and machine learning. Again in 3 – 5 years, the highest potential technologies would be virtual reality, energy storage, perovskite solar cells (high efficiency solar power cells), blockchain and adaptive security architecture (Figure 5).

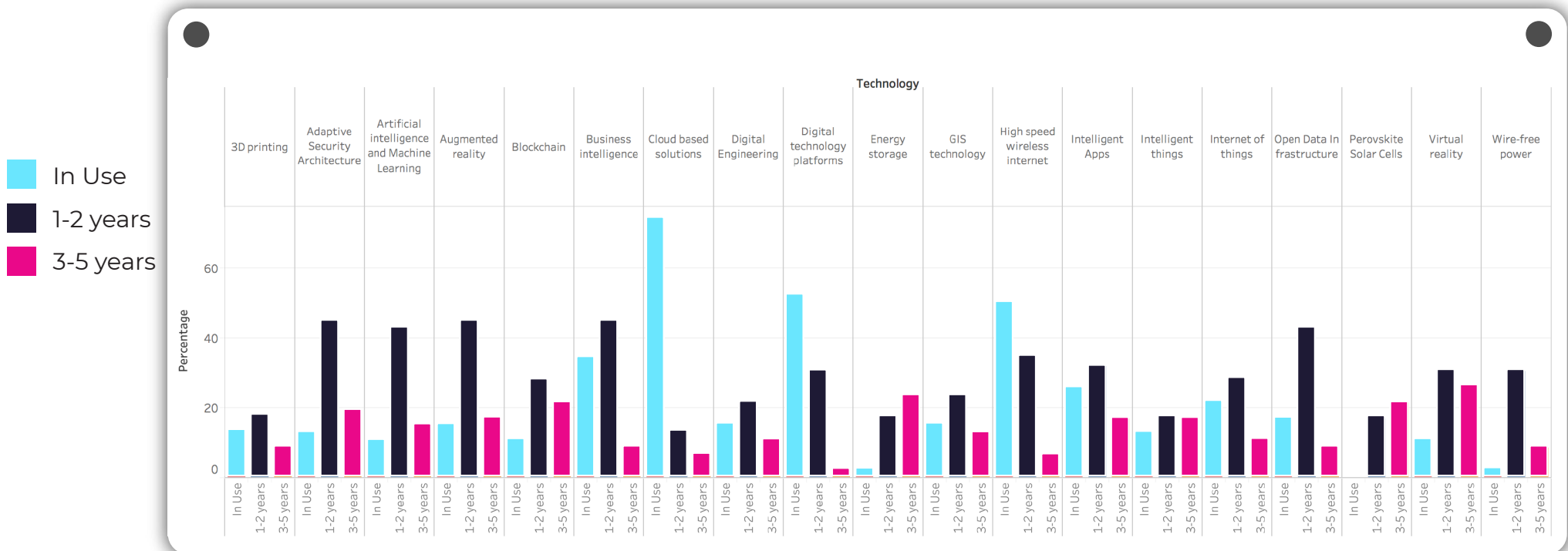


Figure 5: Use of technology in 0-5 year horizon.

Technology challenges in your business

From asking respondents about the technology challenges, a number of important issues emerged. The survey respondents voted the 'cost of technology investment' as being the top information technology challenge. The telecom market in Australia is highly monopolized, with Telstra, the largest network provider in the country, charging some of the highest Internet pricing in the world. It is claimed that bandwidth pricing in Australia is 17 times higher than the benchmark in Europe [21]. The cost of technology investment does not only come from the cost of Internet, but also from the associated cost of data analytics and the cost of employees. The survey respondents indicated 'aligning information technology processes to business process' is a key challenge. The CEO of one of the companies mentioned 'the time it takes to align IT processes to

business processes' as a major challenge for them.

Among others, 'Internet connectivity', 'reliability of technology' 'difficulties in selecting appropriate technology' and 'time to make changes' remain as key challenge for the businesses. Figure 6 shows the information technology challenges identified by the businesses.

Survey participants indicate risk management and IT abuse and fraud as the least challenging issues for them. However, this finding does not reflect the relative importance of the issues. Rather, relative challenges SMEs face, especially in the context of their digital maturity. Previous studies indicate a lack of awareness about IT risk management issues in SMEs (<http://www.dcs.gla.ac.uk/~karen/pdf/flyerReport.pdf>). However, we leave in-depth analysis of this issues for our next research.

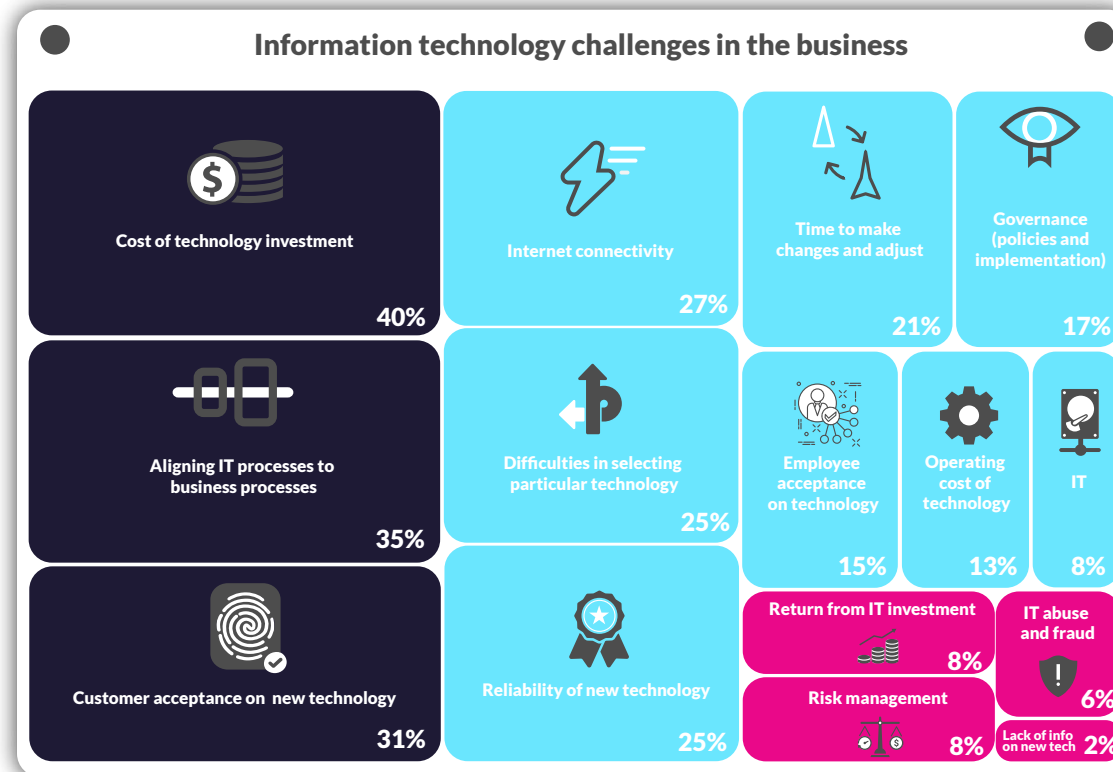


Figure 6: Information technology challenges in the business

Note: Respondents were asked to identify three challenges at most.

