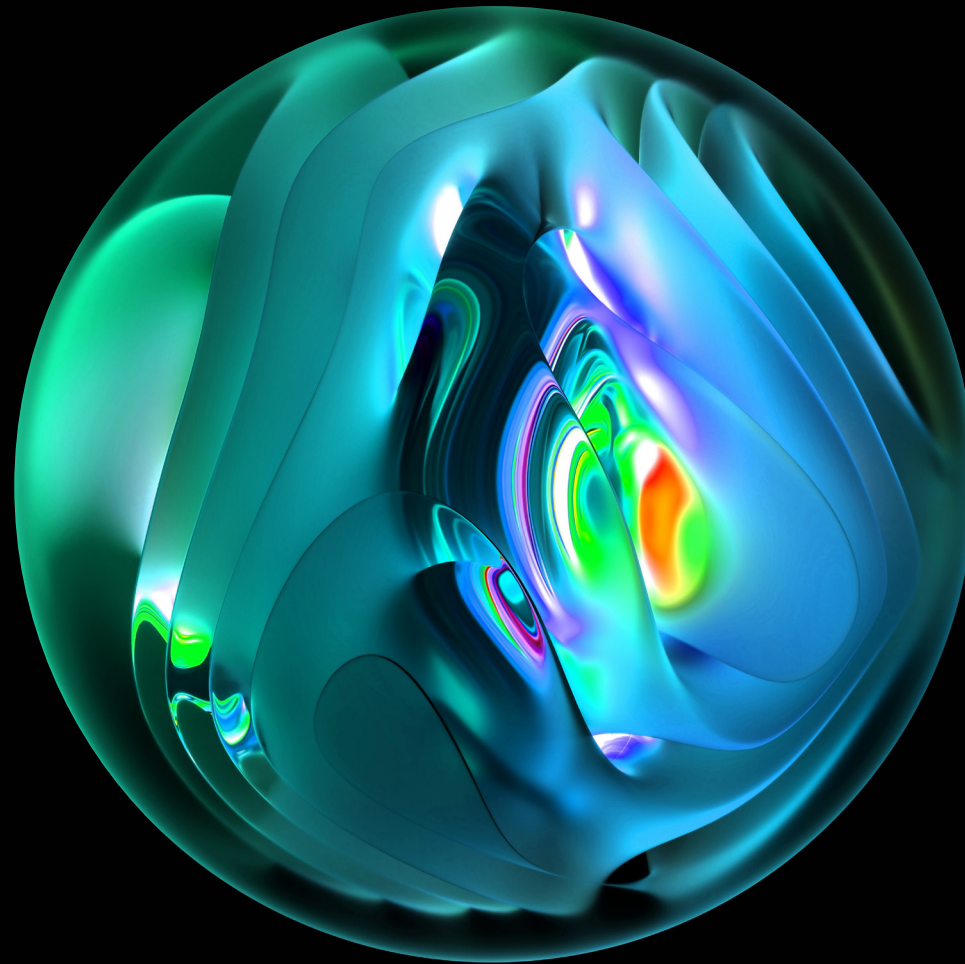# Deloitte.

Australia's Digital Pulse

A new approach to building technology skills

Queensland edition

Deloitte
Access Economics

Powering Australia's technology brilliance.

ACS is the professional association and largest community for Australia's technology professionals, with more than 47,000 members across business, government and education.

As the trusted leader in the tech sector, we work to accelerate the growth of diverse and highly skilled technology professionals, equipping them with the right skills and knowledge to power Australia. Now and in the future.

We deliver value for our members, businesses and society in four ways.

Community

We foster an innovative and inclusive community that is dedicated to powering positive change through technology.

47,000+
Total members

12,000
Event attendees a year

Career

We create career pathways to guide technology professionals and ensure Australia has a pipeline of talent with the right skills and knowledge.

46
Accredited universities

368
ACS Google Scholarships

Capability

We set the standard for assessing, developing and recognising the skills and experience of technology professionals.

11,128+
Learning Accelerator unique users

44,000
Digital resources

Migration

We assess and support skilled technology migrants to address critical skills shortages, improve diversity and enrich Australia's workforce.

40,200
Skilled migrant applicants in 2022–23

7,107
ACS Professional Year graduates in 2022–23

ACS Australia's Digital Pulse 2023
Queensland edition

Queensland has Australia's third largest digital economy. The rapid pace of developments in technologies such as AI, robotics and advanced data analytics are expected to have a profound impact across the entire Queensland economy. Critical technologies will affect 2.7 million workers and require 225,000 critical technology skills by 2030.

Queensland faces a growing digital divide between its regions. Critical technology threatens to widen this divide, with outdated digital skills already cost Queensland large businesses $505 million per year. However, with the right framework in place, it would be able to improve digital inclusion of regional populations to create long-term productivity increases, jobs and economic growth.

Key principles of the new approach

All hands on deck	Skills first	Driving diversity	Lifecycle of learning	Systems approach

$33 billion
Projected annual technology investment in Queensland in 2030

2.7 million
Queensland workers who will need some reskilling because new tech will affect at least 20% of work time

9,500
New technology workers needed each year

225,000
critical tech skills needed in Queensland by 2030

$505 million
Cost of outdated digital skills for large Queensland businesses each year

Queensland's technology workforce is picking up steam

The growth of Queensland's tech workforce is accelerating

Queensland's technology sector has grown rapidly, with the number of technology workers increasing 21% to 139,100 in 2022. Part of this increase may be a result of an increase in interstate migration following COVID-19 and additional investment in the tech sector following the shift towards more online work.[3]

ICT is important for Queensland with the sector contributing $14.3 billion in value added to the Queensland economy in FY22 and 13,000 ICT businesses headquarters in the state.[1,2] Investment in technology in Queensland now makes up 17% of national tech investment.

The importance of digital technology extends across the whole economy. For example, research from Deloitte's *Generation AI: Ready* or not found that the five industries which will experience imminent and extensive disruption from Generative AI – professional services, financial and insurance services, information, media and telecommunications, education and wholesale trade – account for 23% of the Queensland economy.[2]

The impact of Generative AI and other digital technologies will only increase as investment in technology. Forecasts from the International Data Corporation (IDC) indicate that technology investment in Queensland will increase from $23 billion in 2022 to $33 billion by 2030.

The Queensland Government recognises the important role of digital technology in supporting the creation of high skilled roles and achieving economic and social objectives.

The Queensland Government has committed to an investment of over $1.7 billon in *Advance Queensland – Innovation for a Future Economy 2022-32 Roadmap* to increase productivity, knowledge and digital uptake. This program has already supported 28,000 jobs with 40% being in regional areas.[4]

Embracing the potential of digital technology is beneficial for government. The Queensland Government is already trialling generative AI tools to improve the productivity of government service delivery and for education in schools.[5,6] Advanced data analytics will be crucial to meeting key policy objectives of emissions reduction, land use and housing. The Queensland Future Climate Dashboard is an example of this with 11 state-of-the-art climate models summarised to provide simulations of climate scenarios at a granular scale across Queensland.[7]

To realise the benefits of technology for economic and social outcomes will require Queensland to overcome challenges with digital infrastructure. The *Regional Strengths and Infrastructure Gaps* report highlights a lack of internet access as the second largest impediment in regional development for Queensland.[8]

Addressing these issues facing will help unlock the potential of digital technologies for the Queensland economy and the associated social benefits.

