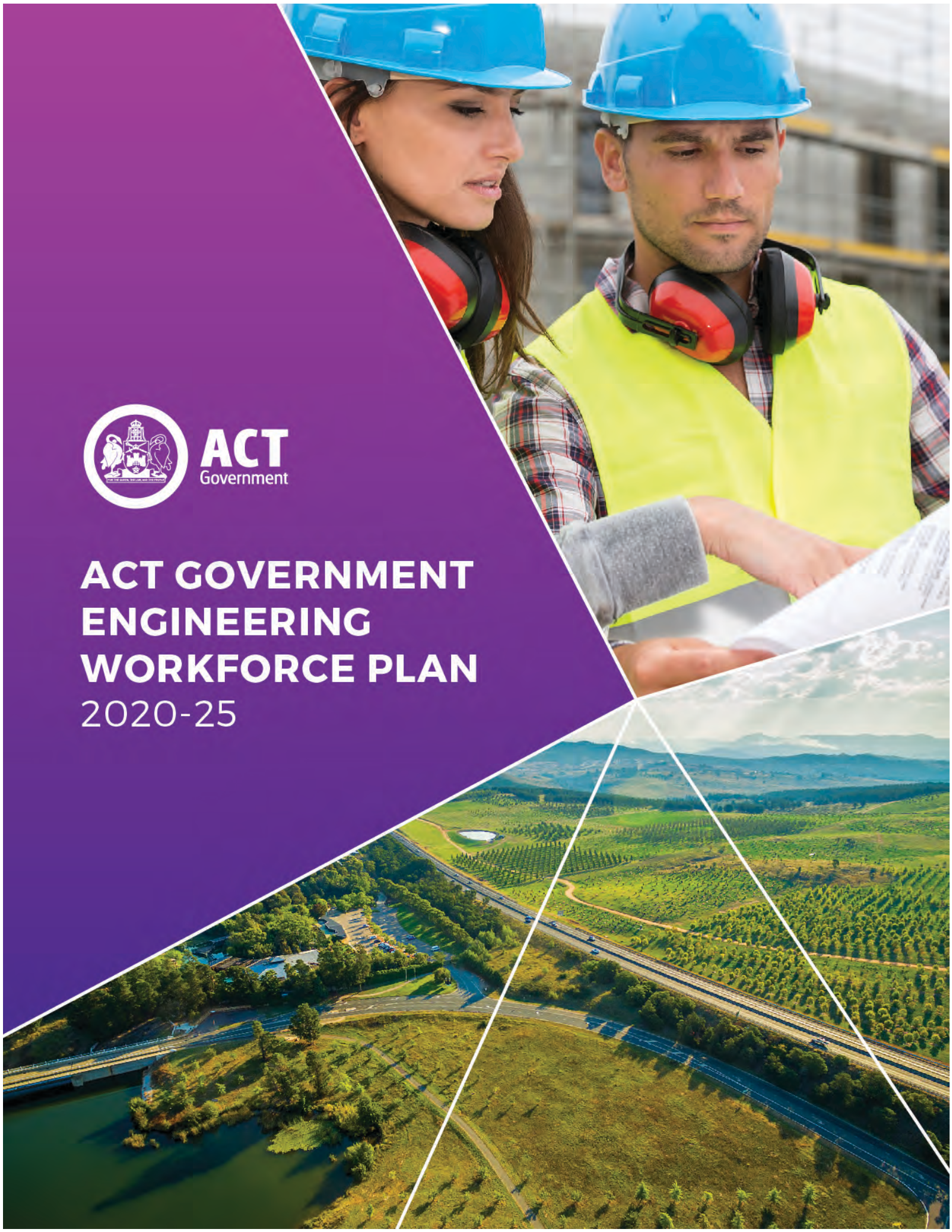




ACT
Government

ACT GOVERNMENT ENGINEERING WORKFORCE PLAN 2020-25



An aerial, high-angle view of a modern city street intersection. A red tram is moving through the intersection. Several cars, including a white van and a blue car, are visible. Pedestrians are walking on the sidewalks. The scene is set in a green, urban environment with trees and a large white pillar on the right side. The overall tone is bright and clear.