Pace of technological change relative to business

Regarding the pace of technological change relative to business, the survey respondents provided mixed results. About 48% of the survey respondents believe technology is moving at a faster pace than their business can comprehend, while the rest voted 'No' and 'Not sure' (Figure 7). On the other hand, more than 60% of the respondents defined themselves as a first mover on trusted technology (Figure 8). Nonetheless, a generic conclusion from the

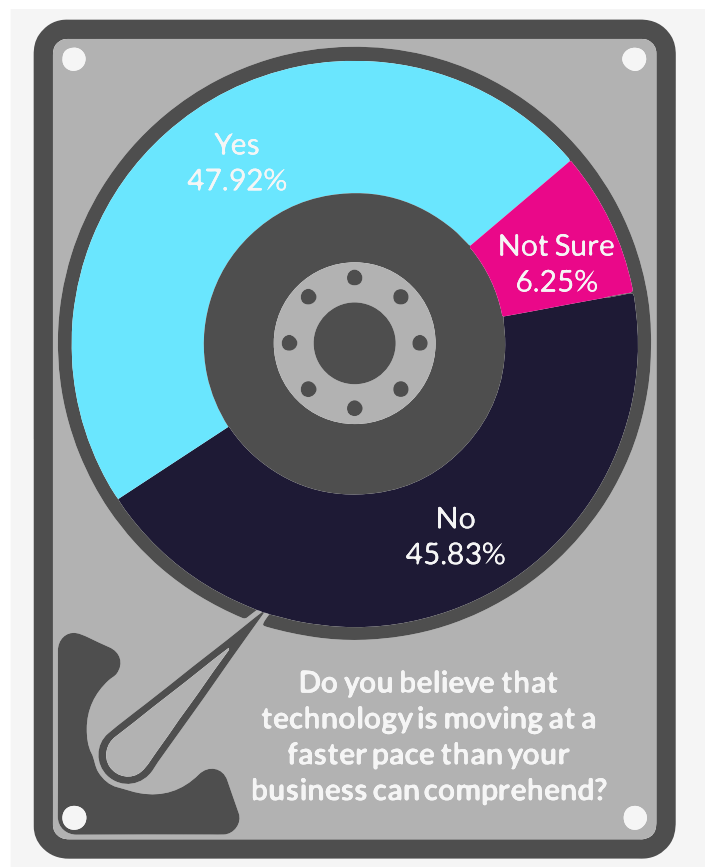


Figure 7: Pace of technological change (Q. Do you believe that technology is moving at a faster pace than your business can comprehend?)

results in Figure 8 is difficult to make as those people having a good sense of the external environment and technology might tend to participate the survey. Accordingly, the relative weight of the options in Figure 8 may change when a larger sample can be employed. Our results indicate that a large segment of participating companies still find technological integration a key challenge for their business (as discussed in the previous section that 'aligning IT processes to business process' was ranked second most important challenge for their business). The CEO of one of the companies identified 'the time it takes to align IT processes to business processes' as a major challenge for them.

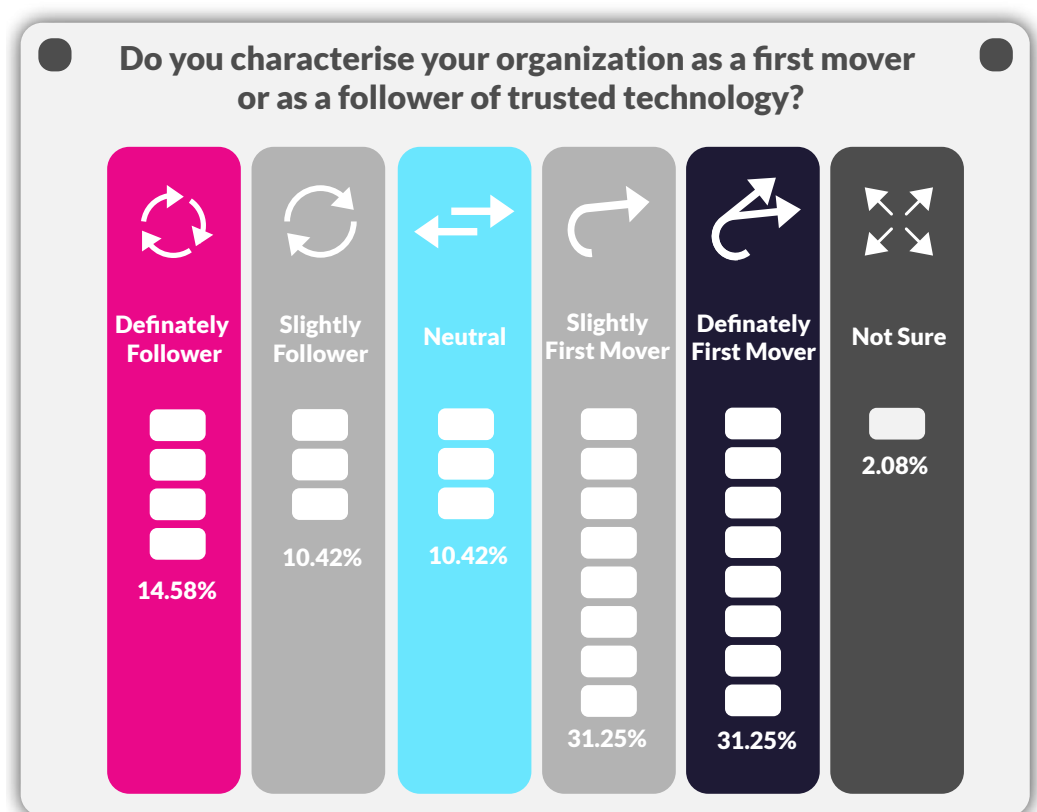


Figure 8: Technology adoption (Q. Do you characterize yourself as a first mover or as follower of trusted technology?)

The background is a dark blue field filled with intricate geometric patterns. Concentric circles and radial lines create a sense of depth and movement. Overlaid on these are complex wireframe structures that resemble architectural models or molecular frameworks. Some of these structures are solid, while others are composed of thin lines and dots. The overall aesthetic is futuristic and technological.

BUSINESS TRENDS

Business trends

Business trends are trends that companies embrace to drive success in the digital economy. These trends emerge regardless of the demographic characteristics of a company. Business trends can be found in the creation of new products or services, in new business models or in the environment.

Queensland businesses view some business trends as more dominant than others. The top three emerging business trends are data and analytics, digital product and services, and digital entrepreneurship (Figure 9). These trends reflect advances in digital economy and are consistent with the technology trends as discussed above (e.g. business intelligence which deals with a huge amount of data). The demand for 'data and analytics' has grown rapidly in recent years and there might be a great opportunity for start-ups and entrepreneurs in the Queensland context. The Chief Executive Officer of one food manufacturing company commented that they spend a huge amount of money for social analytics from a US-based company, yet they are not happy with the service provided.

If local businesses emerge providing similar services, this might meet the surge in demand in this field that the results from the survey indicates. Policy-makers providing hubs and incentives should be aware of this need. Estimates find that big data and analytics could unlock trillions of dollars in business value by 2020. Other emerging trends in business are automation; the sharing economy and distributed trust; customer empowerment; social enterprise; the freelance workforce and crowd funding. These are the emerging business models (e.g. Uber) and will potentially be the major thrust for the Queensland economy in the near future.