Critical tech will help enable the Brisbane Olympics

The hosting of the Brisbane 2032 Olympics will be one of the most a marquee event for the state in terms of size and global standing. Initial estimates suggest the economic and social benefits of hosting the Olympics will be in the magnitude of $8 billion and 91,600 job over the next 20 years.[9]

Hosting of the Olympics involves significant investment in infrastructure and an uplift in the use of digital technology. For instance, the 2020 Tokyo Olympics saw the use of over 1,800 drones in the opening ceremony, the use of wearable sensors for athletes to measure health and performance and AI-backed cameras being used to streamline viewing experiences.[10] For the Brisbane 2032 Olympics, there is expected to be similar uplift of smart infrastructure across the city to manage international and domestic visitors and deliver quality experiences for global audiences. This will include sensors and data technology embedded in 32 existing and planned Olympic venues across the city, a range of smart sensors used throughout the city and one speculative proposal to introduce aerial taxis to fly passengers with remote supervision.[11]

The economic uplift and increase in digital infrastructure will require the digital skills to design, build and operate the infrastructure and devices in the lead up and during the games. With the Games 8 years away, the development of these skills will be an important part of the preparations for the Games.

A tech perspective

"We have witnessed a massive surge of interest and investment in generative AI from business leaders – and the excitement has not abated.

For Queensland businesses looking to convert excitement into dividends requires experimentation with use cases specific to the business needs and scaling up what works. Importantly, some of the most innovative ideas may come from workers who are digital natives – who we call Generation AI."

Kellie Nuttall
Lead Partner, AI Institute Leader
and Strategy and Business Design
Deloitte Australia

Critical technology will significantly impact the work of 95% of the Queensland workforce

Over 2.7 million workers across Queensland will be substantially impacted by critical technology

To begin preparing for the incoming disruption, the Australian Government has developed the *List of Critical Technologies in the National Interest*. The latest edition of *ACS Australia's Digital Pulse* analyses the impact of eight key technologies from this list including AI, additive manufacturing, advanced data analytics, advanced robotics and sensors, additive manufacturing, cyber security, enabling cloud technology, Internet of Things (IoT) and virtual worlds.[1]

To assess the skills needs for these critical technologies, Deloitte Access Economics has analysed a 2,136-task taxonomy of 229 Australian occupations from the National Skills Commission (NSC) and academic research on the impact of these technologies on tasks to understand the potential impact of the critical technologies for the Australia workforce.

This analysis shows that almost all of Queensland workers (95%) are expected to have at least 20% of their work time affected by critical technologies over the coming years. In total, 73% of all working hours across Queensland will be affected.

Advanced data analytics and AI technologies will have the largest workforce impact, each affecting the work time of almost two-in-three workers. In total, these technologies will affect 27% and 23% of all working hours in Queensland, respectively.

Queensland's workforce will be more affected by advanced robotics and sensors, and Internet of Things than most other states and territories. The significant mining and manufacturing industries in Queensland, which will be heavy users of these technologies, contribute to this exposure.
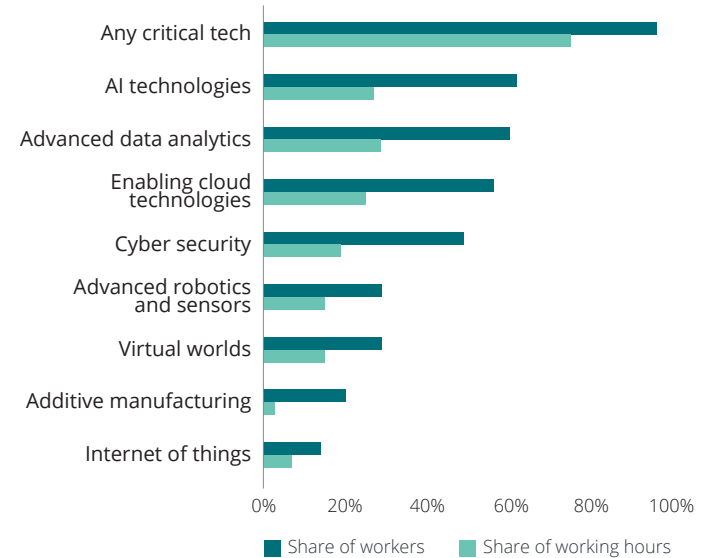
While a broad range of workers will be impacted by critical technology, some jobs face greater changes in skills than others.

Of all the occupations impacted by critical tech, technology workers are among the most impacted accounting for eight out of the top twenty impacted occupations. For Queensland with one of the largest technology workforces in the country, this means thinking strategically about how to skills these workers.

Occupations outside of technology workers will also be impacted. Sales assistants, registered nurses and teachers will all have more than 60% of their work time impacted. While these roles all have some tasks that are less likely to be impacted, administrative and cognitive tasks within these occupations are likely to be made more productive or change entirely.

Manual labour-intensive occupations such as those in hospitality and construction are expected to be less impacted by critical technology relative to other industries. Yet every industries is being transformed by these technologies and strategies to upskill workers in these areas will be important.

Proportion of Queensland workers and work hours affected by critical technology

Legend: ■ Share of workers ■ Share of working hours

Categories (top to bottom): Any critical tech, AI technologies, Advanced data analytics, Enabling cloud technologies, Cyber security, Advanced robotics and sensors, Virtual worlds, Additive manufacturing, Internet of things

Knowledge industries, services and priority industries will have more than 80% of work time impacted

Eleven Queensland industries will all have at least 80% of their work time affected by critical technology

A broad range of industries are expected to be affected by critical technology including knowledge industries like financial and professional services, other service-based industries like retail trade and a number of priority industries such as utilities, mining and construction. Collectively, the top ten impacted industries account for 61% of Queensland economy in 2022.[1]

The highly codified information within existing digital infrastructure alongside the highly skilled workforce means that knowledge industries like financial and professional services are likely to experience significant impacts from future waves of critical technologies like data analytics and AI.[1, 2]

Queensland is a leader in AgTech with the global market set to triple in value to $45 billion by 2026.[3] With the Queensland agribusiness sector employing 363,000 people across the supply chain, AgTech provides an enormous opportunity to improve regional digital adoption and innovation but will also require workers to adapt to change and acquire new skills.

Queensland's mining sector, which accounts for almost a fifth of the state's economy, will also be significantly affected. However, other research that compares the data infrastructure of various industries found relatively lower capabilities in the mining sector compared to other industries.[5]

The mining sector recognises that building a technologically skilled workforce is essential for its ongoing success.
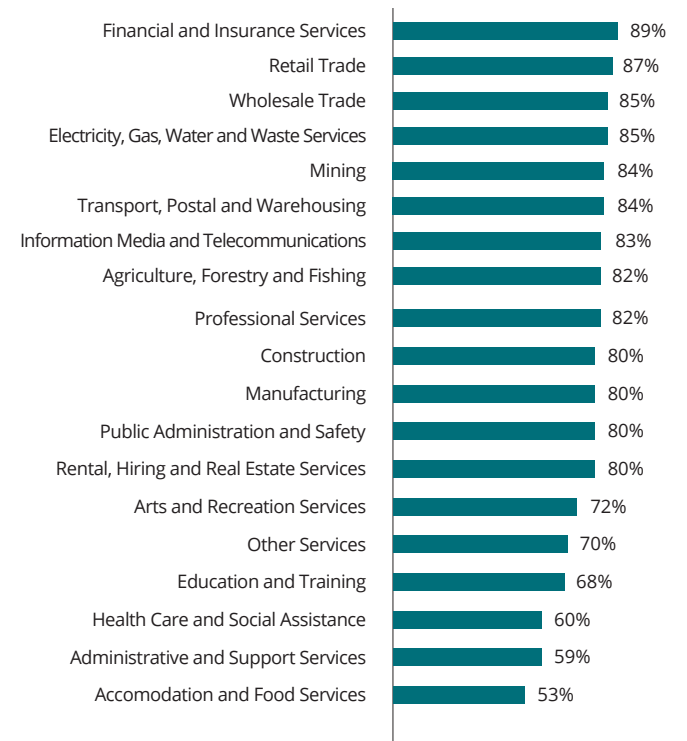
Initiatives such as the Queensland Future Skills (QFS) Partnership are targeted at supporting workers gain skills in new technologies within the resources sector. The QFS has a specific focus on building autonomous mining technology related skills and was recognised as the winner of the Premier's Industry Collaboration Award at the Queensland Training Awards.[6,7]

Getting the skill settings right in priority industries such as mining is essential to take advantage of productivity improving innovations. For example, AI is being increasing being used for asset optimisation, 3D imaging to improve the efficiency of exploration efforts, and advance sensors to sort waste and maximise mineral recovery.[8] Critical technologies are also improving safety in mine with wearable tech monitoring worker's health in real-time and augmented reality technologies delivering schematics to workers through interactive 3D holograms, guiding people through complicated tasks.[9]

Industries with a larger share of the workforce in people and care orientated roles such as nursing, bar attendant and café workers will be relatively less affected than the industries described above. This includes industries such as accommodation and food services, and health care. However, the impact across these industries is still substantial with more than half of all work hours in the least affected industry expected to be affected by critical technology.

With the impacts of critical technology being felt across all industries, competition for workers with critical technology skills will likely be signficant. A focus on upskilling the existing workers in industry specific applications will therefore be key.

Affected work hours by industry, Queensland

Industry	%
Financial and Insurance Services	89%
Retail Trade	87%
Wholesale Trade	85%
Electricity, Gas, Water and Waste Services	85%
Mining	84%
Transport, Postal and Warehousing	84%
Information Media and Telecommunications	83%
Agriculture, Forestry and Fishing	82%
Professional Services	82%
Construction	80%
Manufacturing	80%
Public Administration and Safety	80%
Rental, Hiring and Real Estate Services	80%
Arts and Recreation Services	72%
Other Services	70%
Education and Training	68%
Health Care and Social Assistance	60%
Administrative and Support Services	59%
Accomodation and Food Services	53%

Source: Deloitte Access Economics analysis of ABS Census (2023)

The tech skills challenge for Queensland

Queensland will require an additional 159,000 critical technology skill by 2030

The number and type of skills needed for the technology workforce in 2030 will look vastly different to those in use today. In total, 225,000 skills will be required for critical technologies by 2030, an increase of 159,000 compared to current skills within the Queensland workforce.

Among the largest increases in skills demanded will be for those people skills needed by most workers including communication and team teamwork skills. Cloud solutions, software development, and databases and programming skills are the most common technical skills that will be needed in Queensland.

The current need for digital skills is not being met. Previous Deloitte Access Economics research suggests that three in five businesses lack the digital skills they require to do business.[1] These out-of-date digital skills come at a cost with $505 million per year in lost output among large Queensland businesses alone.[2] This estimate only reflects costs associated with existing employees, with the full opportunity from digital technology likely to be much larger.

With seismic developments occurring in technology, the potential for rapid change in the skills required across the Queensland workforce means the gap in digital skills is likely to grow without significant action. To ensure that Queensland's technology skills challenge is met, barriers facing the labour market need to be addressed.

Queensland's tech workforce is geographically dispersed with 48% working outside the greater Brisbane area.[1] Ensuring critical tech jobs are available across the state is essential for businesses to access the most skilled workers. Achieving this requires sufficient tech infrastructure in regional areas, innovative businesses to be supported and regions playing to their comparative advantage.

The **lack of diversity** in tech not only holds back key talent but severely limits the ability to meet our skill needs. Only 29% of people working in technology occupations in Queensland are women, which is substantially lower than in comparable industries such as professional services (47%).[3] Queensland also has **one of the lowest share of women enrolled in IT university courses (24%) nationally,** meaning the gender gap in the Queensland technology workers and skills is likely to persist.[4]

Decreasing student completions of IT degrees in Queensland in 2021 signals an **increasing lack of interest in tech among younger generations.[5]** This could lead to future generations lacking critical skills needed to build a successful career.

Not only will Queensland need more workers with technology skills, but it will also need workers with a variety of new or emerging technology skills. Skills to work with AI will be some of the most sort after with 216,000 additional AI skills needed by 2030. These include technical skills such as data science, machine learning and deep learning (see page 9).

Additional skills needed by critical technology workers by 2030, Queensland

Skill	Value
Communication skills	14,626
Cloud solutions	14,512
Teamwork/collaboration	12,430
Problem solving	10,185
Software development principles	9,753
Databases and programming	8,941
Scripting languages	8,890
Data science	8,464
Data analysis	7,007
Planning	6,453
Machine learning	6,374
System design and implementation	5,242
Data warehousing	5,005
Research	4,376
Technical support	4,173

People skills ■ Technical skills

Source: Deloitte Access Economics analysis of ABS Census (2023)

2030 skills for Artificial Intelligence, Machine Learning and Natural Language Processing
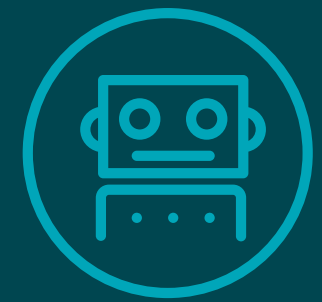
One of biggest areas of additional skill requirements will come from AI, Natural Language Processing (NLP), and Machine Learning (ML). Annual business investment across Australia in these areas is forecast to jump from less than $5 billion in 2022 to over $27 billion by 2030. Business use of these technologies across Australia will grow from less than 1% in 2022 to almost two-thirds by 2030.

What skills will tech workers need for this enormous change?

Already, we know that the essential technical skills include: Data Science Principles, Data Analytical Thinking, Programming, Scripting Languages, Machine Learning, and Software Development Principles. Workers will also need soft skills such as planning, research, problem-solving, effective communication, collaboration, and teamwork.

How many extra professionals and how much more skilling will be needed in Queensland?

The number of Queensland tech workers focusing on AI, ML and NPL is expected to grow from just 1,600 in 2022 to 14,000 by 2030.

The total skill requirement in Queensland to support just the core tech workforce is projected to grow 793% from 6,781 in 2022 to 60,551 in 2030. The gap between skills now and in the future is a staggering 53,770 technical and soft skills.

The introduction of these new technologies will also give rise to new job roles, including positions such as AI Ethicist, AI personality designers, algorithm bias auditors, information validators, and AI regulatory roles.