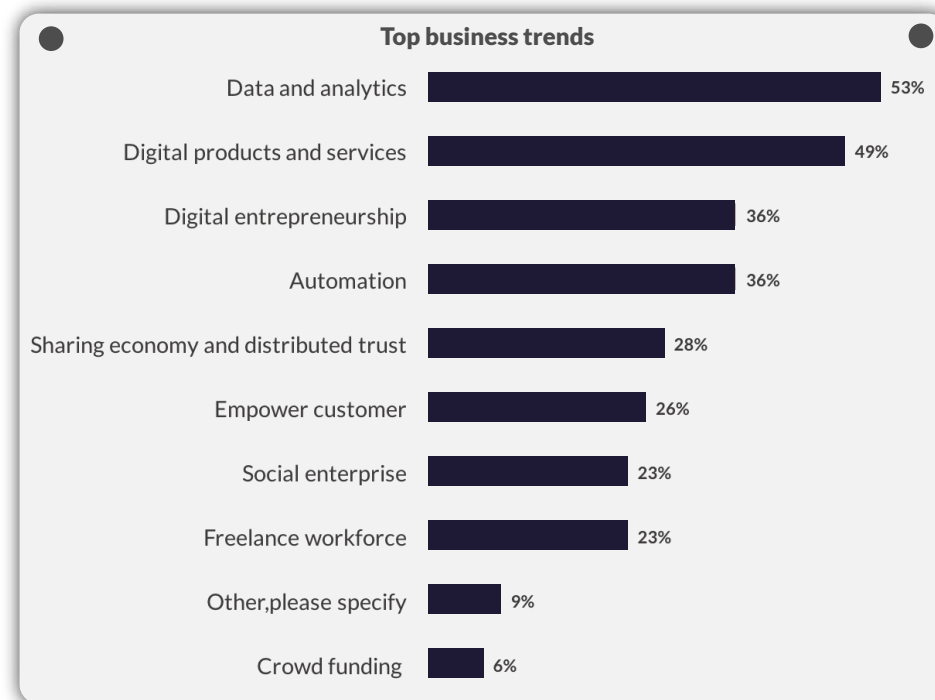


Figure 9: Top business trends. Numbers show the % share of respondents' preferences over other categories. Total numbers do not add to 100 as respondents were asked to identify a maximum of three top business trends.



Figure 10: Interest index on crowd funding in Australia in recent years. Note: Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. Likewise, a score of 0 means the term was less than 1% as popular as the peak.

Source: Google Trends (data downloaded 28 May, 2017, 10.28 pm)



Data and analytics: A key feature of the digital economy is the emergence of a huge amount of unstructured data. Advanced analytics allow businesses to gain insights from this data and improve performance. Estimates find that big data and analytics could unlock trillions of dollars in business value by 2020.



Digital product and services: The first digital revolution is seeing the emergence of thousands of digital products and services. This includes both tangible products, such as smart phones, digital Television, smart sensors to e-goods, such as Netflix, e-book, Google and Blockchain to name a few. Digitalized services provide a complete new service model with limited human involvement. Digitalised goods and services will drive economic performance and productivity in the future.



Automation: Automation, or automatic control, is the use of various control systems for operating equipment such as machinery, processes, networks. Automation will improve productivity by saving labour per unit of output and by improving precision, accuracy and quality. However, this creates a new threat to employment.



Digital entrepreneurship: Digital entrepreneurship is both a driver and product of the digital environment. It encompasses both the creation of new ventures and the transformation of existing business models to develop completely new products or services, as well as the novel use of existing technologies.



Sharing economy and distributed trust: The sharing economy is the product of the environment, where both physical and intellectual assets can be shared as services and to make money. Uber is a great example of the sharing economy and so is the social web, Botsman, which enables programmers to share codes. A key feature of the sharing economy is to create a model of trust in using assets.



Customer empowerment: One of the key trends in the digital economy is engaging and empowering customers. Our previous research on Queensland-based businesses indicates that customer-centricity is a key feature of relative performance of firms. [18]. Successful firms in the digital economy not only understand the customer 'pain' when they think about innovation, but also become experts on customers and allow personalised services. For example, the Brisbane-based company The Print bar (<http://www.theprintbar.com/>) allows customers to design their own T-shirt. Similarly, US-based Nordstrom (<http://shop.nordstrom.com/>), which supplies globally, offers personalised stylist services to its customers.



Social enterprise: Social enterprises are both for-profit and non-profit organisations that consider social values and responsibilities as a core aspect of their business. Social enterprises seek to create a win – win game for both company and society.



Freelance workforce: In today's economy, a large number of workers are making the choice to work as a free agent, rather than working within the grind of corporations. This transition has been enabled by popular digital freelancing platforms, such as Upwork.com and Freelancer.com. It is estimated that freelancers now make up of 35% of the workforce in the US economy, and the number is growing rapidly (<https://www.upwork.com/i/freelancing-in-america/2016/>).



Crowdfunding: Crowd funding is the practice of funding creative projects by raising capital from a large number of people. It evolved rapidly in recent years due to the use of internet platforms (e.g. Kickstarter and IndiGoGo). Interest in crowd funding has surged multifold in recent years.

The background is a dark blue field filled with complex geometric patterns. Concentric circles and radial lines create a sense of depth and movement. Overlaid on these are wireframe structures that resemble architectural models or molecular frameworks. Some of these structures are elongated and vertical, while others are more compact and spherical. The overall effect is one of a futuristic or technological environment.

SOCIAL TRENDS

Social trends that shape life, business, and economy

The pace of technological progress is so high that it is shaping societal norms and values. This is reflected in the survey with about 48% of participants identifying 'Digital immersion' as a top social trend in the digital economy. Technological advances are

touching every aspect of life, from food to travel, education to jobs, grocery to clothing, shelter to health care and so forth. However, technology is not the only force that is driving transition to the new economy. The other important forces of changes are globalization and demographics [15]. The list also includes, rising expectation, the innovation economy, urbanization, environmental concerns and others as presented in Figures 11 and 12.