Skills sets demanded for AI, NLP, and ML by 2030

Data science
8,464+

Machine learning
6,348+

Data analysis
3,112+

Scripting languages
5,974+

Data warehousing
2,863+

Databases & programming
3,485+

Software development principles
4,356+

12k Skilled workers needed (2030)

54k Skills gap (2030)

+793% Growth in skilled workers (2022–2030)

People skills

Teamwork/collaboration	4,232+
Communication skills	4,232+
Problem Solving	3,236+
Research	2,738+
Planning	1,867+

Extra skills identified

- Ethical & responsible use of AI
- Critical thinking
- Linear Algebra and Calculus
- Machine Learning
- Deep Learning

Source: Deloitte Access Economics analysis based on Lightcast (2023) & IDC (2023)

Queensland will need to skill at least 9,500 technology workers per year for Australia to keep up with international peers

Queensland needs to skill at least 9,500 technology workers per year but is only expected to educate 3,400 annually

Based on currently available data, Australia will need to spend an additional $92 billion through to 2030 on critical technologies to be at the forefront of forthcoming disruption. Based on forecast technology investment, this would amount to an additional $16 billion of critical technology spend in Queensland by 2030.

Queensland's technology workforce has grown to meet the needs of businesses and the economy. The number of technology workers has grown by over 40,000 in the 8 years since the first edition of Australia's Digital Pulse was published.

While 139,000 people were employed in the Queensland technology workforce in 2022, our forecasts suggest an additional 67,000 workers will be required be 2030. That's 9,500 annually. Despite this, Queensland is only expected to formally educate around 3,400 workers per year over this period (27,000 in total by 2030).

The number of workers in Australia's technology workforce grows and shrinks based on a number of drivers. These include:

- Retirements capturing those workers expected to leave the labour force through to 2030
- Migration accounting for permanent and temporary workers in the sector

- Education accounting for domestic and international students who work in the tech sector after completing their studies
- Net reskillers accounting for workers coming and going from technology occupations.

Projecting the supply of workers from each of these sources between 2022 and 2030 (chart below) suggests Queensland technology sectors expected to reskill an additional 20,000 workers but will need to reach 26,000 to match business-as-usual demand by 2030. This rises to 31,000 workers if Australia was to match levels of spending on critical technology in the USA (proportionate to GDP).

Projected source of technology workers, 2022-2030
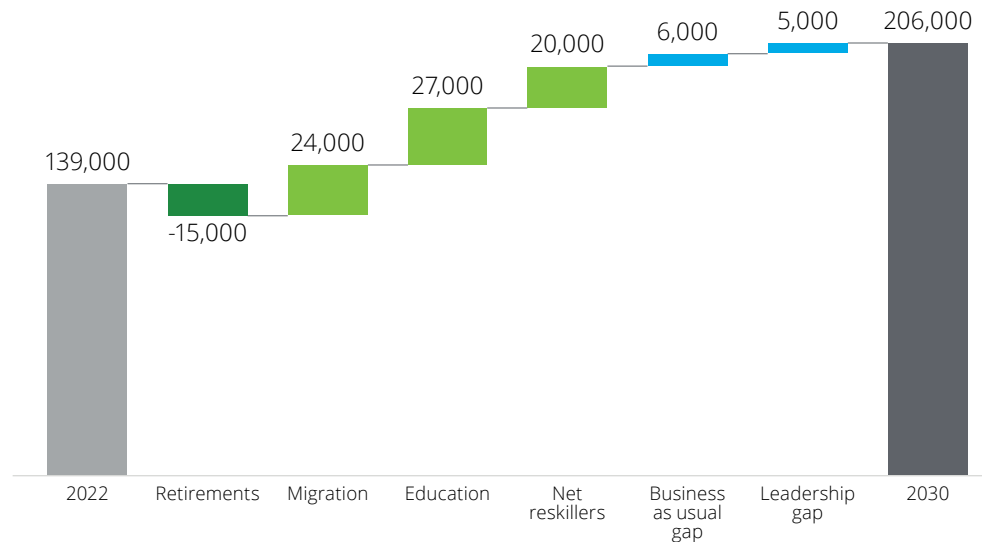
Source: Deloitte Access Economics (2023)

Tech workers expect critical technology to significantly disrupt the workforce over the coming years

Almost two-thirds of Queensland technology workers agree critical tech will significantly disrupt the technology sector

Like their peers across Australia, tech workers in Queensland see the extent of potential disruption in the sector. Most do not think they are ready for the coming change. Less than half (49%) of current technology workers surveyed believe their formal education has equipped them with the skills they need for critical technology.[1]

As well as adapting to change, there is also underutilisation of technology workers who are currently employed. This means not getting the finding the best jobs for workers and adding to the likelihood they leave the profession.

Better utilising tech workers in Queensland includes ensuring workers have meaningful work for their skills. Based on a technology workforce survey completed for this report, a quarter of technology workers do not agree that their skills are being fully utilised. Workers think that they could be given more technical tasks (48%), have their capabilities and contributions recognised (45%), and given more management opportunities (41%).[2]

Many Queensland tech workers (38%) also want to work more hours. While systemic barriers such as caring for children or other personal responsibilities are key barriers for these workers, a lack of full-time opportunities is a barrier for almost one in five workers. Addressing workers being stuck in a part-time role that underutilises their time and skills represents a key opportunity for meeting the needs of the future workforce.

Two in five Queensland tech workers are planning on leaving the sector in the next five years.

This level of planned exits from the sector highlights the need address the challenges that workers in the sector face. The top reasons for workers wanting to leave the tech sector in Queensland is wanting to do something different (32%).[3] However, Queensland tech workers are more likely to want to leave the sector for better pay (30%) and due to a lack of workplace flexibility (26%) compared to Australia at large.[4]

While workers leave technology roles, workers also reskill into the sector. The leading reasons for workers in Queensland reskilling into the tech sector include better pay (50%), opportunities for leaning and development (40%) and a personal interest in technology (33%).[5] Compared to Australian technology workers generally, salary is a more prevalent reason for entering the technology workforce in Queensland.

For workers who reskilled into the technology workforce, formal and self-directed training was an important part of the process. Across the technology workforce more than half (52%) of workers reported upskilling by learning through channels such as reading articles and watching video while 41% undertook some mandatory employer provided training.[5]

Agreement that critical technology will significantly disrupt the technology sector

4%	11%	22%	49%	16%

Strongly disagree · Disagree · Neutral · Agree · Strongly agree
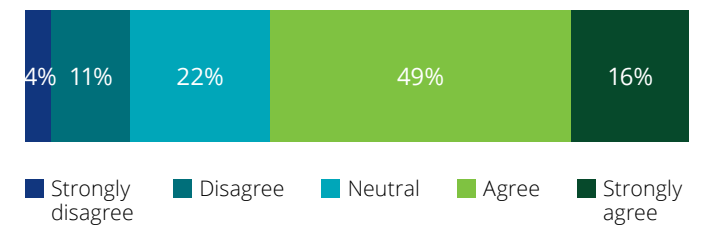
Source: Technology workforce survey (2023)

Reasons reskillers move into a technology role in Queensland

Source: Technology workforce survey (2023)

A professional association perspective

"Queensland faces two long-term technology challenges, and they are not unrelated. Firstly we need more people with the required skill needs in critical technologies. The second is to ensure all Queenslanders are encouraged to build these skills and enjoy the benefits of digital technologies.

The larger and more diverse the technology workforce, the more likely we can achieve the required growth in technology skills. "

Josh Griggs
Interim CEO
Australian Computer Society

Closing the digital divide

Digital inclusion and infrastructure is required to close the gap

Queensland is one of the largest digital economies in Australia. However, due to the geographic dispersion of Queensland's population, digitally connecting the state is a challenge. With almost half the Queensland workforce working outside the Greater Brisbane region, a lack of high-quality digital infrastructure represents a barriers to regional economic development and growth.[1]

More limited access to digital technology in Queensland's regions creates a digital divide and disadvantages regional communities. It contributes to lower levels of digital literacy and exposure to technology, leading to gaps in the opportunities and capabilities of individuals and businesses.

The Queensland government is focusing its key technology initiatives towards closing this digital divide. The **$200m *Our Thriving Digital Future: 2023-26 Action Plan*** underpins the medium-term strategy with the key target of promoting access and literacy for a digitally enabled economy as well as digital inclusion and security.[2]

More broadly, $1.7 billion has also been committed to the ***Advance Queensland – Innovation for a Future Economy 2022-32 Roadmap*** to increase productivity and skills throughout the broader economy.[3] The program has already provided support to over 26,000 businesses throughout Queensland with a deliberate effort to build regional economic strength, particularly in digital literacy and technology uptake in businesses.

Critical technology risks widening the divide if action is not taken. Over 20% of regional local government areas fell behind the state average by over 15 points in the 2022 Australian Digital Inclusion Index.[4] Without improving digital inclusion, the growth of critical tech risks creating further barriers to entry as technology skills become more important. Further, the threat of automation and generative AI replacing jobs may increase skill shortages if digital literacy is not improved.

Addressing the digital divide will be important as the impact of critical technologies is not limited to city boundaries. Both Greater Brisbane and areas outside of Greater Brisbane have over 70% of working hours affected by critical technologies.

The Queensland Government is currently taking direct action to tackle a lack of access to reliable internet and physical technology in regional areas. The Queensland Regional Precincts and Places Infrastructure Technology Program will create hubs to provide learning and improve digital inclusion through better access to physical technology. Increasing reliability of the network and access to tech across the expanse of Queensland will be crucial in allowing the digital divide to close.[8] Further the Strengthening Telecommunications Against Natural Disasters program is aimed at increasing robustness of networks through collaborating with NBN to provide emergency facilities for use during natural disasters.[9]

Leveraging industries where Queensland has a comparative advantage, particularly in regional areas, is crucial to enabling opportunities across the state. Some initiatives have been established to build in these areas such as the Open Data Strategy from the Office of the Information Commissioner and the $5 million QLD AI Hub to develop expertise in AI, robotics and data amongst Queensland firms.[6,7] Queensland's Department of Environment and Science research into Quantum technology has created a job pipeline for science graduates, bringing together resources state-wide for over 30 years.[5]

Affected worktime across Queensland

Rest of Queensland
72% of working hours

Greater Brisbane
74% of working hours

How can Queensland lead change?

More needs to be done for Queensland to develop the technology skills needed to meet the demands of business and the economy. *The Advance Queensland – Innovation for a Future Economy 2022-32 Roadmap and the Our Thriving Digital Future – Queensland's Digital Economy Strategy* both identify six priority outcomes to further grow the digital economy in the state.[1,2]

Underlying the Digital Economy Strategy is the Action Plan 2023-26 that has 74 underlying initiatives to support the realisation of the priority outcomes.

The recently centralised Digital Economy office set up by the Queensland government in 2023 provides a basis to organise coordinated action alongside other relevant areas of Government and private sector organisations and employers.

Addressing the skills issue will require a new approach to building tech skills in Australia and Queensland. This year's Australia's Digital Pulse outlines five key principles needed to guide individual policies and initiatives. These principles are equally as relevant to QLD and below are some examples about how these principles should be applied within the QLD context.

Using these as our foundation, we have identified four high priority recommendations for QLD to kick start this new approach.

These recommendations align with multiple principles listed below and illustrate how solutions should and can bring about transformative change. The four recommendations are detailed in subsequent pages of this report.

01
All hands on deck

We need all actors across both private and public sectors to play a role in addressing the skills challenge in QLD. Combining effort to produce transformational change will be required.

In QLD this coordinating role may be played by the Digital Economy office to develop a skills strategy in collaboration with education providers and major tech employers to outline how skills can be developed.

02
Skills first

We have designed our education system to focus on people being ready for roles they could remain in for their entire career with limited reskilling or upskilling. We need to first and foremost identify and build in-demand skills based on critical technologies shaping the QLD economy and society.

03
Driving diversity

Excluding or not fully utilising existing talent is not only wrong but imposes significant costs on the QLD economy.

Queensland's technology workforce has low representation of women compared to other industries while the digital divide hinders people in regional communities to participate in the tech workforce. Helping these cohorts build skills is critical to realising the benefits of a digital economy.

04
Lifecycle of learning

Building a culture of continual skills development is necessary in the face of a declining half-life of skills. In addition, the skill needs of the QLD workforce will change in unforeseeable ways as technologies interact, highlighting the need for continuous learning. For example, quantum computing may require a large increase in coding skills while Generative AI may streamline the need for in-depth knowledge of coding specific knowledge.

05
Systems approach

Too often we are working on solving the same problem in silos. Combining our efforts and thinking holistically about our networks, organisations and institutions is necessary to maximise the impact of our initiatives.

Turning the principles of the new approach into practice in QLD

Coordinating action and evaluating success in building tech skills

The *Our Thriving Digital Future – 2023-26 Action Plan* has 74 initiatives designed to support the realisation of the six priority outcomes identified in the *Queensland Digital Economy Strategy*. For example, one outcome is to significantly reduce the urban-rural digital divide. These 74 initiatives provide a detailed plan of digital priorities for the state to pursue.

The Strategy also identifies lead organisations to drive the initiative forward, which will improve accountability while also identifying some required partners such as relevant education providers and major tech employers.

The recently established Digital Economy office provides a government agency that should support the relevant organisations in implementing the initiatives where barriers are encountered or there is a lack of motivation for change.

An annual evaluation of progress made against each of the 74 initiatives and the 6 priority outcome areas should be developed by the Digital Economy office to track system progress and identify any potential lessons for implementation would assist implementation. Lessons could also be drawn from actions and initiatives from other states and territories or at the national or international level. This should lead to revisions or updates to the action plan, so it becomes a living document.

At the end of this first action plan in 2026, specific quantitative targets should be included in the priority outcomes. Identifying these targets at the completion of the first action plan should provide tangible and achievable goals for improvement in the key metrics.

Bridging the digital divide in Queensland

The impact of critical technologies will impact the skills needs for workers across Queensland. With almost half the Queensland workforce working outside the Greater Brisbane region, a lack of high-quality digital infrastructure and relatively lower digital skills as suggested by the Australian Digital Inclusion Index represents a barriers to regional economic development.