Social trends: Five **very strong** forces

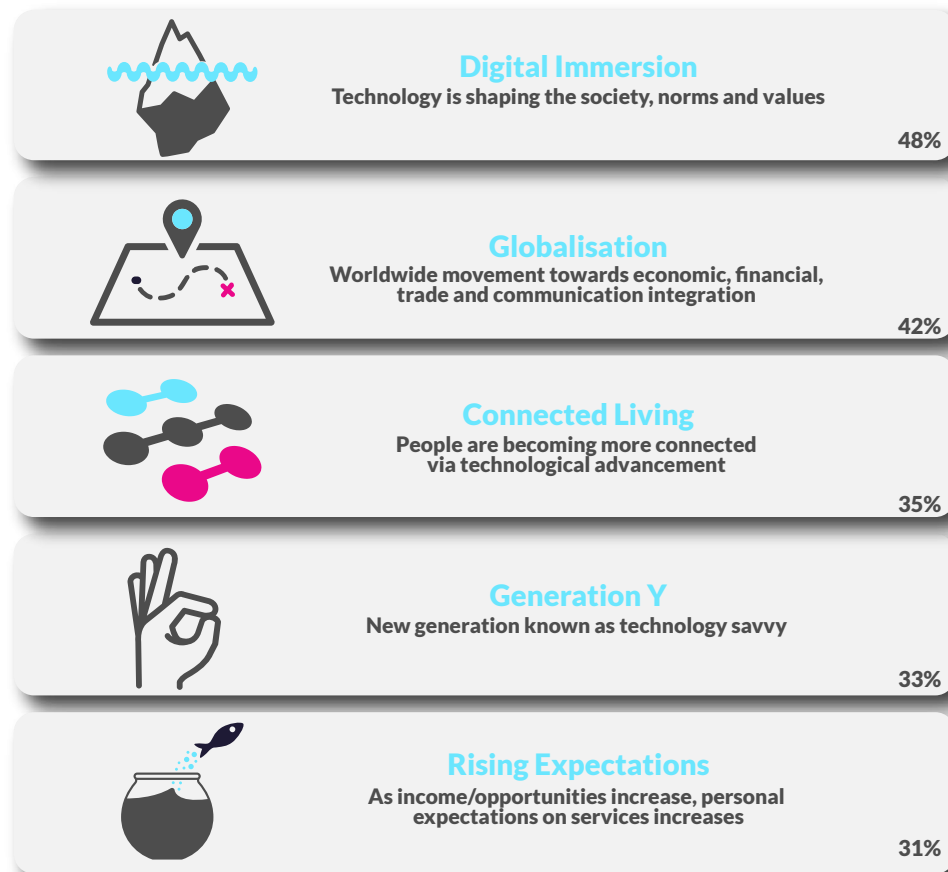


Figure 11 Social Trends: Five very strong forces

Environmental Sensing Report

Social trends: Five **strong** forces

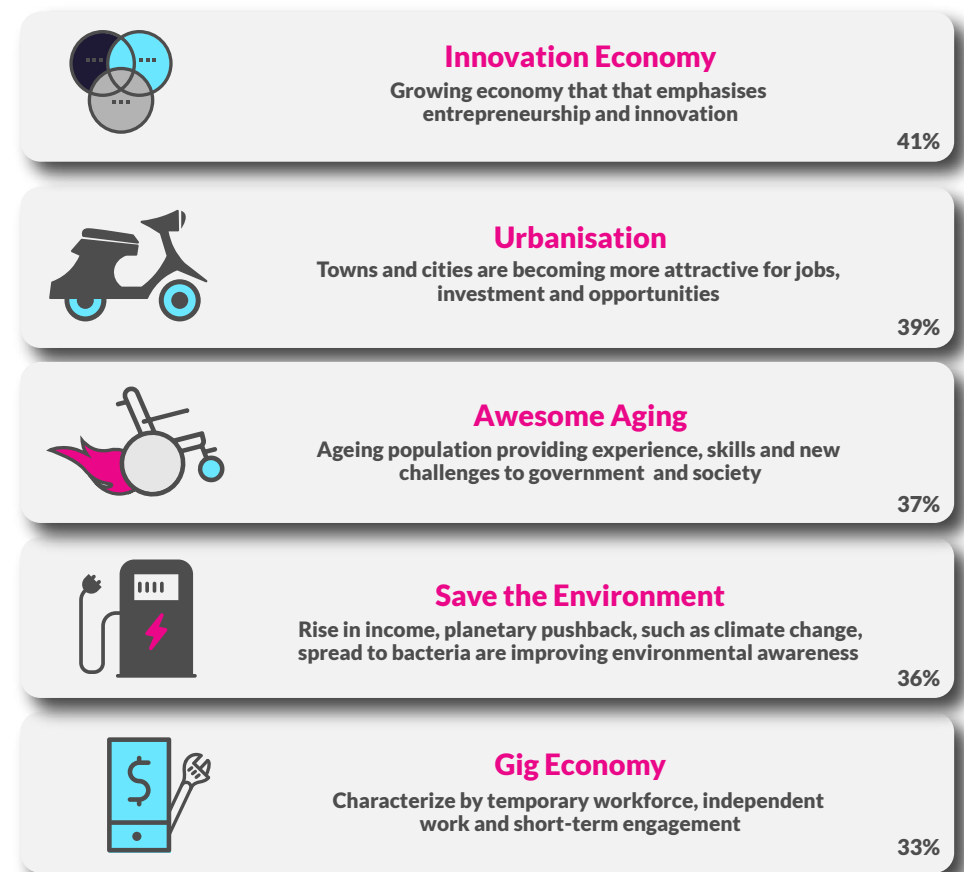


Figure 12 Social Trends: Five strong forces

The background is a dark blue field filled with complex, abstract geometric patterns. Concentric circles and arcs are prominent, some with dashed lines. Overlaid on these are wireframe-like structures that resemble architectural or mechanical designs, including what looks like a dome or a series of interconnected points and lines. The overall effect is one of high-tech or futuristic design.

GOVERNMENT SUPPORT

Government support to cope with challenges in the digital economy

How can governments support businesses to cope with the challenges presented by the digital economy? Broadly, governments can play a major role in setting up the policies and regulations so digital markets operate efficiently. Governments also frame tax policy and spend money on digital infrastructure. Government investment and procurement can support local businesses to grow. Our previous report [18] identified three areas where public policy can play a great role to support growth of business. They are:

- Building confidence through bringing people together to share stories of success with others
- Providing incentives that reduce the cost of doing business, and
- Enabling talent with the knowledge, skills and ability to build strong firms

In this report we revisit the policy options with a particular focus given to building the technology capability. The top five preferences are: Provide incentives (57%), Government grants and funding (53%), Enable innovation through hubs and groups where people can connect (49%), Access to government procurements and contracts (45%) and Build business confidence (40%). Businesses also viewed Partnership between Public and Private, Digitalisation of government services, Improving regulatory framework to support new business models using digital technologies as important supports that government can provide.

The CEO of one business mentioned the Cost of compliance as an area where government can pay attention, as the business needs to incur the cost at multiple points of the supply chain. Figure 13 presents the results from the survey on government support.

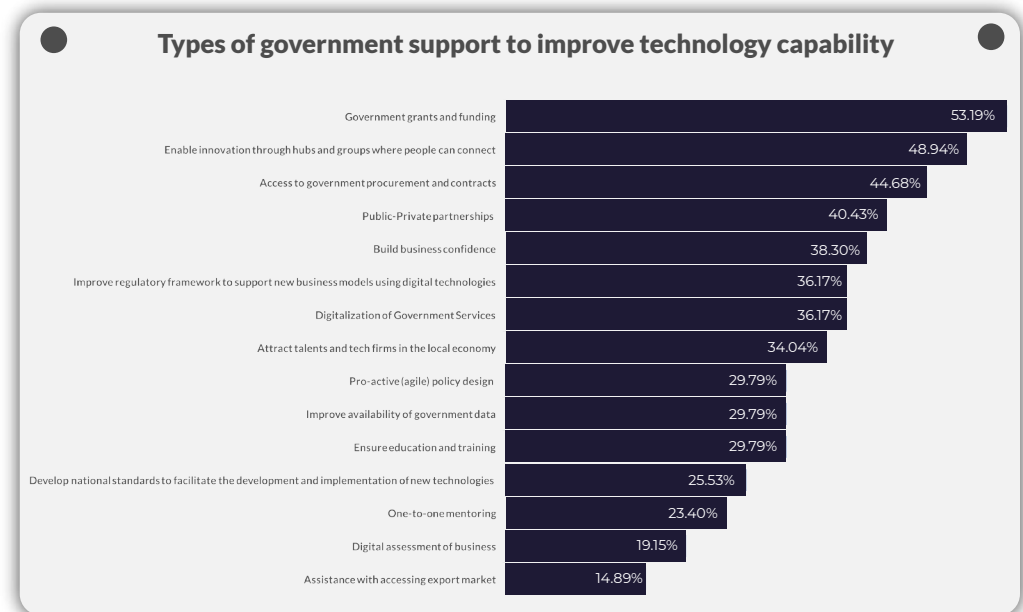


Figure 13: Participants preference on the types of government support to improve technology capability.
Note: Numbers reflects respondents' preference. The total does not add to 100 as respondents were given option to prefer multiple.

The background is a dark blue field filled with complex geometric patterns. Concentric circles and radial lines create a sense of depth and rotation. Overlaid on these are wireframe structures that resemble architectural models or molecular frameworks. Some of these structures are solid, while others are composed of thin lines. The overall aesthetic is technical and futuristic.

CASE STUDIES

Sectoral Case Studies

In this section we present case studies from eight different Queensland industries based on the survey and secondary data. These industries are Beef, Education and Training, Fintech, Health Care and Social Assistance, Manufacturing, Spatial, and Veterinary services.

The case studies provide insights into industry background, technological advances, technology horizon, and other trends and challenges relevant to these industries. While each of these industries have different levels of technological uptake and challenges, one common finding from the case studies is that all industries are heavily disrupted by the technological change. Given below are the description of technological disruption in each of the industries.

Queensland beef industry, which is the Australia's largest supplier of beef and beef products, owns huge amount of data from its supply chain. Survey participants indicate that it is important to invest in a data feedback loop to realise the full potential of data and improve efficiency. By analysing the collected data by its processors it is possible to assess the extent and cost of carcass downgrades caused by parasites, disease and husbandry. The most disruptive effect on the industry in the near future will come from mobile internet, blockchain, business intelligence, cloud based solutions, open data infrastructure and DEXA (advance body composition scanning to assess distribution of lean muscle, fat, water and bone).

Technological changes have significantly disrupted **the education and training industry** by transforming the way data knowledge has been stored, accessed, disseminated, analysed, and presented. Augmented reality, artificial intelligence, machine learning, intelligent apps and adaptive security architecture are the potential


disruptive technologies in the near future (1-2 years). The top information technology challenges for this industry are internet connectivity, employee acceptance of technology and information technology management.

Australian fintech industry, which has grown by more than 10 times in its size from 2011 to 2016, characterise themselves as first movers in terms of adopting new and trusted technologies. The top information technology challenges for this industry are customer acceptance of technology, information technology governance, and reliability of technology.

The healthcare and social assistance industry, which is the largest employer in Queensland over 4 years, has experienced major technological advances such as robotics surgery, 3D imaging, information technology systems that allow real-time access to patient information, and online medical services. The most disruptive effect on this industry in the near future will come from business intelligence, cloud based solutions, intelligent apps and digital technology platforms.

The manufacturing industry, which is the 4th largest sector in Queensland in terms value added, finds aligning of information technology to business process as top technology challenge. Current technological advances in this industry include 3D printing, digital engineering, digital platforms, business intelligence. Automation, freelance workforce, sharing economy, data and analytics are some business trends identified by the survey participants.

Veterinary Services industry, which generated \$2.6 billion revenue in Australia in 2016-17, is currently experiencing a high level of technological change, particularly through improvement to equipment, such as ultrasound, and X-ray. The information technology challenge in this industry is the cost of technology investment, customer acceptance and reliability of the technology.



Queensland Spatial industry, which is expected to grow over the coming years, requires adoption to rapidly changing technological landscape. The effects of disruption are already being felt in the industry, but more to do to exploit opportunities. The potential disruptive technologies for the industry in the near future are adaptive machine learning, artificial intelligence, advanced machine learning, and augmented reality. The survey participants viewed automation, freelance workforce and sharing economy, and distributed trust as top three business trends.

QLD beef industry

Queensland is Australia's largest supplier of beef and beef products with beef export valued at \$4.95 billion in 2014-15. Beef processing makes up the majority of Queensland's manufacturing industry, employing an estimated 18,000 workers [22].

Key business activities include:

- Product procurement and logistics
- Processing, packing and distribution
- Working with suppliers to encourage 'right specification of product'.

Challenges

The industry owns a huge amount of data from its supply chain. Survey participants indicate that it is important to invest in a data feedback loop to realize the full potential of data and improve efficiency. By analysing existing data collected by its processors it is possible to assess the extent and cost of carcass downgrades caused by parasites, disease or husbandry.

This information can be used to clearly communicate to producers how practice changes could make a difference to their enterprise in dollar figure terms. The data feedback loop reduces waste in the supply chain and improves the quality of the product, ultimately increasing profitability.

*based on surveyed businesses

**Queensland Department of Agriculture and Fisheries 2016

KEY INSIGHTS

Key technological advances in the beef industry

The most disruptive effect on industry in the near future [22]

- Mobile Internet
- Blockchain
- Business intelligence
- Cloud based solutions
- Open data infrastructure
- DEXA (advanced body composition scanning to assess distribution of lean muscle, fat, water and bone)

Top 4 IT challenges

- 1 IT and business process alignment
- 2 Cost of technology investment
- 3 Cost of compliance
- 4 Harmonisation of information being transferred between multiple brands of software

Technology implementation timeframe



Current

- Business intelligence
- Cloud-based solutions
- Mobile Internet

One to two years (potential)*

- Blockchain
- Internet of Things
- Open data infrastructure
- Virtual reality

Top 5 influencing social trends

- 1 Globalisation
- 2 Healthy living
- 3 Innovative economy
- 4 Rising consumer expectations
- 5 Save the environment

Top 3 influencing business trends

- 1 Data and analytics
- 2 Sharing economy and distributed trust
- 3 Sharing information through supply chain

QLD education and training industry

The education and training industry encompasses Preschool Education, School Education, Tertiary Education, Adult & Community Education, and Educational Support Services.

The industry is the fifth largest source of employment in Australia, employing approximately 931,600 workers (or 8.0% of total employment) in August 2014.

Technological change over the past five years has transformed the way knowledge has been stored, accessed, disseminated, analysed, and presented. However changes to the sector are expected to be gradual [23, 24].

**based on surveyed businesses*

KEY INSIGHTS

Three-quarters of survey respondents in the industry felt technologies were moving at a faster pace than their businesses could keep up with and that their businesses were influenced by the social trend towards digital immersion.

Key technological advances in the education and training industry with the most disruptive effect on industry in the near future:

- 1 Mobile Internet
- 2 Artificial intelligence and automated machine learning
- 3 Digital technology platforms

Technology implementation timeframe



Current

- **Cloud**
- **Mobile Internet**
- Business intelligence
- Digital technology platforms

One to two years (potential)*

- **Augmented reality**
- Artificial intelligence and automated machine learning
- Intelligent apps
- Adaptive security architecture

Top IT Challenges

- 1 Augmented reality
- 2 Artificial intelligence and automated machine learning
- 3 Intelligent Apps
- 4 Adaptive security architecture

Top 3 influencing business trends

- 1 Digital products and services
- 2 Social enterprise
- 3 Data and analytics

QLD FinTech industry

The FinTech industry provides Information Technologies that support and/or enable banking and financial services.

Disruption and Increasing Investment

The Australian FinTech industry has grown from US\$51 million in 2011 to an excess of US\$600 million in 2016. This is thanks to Australia's relative strength in financial services and governmental commitment to supporting the industry.

Businesstrends including the sharing economy and mainstream digital are forecast to drive greater efficiencies and investment in this sector, with Australia set to become a leading player in the industry [25, 26].

Though the financial sector has experienced a period of significant disruption as FinTech entrants have harnessed technologies to make financial services more convenient and relevant to consumers, financial institutions are increasingly embracing disruption and partnering with FinTech firms [25].

**based on surveyed businesses*

KEY INSIGHTS

Businesses within the FinTech industry characterize themselves as first movers in terms of adopting new and trusted technologies. Increasingly they are partnering with incumbent financial institutions to improve efficiency.

Key technological advances in the FinTech industry with the most disruptive effect on industry in the near future:

- 1 Artificial intelligence
- 2 Blockchain
- 3 Business intelligence
- 4 Intelligent apps

Technology implementation timeframe



Current

- AI and advanced machine learning
- Blockchain
- Cloud-based solutions
- Digital technology platforms

One to two years (potential)*

- Adaptive security architecture
- Augmented reality
- Business intelligence
- Geographic information systems technology
- Intelligent apps
- Internet of Things
- Mobile Internet

Top IT Challenges

- 1 Customer acceptance of technology
- 2 IT governance
- 3 Reliability of technology

Top 3 influencing business trends

- 1 Data and analytics
- 2 Empowered customers
- 3 Sharing economy and distributed trust

QLD healthcare and social assistance industry

The health care and social assistance industry has been the largest employer in Queensland for over four years, accounting for 12.4% of the workforce and contributing approximately \$13.5 billion to the state economy in salaries and wages annually [29].

Technological change

Technological change within the industry is continuous and significant and will continue saving costs and improving health outcomes.