The Queensland Government is currently taking action to tackle a lack of access to reliable internet and physical technology in regional areas. The *Queensland Regional Precincts and Places Infrastructure Technology Program* will create hubs to provide learning and improve digital inclusion through better access to physical technology. The *Our Thriving Digital Future – 2023-26 Action Plan* has seven specific initiatives to increase access to skills education for communities in regional areas.

Efforts to close the digital divide should specifically consider differences in digital infrastructure quality across the state, specifically in regional communities. Prioritisation of infrastructure upgrades in regional areas should consider quality of existing infrastructure and population impacted and potential economic uplift.

The initiatives developing skills in regional areas should consider where partnering with current tech employers could provide valuable industry workers who may provide career guidance for students, as suggested in the national edition of *ACS Australia's Digital Pulse.* Consideration should also be given to the impact of AI and the changing skills required for careers across the workforce.

Turning the principles of the new approach into practice in QLD

Focusing AI tech hubs on priority industries
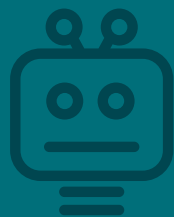
The application of critical technologies such as AI or big data analytics will be industry specific. For example, health professions can use AI to help tailor training programs for clinicians while the resource sector can use geospatial imagery and AI to identify areas with the greatest likelihood of containing accessible resources.

The Queensland Government has recognised the importance of AI for the Queensland economy and has committed $5 million to develop QLD AI Hubs to develop expertise in AI, robotics and data for businesses.

While this investment provides a starting point for encouraging adoption, the scale of these hubs should be increased after a pilot period and become more tailored for specific industries that are a priority for the state such as agriculture, mining, health care and tourism. These hubs should be accessible and promoted to businesses in a variety of locations and business sizes to have the largest impact on the broader industry.

By focusing on these specific industries, the hubs can provide more bespoke and relevant advice with the potential for businesses to learn about best practice or common issues across the industry when it comes to implementing AI solutions.

These AI hubs alongside other initiatives related to critical technology and the implications for industries should play a key role in the refresh of the 10-year Queensland Government Priority Industry Roadmaps that are being undertaken as part of the *Our Digital Future – 2023-26 Action Plan*.

Encouraging greater diversity in the start-up ecosystem

Start-up and scale-up businesses are a key component of a vibrant economy and a critical component of diffusing innovative products and business models through an economy. For this reason, supporting start-up and scale-up businesses could be a key way to lift the share of businesses using critical technologies identified in this report.

However, women entrepreneurs across Australia and Queensland face a range of barriers that prevent their participation in this vital component of the economy, such as difficulty accessing capital. For example, 76% of FY22 private start-up funding went solely to male founding teams and women are six time more likely than men to say their gender has impacted their ability to raise capital.

In Queensland, government programs like the Accelerating Female Founders Program and Backing Female Founders Program, provide support and finance to women entrepreneurs in the state. The continuation, development and scaling up of these programs will be important to enabling more women entrepreneurs to realise their potential.

Additional programs could also be tailored for women entrepreneurs that are looking to use or offer products and services involving critical technologies.

Greater efforts should also focus on the investor ecosystem (including institutional investors, venture capital and other personal investors) to consider current investment decision making and the potential to be influenced by unconscious bias that favours male entrepreneurs and proposal.

About this report

This report is a companion report to the ACS Australia's Digital Pulse written by Deloitte Access Economics for the ACS. As such, this report should be read in conjunction with the national *ACS Australia's Digital Pulse*, which can be viewed here.

This report, like the national report, focuses on eight critical technologies based on the Australian Government's *List of Critical Technologies in the National Interest* which identifies 63 key technologies within 7 fields that will have the greatest impact on Australia.

These critical technologies will profoundly impact the Queensland economy and labour market. This report has collated a variety of data sources to provide an analysis on the impact of these technologies on the Queensland tech workforce.

The research notes that while the technology workforce in Queensland has grown strongly, there are risks to achieving the required growth in skills and people.

The analysis in this report is informed by the following data sources:

- Forecasts from the International Data Corporation (IDC) on investment spending in Artificial Intelligence (AI), cyber security, cloud computing, Internet of Things (IoT), big data and analytics, and Virtual Worlds in Australia, Japan and USA

- Lightcast data based on 265,000 technology worker job advertisements in Australia and the required skills for each role, with data extending from 2021 to 2023

- Data from the Australian Bureau of Statistics, both publicly available and from a customised data request as well as other reports and statistics from Australian government sources.

A detailed methodology assumptions and caveats for the figures produced in this report and the national report are available in the appendix of the national report.

The analysis contained in this report around technology workforce has been calculated using ABS occupation and industry classifications, based on the methodology used in previous editions of Australia's Digital Pulse. This methodology draws upon definitions and nomenclature developed by Centre for Innovative Industries Economic Research (CIIER) lead researcher Ian Dennis FACS, and used in the ACS's 2008 to 2013 statistical compendiums and other CIIER analysis.

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Appendix A: Technology workforce skill impacts from critical technologies in Queensland

2030 skills for Advanced data analytics

One of biggest areas of additional skill requirements will come from Advanced data analytics. Annual business investment in Australia in these areas is forecast to jump from $8 billion in 2022 to $15 billion by 2030. Business use of these technologies will grow from less than 5% in 2022 to more than half by 2030 nationally.

What skills will tech workers need for this enormous change?

The essential technical skills needed for advanced data analytics workers include: Data analysis, Data techniques, Scripting languages, Big data, Databases and programming, and Data warehousing. Workers will also need soft skills such as planning, research, problem-solving, effective communication, collaboration, and teamwork.

How many extra professionals and how much more skilling will be needed in Queensland?

The number of Queensland tech workers with skills in advanced data analytics is expected to grow from 5,500 in 2022 to 15,200 by 2030.

The total skill requirement to support just the core tech workforce in Queensland is projected to grow 179% from 18,454 in 2022 to 51,469 in 2030. The gap between skills now and in the future is a sizable 33,015 technical and soft skills.

Skills sets demanded for cyber security by 2030

Cyber security
3,896+

Network configuration
2,824+

Cloud solutions
2,532+

General networking
2,630+

Information security
2,143+

Software development principles
2,532+

System design & implementation
2,240+

10k Skilled workers needed (2030)

33k Skills gap (2030)

+179 Growth in skilled workers (2022–2030)

People skills
Communication skills	3,409+
Teamwork/collaboration	2,824+
Problem Solving	2,532+
Planning	1,656+
Stakeholder management	1,558+

Extra skills identified
Linear Algebra and Calculus
Machine Learning
Critical thinking

2030 skills for cyber security

One of the most important areas of additional skill requirements will come from cyber security. Annual business investment in Australia in these areas is forecast to jump from slightly more than $9 billion in 2022 to $15 billion by 2030. Business use of these technologies across Australia will grow from less than 63% in 2022 to 78% by 2030.

What skills will tech workers need for this enormous change?

Already, we know that the essential technical skills include: Cyber security, System design and implementation, Information security, Network configuration, Cloud solutions and Software development principles. Workers will also need soft skills such as planning, stakeholder management, problem-solving, effective communication, collaboration, and teamwork.

How many extra professionals and how much more skilling will be needed in Queensland?

The number of Queensland tech workers focusing on cyber security is expected to grow from 3,300 in 2022 to 6,400 by 2030.

The total skill requirement to support just the core tech workforce in Queensland is projected to grow 94% from 11,020 in 2022 to 21,384 in 2030. The gap between skills now and in the future is a substantial 10,365 technical and soft skills.

Skills sets demanded for cyber security by 2030

Cyber security
2,506+

Network configuration
650+

Cloud solutions
619+

General networking
619+

Information security
681+

Software development principles
526+

System design & implementation
743+

3,100 Skilled workers needed (2030)

10k Skills gap (2030)

+94% Growth in skilled workers (2022–2030)

People skills
Communication skills	1,176+
Teamwork/collaboration	804+
Problem Solving	681+
Planning	495+
Stakeholder management	371+

Extra skills identified
Forensics and incident analysis
Cloud security
Adaptability and continuous learning

Source: Deloitte Access Economics analysis based on Lightcast (2023) & IDC (2023)

2030 skills for enabling cloud technology

One of the largest and most fundamental skilling needs over the coming years is in enabling cloud technology. Annual business investment in Australia in these areas is forecast to jump from almost $21 billion in 2022 to $41 billion by 2030. Business use of these technologies will grow from 59% in 2022 to 84% by 2030 across Australia.

What skills will tech workers need for this enormous change?

Enabling cloud technology will require a broad set essential technical skills include: Cloud solutions, Software development principles, System design and implementation, Operating systems, Network configuration and Databases and programming. Workers will also need soft skills such as planning, research, problem-solving, effective communication, troubleshooting, and teamwork.

How many extra professionals and how much more skilling will be needed in QLD?

The number of Queensland tech workers with skills in cloud technology is expected to grow from an already sizable 7,100 in 2022 to 21,700 by 2030.

The total skill requirement to support just the core tech workforce in Queensland is projected to grow 206% from 27,143 in 2022 to 83,126 in 2030. The gap between skills now and in the future is a substantial 55,983 technical and soft skills.

To date, the relationship between business investment in and adoption of cloud has generated significant jobs and skill needs. We note that this relationship could shift considerably by 2030, with businesses able to achieve similar outcomes with fewer cloud specialists. If there is a big change, that will mean these projections overstate the jobs and skill needs.

Skills sets demanded for cloud technology by 2030

Network configuration
2,923+

Operating systems
3,216+

Technical support
3,508+

Cloud solutions
13,740+

System design & implementation
4,239+

Databases & programming
2,923+

Software development principles
4,385+

15k Skilled workers needed (2030)

56k Skills gap (2030)

+206% Growth in skilled workers (2022-2030)

People skills
Communication skills	5,262+
Teamwork/collaboration	4,093+
Problem Solving	3,508+
Troubleshooting	3,070+
Planning	2,193+

Extra skills identified
Cost optimisation
Data management
Service selection
Collaboration & communication

2030 skills for Internet of Things

Continued proliferation of the Internet of Things will grow the skill requirements for technology workers involved in this technology. Annual business investment in these areas is forecast to jump from less than $20 billion in 2022 to over $34 billion by 2030 nationally. Business use of these technologies across the country will grow from less than 6% in 2022 to almost half by 2030.

What skills will tech workers need for this enormous change?

Already, we know that the essential technical skills include Software development principles, Scripting languages, System design and implementation, Cloud solutions and General networking. Workers will also need soft skills such as planning, research, problem-solving, effective communication, project management, and teamwork.

How many extra professionals and how much more skilling will be needed in Queensland?

The number of Queensland tech workers focusing on the Internet of Things is expected to grow from 500 in 2022 to 1,200 by 2030.

The total skill requirement to support just the core tech workforce in Queensland is projected to grow 156% from 1,745 in 2022 to 4,462 in 2030. The gap between skills now and in the future is 2,717 technical and soft skills.

Skills sets demanded for Internet of Things by 2030

Internet of Things
656+

General networking
117+

Technical support
124+

Scripting languages
197+

Cloud solutions
153+

Software development principles
189+

System design & implementation
277+

700 Skilled workers needed (2030)

2,700 Skills gap (2030)

+156% Growth in skilled workers (2022–2030)

People skills

Communication skills	291+
Teamwork/collaboration	240+
Problem Solving	175+
Project management	95+
Planning	95+

Extra skills identified

Hardware
Networking
Remote Sensing
Security

Source: Deloitte Access Economics analysis based on Lightcast (2023) & IDC (2023)

2030 skills for virtual worlds

Virtual worlds technology including augmented and virtual reality will experience continued growth over the coming years. Annual business investment in Australia in these areas is forecast to jump from about $267 million in 2022 to $1 billion by 2030. Business use of these technologies will grow from less than 1% in 2022 to almost one-quarter of businesses in Australia by 2030.

What skills will tech workers need for this enormous change?

Essential technical skills for virtual worlds include: Drafting and engineers design, Graphic and visual design software, Animation and game design, Software development principles and Social media. Workers will also need soft skills such as planning, research, problem-solving, effective communication, collaboration, and teamwork.

How many extra professionals and how much more skilling will be needed in Queensland?

The number of Queensland tech workers with skills in virtual worlds is expected to grow from just 100 in 2022 to 600 by 2030.

The total skill requirement to support just the core tech workforce in Queensland is projected to grow from 314 in 2022 to 2,317 in 2030. The gap between skills now and in the future is a total of 2,003 technical and soft skills.

Skills sets demanded for virtual worlds by 2030

Graphic design software
253+

Visual design production
160+

Visual design
83+

Social media
83+

Software dev principles
103+

Animation &
238+

Drafting & engineers design
398+

516 Skilled workers needed (2030)

2,003 Skills gap (2030)

+639% Growth in skilled workers (2022-2030)

People skills
Communication skills	176+
Teamwork/collaboration	165+
Planning	103+
Detail-oriented	88+
Organisational skills	77+

Extra skills identified
3D modelling and design
User Interface/User Experience
Sensor technologies
Adaptability to change

2030 skills for additive manufacturing (including 3D printing)

The expected growth and size of the technology workforce involved in additive manufacturing is comparatively modest. Annual business investment in these areas across Australia is forecast to jump from $317 million in 2022 to $434 million by 2030. Business use of these technologies is currently around 2%, in Australia.

What skills will tech workers need for this enormous change?

For additive manufacturing the essential technical skills include: Drafting and engineers design, Robotics, System design and implementation, Software development principles and Mechanical engineering. Workers will also need soft skills such as research, effective communication, technical support, problem-solving, collaboration, and teamwork.

How many extra professionals and how much more skilling will be needed in Queensland?

The number of Queensland tech workers focusing on additive manufacturing is expected to grow slightly from 35 in 2022 to 130 by 2030.

In observing that these numbers appear low, it is important to note that they are simply the tech workers involved with the development of the technology. Additive manufacturing could have dramatic impacts on the manufacturing (and other) workforces and be used by a great many workers.

Skills sets demanded for additive manufacturing by 2030

Drafting and design
11+

Operating systems
2+

Robotics
4+

Test automation
2+

Mechanical engineering
3+

Software dev principles
3+

System design & implementation
3+

11 Skilled workers needed (2030)

50 Skills gap (2030)

+156% Growth in skilled workers (2022-2030)

People skills

Research	4+
Communication skills	4+
Technical support	4+
Problem solving	3+
Teamwork/collaboration	3+

Extra skills identified

CAD modelling

Material selection

Production and business development

Patent law

2030 skills for high-performance computing

An early technology expected to grow other the coming years, high-performance computing (HPC) skills will begin to be need in the technology workforce. Annual business investment nationally in these areas is forecast to jump from less than $349 million in 2022 to over $699 million by 2030.