Major technological advances include:

- Robotic surgery in hospitals
- 3D imaging for PET scans
- Information and communication systems providing real-time access to patient information
- Risk-management systems in hospitals comprising medication, equipment, incidents and infection control.
- Growth in online medical services.

**based on surveyed businesses*

KEY INSIGHTS

Key insights are across three businesses in two sectors: healthcare and social assistance, acute hospital, and aged care nurse call systems.

Key technological advances in the healthcare industry with the most disruptive effect on industry in the near future:

- 1 Business intelligence
- 2 Cloud-based solutions
- 3 Intelligent apps
- 4 Digital technology platforms

Pace of change

Two-thirds of respondents thought that technology was not moving faster than their business could comprehend. All respondents felt like they were first-movers in the industry.

Technology implementation timeframe



Current

- Cloud-based solutions
- Digital platforms
- Intelligent apps

One to two years (potential)*

- Geographic information systems (GIS)

Key social trends:

Raising expectations, awesome ageing and connected living

Top IT Challenges

- 1 Customer acceptance of technology
- 2 IT governance

Top 3 influencing business trends

- 1 Digital entrepreneurship
- 2 Social enterprise
- 3 Digital products and services

QLD manufacturing industry

The Queensland manufacturing sector is of critical importance to the Queensland economy as a source of jobs, exports, investments and innovation.

Manufacturing is on the threshold of major transformation as new design production and business capabilities are opening the way to new types of manufacturing - termed 'advanced manufacturing'.

Key statistics

- The sector is estimated to contribute over \$19 billion directly to the state economy
- 4th largest sector behind construction, mining, health care and social assistance
- 16,388 manufacturing businesses
- 169,700 directly employed by manufacturing businesses (December quarter 2015).

**based on surveyed businesses*

KEY INSIGHTS

Key insights across four manufacturing sectors: chemical and chemical products, wood products, food products, and beverages and tobacco.

Key technological advances in the manufacturing industry with the most disruptive effect on industry in the near future:

- 1 Cloud-based solutions
- 2 Geographic information systems technology
- 3 Business intelligence
- 4 Intelligent things

Pace of change

Respondents who identified as technology 'followers' felt technology was moving at too fast a pace for their business to comprehend, while respondents who identified as technology 'first movers' did not.

Technology implementation timeframe



Current

- **Cloud technologies**
- 3D printing
- Digital engineering
- Digital platforms
- Business intelligence
- Mobile Internet

One to two years (potential)*

- Augmented Reality
- Business Intelligence
- Mobile Internet

Top IT Challenges

- 1 Alignment of IT to business processes
- 2 Cost of IT investment

Top 4 influencing business trends

- 1 Automation
- 2 Freelance workforce
- 3 Sharing economy and distributed trust
- 4 Data and analytics

QLD spatial industry

The spatial industry specialises in the collection, analysis, interpretation and management of spatial data and mapping. Spatial information technologies include Geographic Information Systems (GIS), Global Positioning Systems (GPS), Remote Sensing and Spatial Data Management.

Importance in QLD context

(growing, will underpin advances in other sectors)

Spatial industry technologies provide significant economic and employment growth to the Australian economy as they allow for greater efficiencies and innovation in other sectors including:

- mining
- energy and resource management
- infrastructure
- agriculture
- environmental monitoring
- natural disaster management.

The Australian spatial industry is expected to grow over the coming years as it benefits from advances in technology and its global competitive advantage. [27, 33]

However, given the rapidly changing technological landscape the industry is at risk of missing out on key opportunities for growth. This could result in slower growth in related sectors to which spatial information and technologies are central to new innovations [33].

**based on surveyed businesses*

KEY INSIGHTS

The effects of disruption are already being felt with one Geospatial (GIS) small business reporting that although it considered itself to be a first mover in terms of adopting new trusted technology, the pace of technological change was moving faster than it could comprehend.

Key technological advances for improved data collection and analysis [33]

- 1 Internet of Things
- 2 Mobile devices and connectivity
- 3 3D and 4D data
- 4 Collaborative analysis tools
- 5 Artificial intelligence and automation

Key technological advances with the most disruptive effect on industry in the near future

- 1 Adaptive security architecture
- 2 Artificial intelligence
- 3 Advanced machine learning
- 4 Augmented reality

Technology implementation timeframe



Current

- 3D printing
- Business intelligence
- Cloud-based solutions
- Digital technology platforms

One to two years (potential)*

- Adaptive security architecture
- Artificial intelligence
- Augmented reality
- Blockchain
- Digital Engineering
- Intelligent things (Drones, robots etc.)
- Virtual reality and wire-free power

Top IT Challenges

- 1 Customer acceptance of technology
- 2 Internet connectivity
- 3 Reliability of technology

Top 3 influencing business trends

- 1 Automation
- 2 Freelance workforce
- 3 Sharing economy and distributed trust

QLD veterinary services

The veterinary services industry includes practitioners and animal hospitals skilled in animal medicine and surgery.

Key Statistics

- \$2.6 billion in Australia-wide revenue in 2016 – 17
- 2.3% predicted industry growth 2017 – 2022 [34]

Technological Change

The industry is currently experiencing a high level of technological change, particularly through improvements to equipment including:

- Ultrasound machines
- X-ray machines
- Anesthetic equipment
- Diagnostic equipment.

While these improvements can increase the range of services offered by veterinarians and can simplify existing procedures and tests, the improved efficiency that is afforded by technology must be weighed against high costs of equipment and the willingness of clients to pay higher prices [34].

**based on surveyed businesses*

KEY INSIGHTS

Survey respondent in the veterinary service industry identified as a slight first mover in terms of technology adoption reported that the pace of technological change was not moving faster than it could comprehend.

Key technological advances in the veterinary services industry with the most disruptive effect on industry in the near future:

- 1 Digital technology platforms

Technology implementation timeframe



Current

- Cloud-based solutions
- Digital technology platforms
- Internet of Things
- Mobile Internet

One to two years (potential)*

- Artificial intelligence and automated machine learning
- Augmented reality
- Blockchain
- Business intelligence
- Geographic information systems
- Open data
- Wire-free Internet

Top IT Challenges

- 1 Customer acceptance of technology
- 2 Cost of technology investment
- 3 Reliability of technology

Top 3 influencing business trends

- 1 Data analytics
- 2 Empowered customers
- 3 Sharing economy and distributed trust

The background is a dark blue field filled with complex, abstract geometric patterns. Concentric circles and radial lines create a sense of depth and rotation. Overlaid on these are wireframe structures that resemble architectural models or molecular frameworks. Some of these structures are solid, while others are composed of thin lines. The overall effect is one of high-tech, futuristic design.

PARTICIPANT AND BUSINESS PROFILES

Participants profile

The 2017 Technology, Business and Social Trends Survey was implemented during April- May 2017 and targeted SMEs from the Queensland economy. Owners/managers of 50 businesses from diverse sectors of the economy participated the survey. As shown in the Figures below, they came from diverse sectors of the economy (Figure 14). While they perform different types of roles, 90% of them represent Executives/Directors/Managers (Figure 15). The respondents pose different age distributions as shown in Figure 15. Sixty-one percent of survey participants were male and 39% were female (Figure 16).