What skills will tech workers need for this enormous change?

Some of the essential technical skills for HPC workers include: Programming principles, Scripting languages, Software development principles and Operating systems. Workers will also need soft skills such as planning, research, problem-solving, effective communication, collaboration, and teamwork.

How many extra professionals and how much more skilling will be needed in Queensland?

The number of Queensland tech workers focusing on HPC is expected to grow slightly from 35 in 2022 to 130 by 2030.

The total skill requirement to support just the core tech workforce is projected to grow 268% from 176 in 2022 to 648 in 2030. The gap between skills now and in the future is a 472 technical and soft skills.

Skills sets demanded for high-performance computing by 2030

Programming languages
24+

Systems administration
28+

Operating systems
39+

Scripting languages
46+

Technical support
41+

Programming principles
95+

Software development principles
42+

95 Skilled workers needed (2030)

472 Skills gap (2030)

+268% Growth in skilled workers (2022-2030)

People skills

Research	51+
Teamwork/collaboration	28+
Communication skills	25+
Problem solving	17+
Planning	16+

Extra skills identified

Parallel Programming

Algorithm Optimisation

Graphics Processing Unit (GPU programming & accelerators)

2030 skills for advanced robotics and sensors

Advanced robotics and sensors comprises a small share of the overall technology workforce skilled in critical technology. Annual business investment in Australia in these areas is forecast to stay steady at around $1 billion a year between 2022 and 2030. Business use of these technologies will grow from around 1% in 2022 to 15% by 2030 nationally.

What skills will tech workers need for this enormous change?

Already, we know that the essential technical skills include: Robotics, Software development principles, Scripting languages, Programming languages and Imaging. Workers will also need soft skills such as planning, research, problem-solving, effective communication, collaboration, and teamwork.

How many extra professionals and how much more skilling will be needed in QLD?

The number of Queensland tech workers focusing on advanced robotics and sensors is expected to grow slightly from 345 in 2022 to 497 by 2030.

The total skill requirement to support just the core tech workforce in Queensland is projected to grow 44% from 2022 to 2030.

The robotics and sensors skills projections are much smaller than other areas of critical technology. This reflects an assumption that robotics and sensors' most profound impacts will be on complementing work and as a tool used by workers, more so than the number of tech workers directly involved in developing the technology. As the projections are off a relatively low base, they are more uncertain.

Skills sets demanded for robotics and sensors by 2030

Robotics
124+

Mechanical engineering
31+

Imaging
32+

Scripting languages
44+

Programming languages
34+

Software development principles
47+

System design & implementation
61+

153 Skilled workers needed (2030)

577 Skills gap (2030)

+44% Growth in skilled workers (2022–2030)

People skills

Communication skills	52+
Teamwork/Collaboration	40+
Problem solving	34+
Planning	29+
Research	24+

Extra skills identified

Mechatronics

Electronics and hardware integration

Kinematics and Dynamics

Appendix B: Queensland traditional technology workforce

Technology employment forecasts by occupation grouping, QLD, 2022 to 2030

Occupation group	2022	2030	Average annual growth
ICT Management and Operations	45,874	68,554	5.1%
ICT Technical and Professional	55,063	80,300	4.8%
ICT Sales	4,313	4,656	1.0%
ICT Trades	12,721	18,378	4.7%
Electronic trades and professional	604	1,100	7.8%
ICT Industry Admin and Logistics Support	20,495	27,460	3.7%
Total ICT workers	**139,070**	**200,449**	**4.7%**

Government funded VET subject enrolment in IT field of education in QLD, 2016-2022

Qualification	2016	2017	2018	2019	2020	2021	2022
Diploma or above	11,733	4,899	1,940	2,064	2,354	1,977	2,063
Certificate IV	271	264	405	353	595	836	1,096
Certificate III	2,033	2,092	2,027	2,473	2,477	2,809	2,639
Certificate II	5,353	4,719	3,664	3,267	3,084	2,475	1,976
Certificate I	10,030	8,688	6,176	4,772	4,841	3,747	39

Technology employment by industry, QLD

Industry	Employment
Agriculture, Forestry and Fishing	278
Mining	1,842
Manufacturing	4,494
Electricity, Gas, Water and Waste Services	1,847
Construction	1,083
Wholesale Trade	2,495
Retail Trade	2,568
Accommodation and Food Services	507
Transport, Postal and Warehousing	2,314
Rest of Information Media and Telecommunications	1,336
Financial and Insurance Services	7,194
Rental, Hiring and Real Estate Services	826
Rest of Professional, Scientific and Technical Services	20,736
Administrative and Support Services	1,811
Public Administration and Safety	13,901
Education and Training	6,722
Health Care and Social Assistance	4,323
Arts and Recreation Services	1,852
Other Services	1,873
Telecommunications Services	10,335
Internet Service Providers, Web Search Portals and Data Processing Services	939
Computer System Design and Related Services	49,795
Total ICT workers	**139,070**

Domestic enrolments and completions in IT degrees in QLD, 2001 to 2021

	Course enrolments		Course completion	
	Undergraduate	Postgraduate	Undergraduate	Postgraduate
2001	7,519	1,319	1,037	442
2002	7,732	1,487	1,084	517
2003	7,083	1,326	1,240	455
2004	6,338	1,205	1,202	346
2005	5,192	1,002	988	321
2006	4,398	864	813	295
2007	3,956	746	736	230
2008	3,770	722	610	199
2009	3,813	730	637	185
2010	3,897	711	571	201
2011	4,063	805	613	201
2012	4,231	815	604	203
2013	4,611	813	606	217
2014	5,048	896	706	248
2015	5,345	817	762	236
2016	5,787	838	622	199
2017	4,689	793	691	203
2018	4,841	789	720	172
2019	5,037	957	737	233
2020	5,160	1,228	737	335
2021	5,178	1,489	794	383

International enrolments and completions in IT degrees in QLD, 2001 to 2021

	Course enrolments		Course completion	
	Undergraduate	Postgraduate	Undergraduate	Postgraduate
2001	4,492	2,749	830	1,207
2002	5,392	3,154	1,214	1,575
2003	5,102	2,728	1,535	1,302
2004	4,435	3,444	1,554	994
2005	3,054	4,223	1,137	1,549
2006	2,521	3,416	809	1,821
2007	2,235	2,418	693	1,303
2008	2,113	2,477	579	1,126
2009	2,068	2,815	607	961
2010	2,154	2,616	481	1,180
2011	2,216	2,080	583	1,114
2012	2,071	1,863	617	815
2013	2,021	2,295	592	702
2014	1,979	3,066	509	743
2015	1,791	3,431	578	1,066
2016	1,867	3,697	507	1,163
2017	2,083	4,665	494	1,143
2018	2,311	6,211	572	1,674
2019	2,656	7,084	626	2,294
2020	2,380	5,741	551	2,598
2021	1,996	3,224	639	1,773

Deloitte.