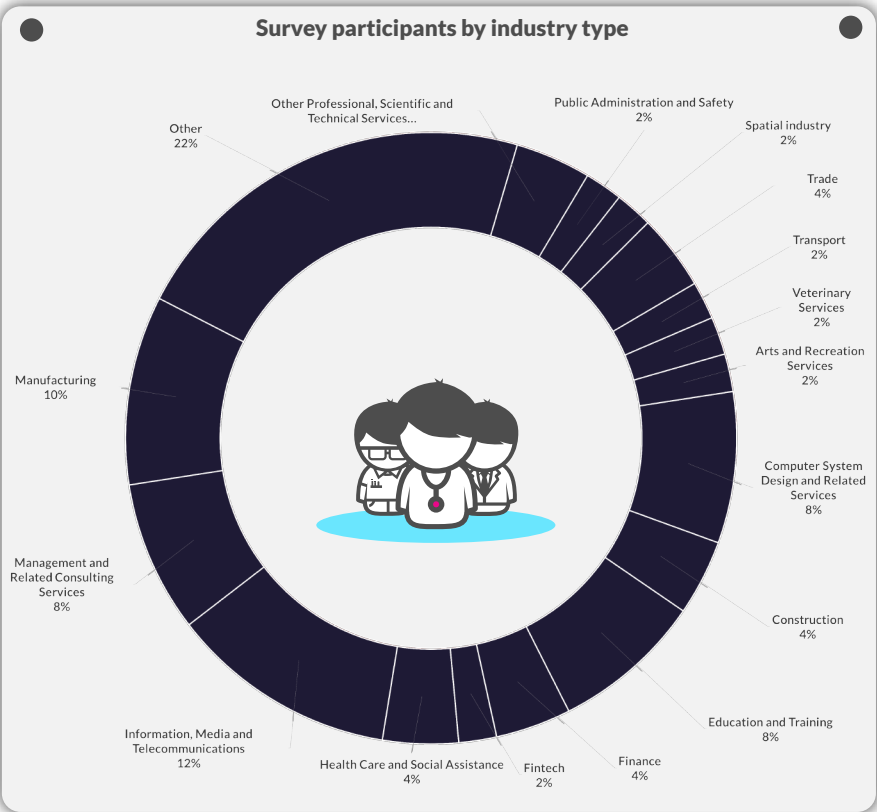


Figure 14: Survey participants by industry type

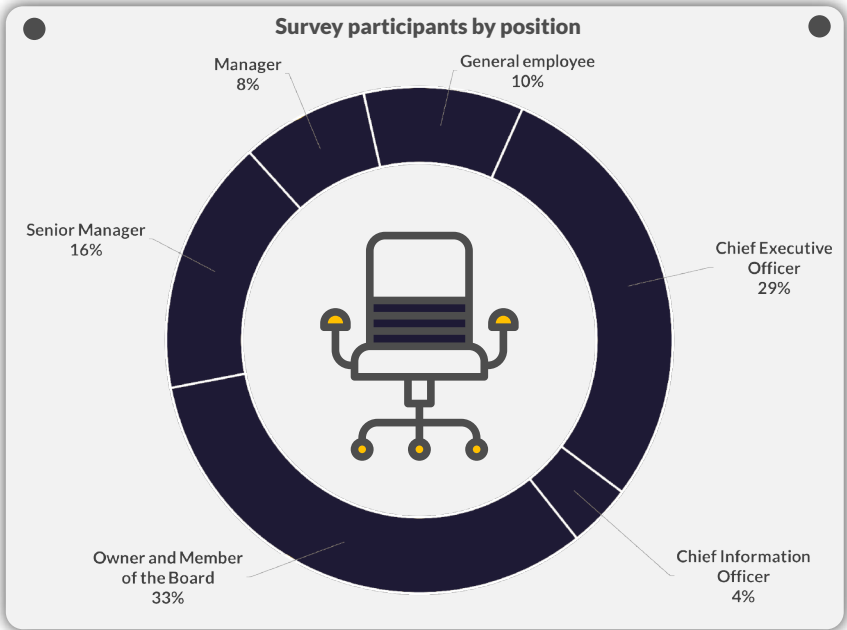


Figure 15: Survey participants by position

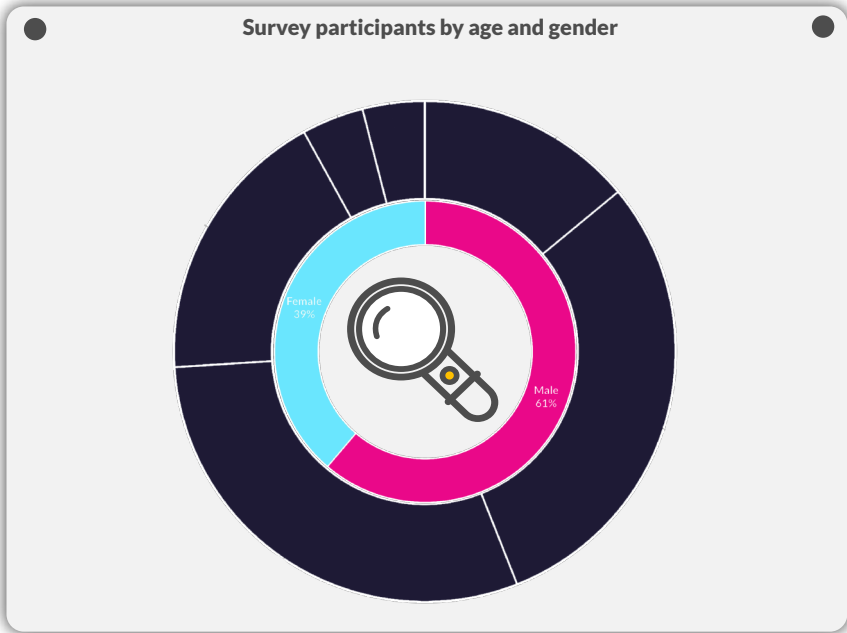


Figure 16: Survey participants by age and gender

Business profile

Survey respondents were also asked questions relating to business age, size and performance. The results are presented in Figures 17 – 19. Figure 17 shows that more than 75% of the businesses represent an age equal to or less than 10 years. Figure 18 shows that about 70% of them represent small businesses (employing fewer than 20 employees).

The businesses indicated their level of performance with about 68% performing 'much better' and 'better', with 13% 'about the same' and 11% worse compared to other businesses in the industry as shown in Figure 19.

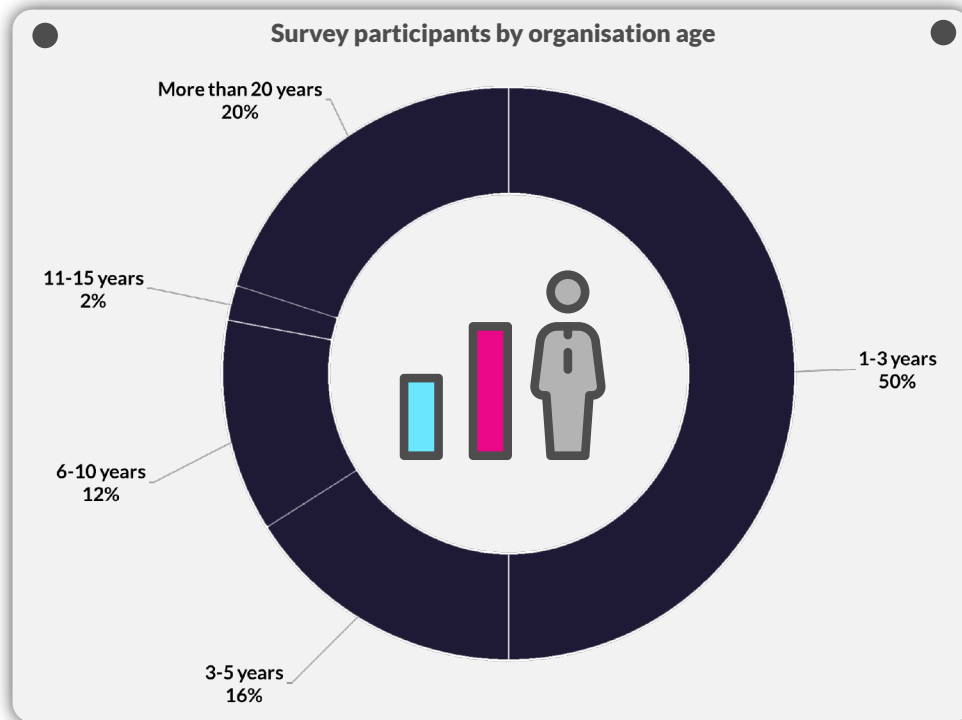


Figure 17: Survey participants by organization age

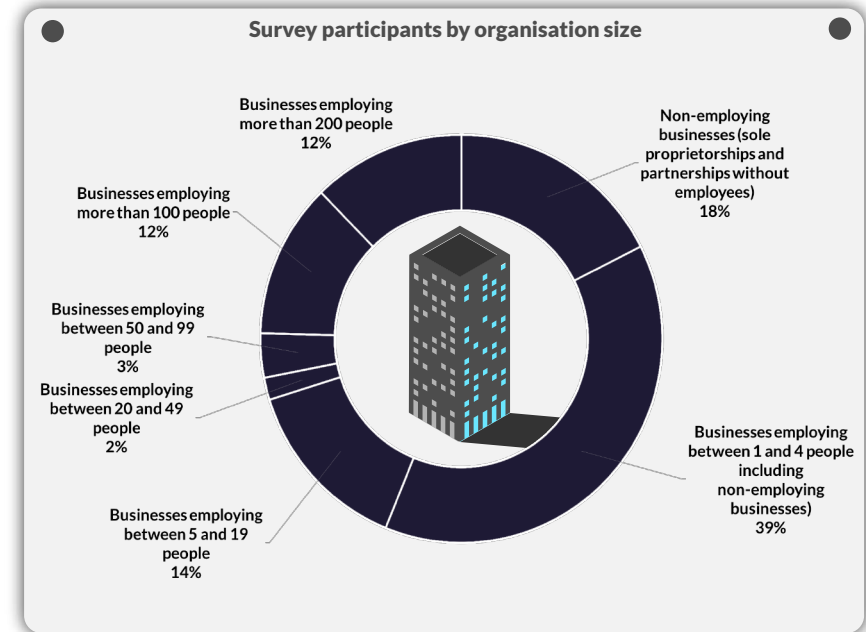


Figure 18: Survey participants by organization size

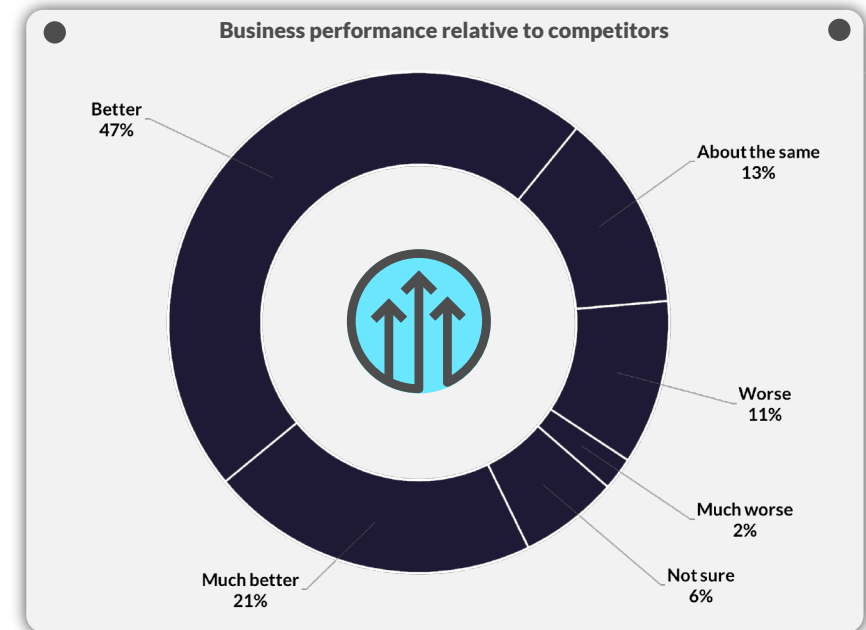


Figure 19: Business performance relative to competitors

TECHNOLOGY DEFINITIONS

Appendix A

3D printing

3D printing is the process of creating physical objects from digital 3D drawings or models by printing thin layers of material in succession. This allows for the creation of unique and sophisticated products without the need for complex equipment. Although 3D printing technology has been in existence for around 30 years, it is becoming cheaper and faster over time, leading to more widespread use and increased applications.

Adaptive security

Adaptive security is a flexible approach to safeguarding systems data whereby security systems are able to recognize threat-related behaviours as opposed to specific files and codes used by viruses [23]. This essentially provides companies with increased ability to manage risk by adapting and responding to a complex and constantly changing environment.

Artificial Intelligence and automated machine learning

Artificial intelligence gives machines and systems the ability to acquire and apply the knowledge needed to carry out tasks that normally require human intelligence. These abilities can include visual perception, speech recognition, reasoning, decision-making and the ability to move and manipulate objects [24]. Automated machine learning gives machines the capacity to adapt and change behaviour to overcome inefficiencies [25].

Augmented reality

Augmented reality is technology that superimposes computer-generated information on a user's view of the real world – providing integration of the physical and digital worlds [26].

Blockchain

Blockchain is a digital ledger that allows transfer of value within

computer networks without the need of a third-party intermediary [27].

Business intelligence

Business intelligence refers to technology applications and practices for collection, integration, analysis and presentation of business information – to support better business decision-making. Business intelligence technologies allow executives to easily interpret big data to make strategic decisions to exploit business opportunities.

Cloud based solution

‘The cloud’ is a metaphor for ‘the Internet’ in Internet based computing. Cloud based solutions allow businesses to access different services such as servers, storage and applications through the Internet.

Digital engineering

Digital engineering (also called Building Information Modelling (BIM)) is the process of designing buildings and structures collaboratively using a system of computer models as opposed to independent sets of drawings [28].

Energy storage

Energy storage systems absorb and release energy on demand to supply energy or power services. This can optimise the performance of existing energy systems and facilitate integration of renewable energy resources [24].

GIS technology

Geographic Information Systems (GIS) are computer systems that capture, store, check and display data related to positions on the Earth’s surface. GIS enables people to more easily see, analyze and understand patterns and relationships [29].

High-speed wireless

High-speed wireless is technology that provides high-speed Internet without wires or cables.

Internet of Things (IoT)

The Internet of Things refers to a web of sensors, devices and objects connected via the Internet [24]. The IoT will allow for more efficient allocation of resources and automation with sensors being introduced in homes, clothes, accessories, cities, transport, energy networks and manufacturing processes [27].

Intelligent apps

Intelligent apps use machine learning technology to analyze historical and real-time data to make predictions and decisions for users [30].

Intelligent Things (Robots)

A robot is a machine capable of carrying out a complex series of actions automatically. Advanced robotics is already being deployed in many fields. It is expected that robots will disrupt the labour markets as a whole in the near future.

Open data

Open data is the concept that public information should be available to be freely used, re-used and redistributed by anyone for any purpose [31].

Perovskite solar cells

Perovskite solar cells are a type of solar cell that include the perovskite structure compound as the light-harvesting active layer. These cells typically achieve higher efficiencies than other kinds of solar cells. Although perovskite solar cells only began to emerge in 2012, they are rapidly becoming cheaper to produce and more simple to manufacture [32].

Virtual reality

Virtual reality refers to computer-generated simulations of 3D images or environments that can be interacted with in a seemingly physical way through the use of specialized electronic equipment [33].

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