ACCESSIBILITY

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ACKNOWLEDGEMENT OF COUNTRY

The ACT Government acknowledges the Australian Aboriginal and Torres Strait Islander peoples of this nation. We acknowledge and pay our respects to Elders, past, present and future of the Ngunnawal people as the Traditional Custodians of the lands on which we live and where we conduct our business. We recognise the significant contribution of the Ngunnawal people and neighbouring Nations—the Ngambri, Ngarigo, Wolgalu, Gundungurra, Yuin and Wiradjuri to the Canberra region. For thousands of years these Nations have maintained a tangible and intangible cultural, social, environmental, spiritual and economic connection to these lands and waters.

THE VISION OF THE ACT CHIEF MINISTER

In 2016, I made a commitment to appoint a Chief Engineer who would not only provide valuable strategic oversight for current and future infrastructure projects but would work with engineering bodies to deliver a workforce plan for engineering capability in the ACT Government. As part of this commitment I am proud to be launching the ACT Government Engineering Workforce Plan with our Chief Engineer, Mr Adrian Piani.

There will always be disruptions outside of our control that will have significant or long-term impacts on our community. COVID-19 is one such instance. For many years we have built resilience into our city - the capacity of individuals, communities, institutions, businesses and systems to survive, adapt and grow no matter what kind of stresses and shocks they may experience – and we need to continue this work.

As the Territory’s engineering and infrastructure projects are critical to the stability and future growth of our economy, it is essential that we have the appropriate engineering capability across the ACT Government to drive this growth. In responding to the challenges we have faced in recent times, one way to build resilience as a city is to strengthen our engineering capacity. This will enable us to bring to life our \$2.8 billion infrastructure pipeline to meet the needs of our vibrant city.

The ACT Government Engineering Workforce Plan has been developed through significant consultation with our relevant peak representative bodies - Engineers Australia, Professionals Australia and Consult Australia, and across the ACT Government, to ensure that we will have the engineering skills required for the Territory now and into the future. We are committed to working collaboratively across the sector to develop an innovative and skilled engineering workforce in the ACT.

With the support of our community, businesses and educational institutions we will build further on what Canberra already offers as a city of choice, of talent and of ambition, and inclusive to all.



*Andrew Barr, MLA
ACT Chief Minister*

A MESSAGE FROM THE ACT CHIEF ENGINEER



As the ACT Government Chief Engineer my responsibility is to provide the ACT Government with strategic advice on key infrastructure projects and the broader industry environment, supporting informed decision making for our city's infrastructure planning. This enables the Government to support the community through the delivery of robust and fit for purpose infrastructure.

As we continue to plan, design and deliver infrastructure projects essential to Canberra's future, the importance of good engineering advice has never been more critical.

A key component in providing this advice is ensuring we have a strong engineering foundation for Government. Like the other professions we work with to deliver infrastructure outcomes – including planners, architects, landscape architects - supporting, developing and improving the capacity of our engineering workforce is of critical importance. Engineers will also play a key role in leading the development and adoption of new digital technologies across Government to support service delivery. This includes the Internet of Things, Big Data, Machine Learning and Artificial Intelligence, and cyber security.

In this age of technical and digital advancement, engineers will play critical roles in shaping our cities by finding new and innovative solutions to anticipated challenges. It is my goal to identify, develop and support engineers across the ACT Government, recognising and promoting their value. I firmly believe our engineers will play a pivotal role in the design, development and maintenance of important infrastructure for the ACT Government and the community now and into the future and will help us set the benchmark for our profession across the public sector in Australia.

This Workforce Plan is a fundamental first step in building the engineering workforce we need, and we look forward to working in partnership with private, public and education sectors to deliver quality infrastructure and technology outcomes for the future.

ADRIAN PIANI
ACT CHIEF ENGINEER

EXECUTIVE SUMMARY

The ACT Government is investing in an ambitious infrastructure program to ensure that we can continue meeting the community's needs as Canberra grows toward a population of 500,000.

Many important decisions will need to be made, and these require sound, forward-thinking engineering advice to support the Government's vision.

We have developed the ACT Government Engineering Workforce Plan (the Workforce Plan) to help understand capability and capacity risks for the engineering workforce and to take the best course of action to mitigate these risks. This applies across the sector, and within each ACT Government Directorate or agency.

The Workforce Plan builds on this understanding of the sector's risks and potential actions by:

- reviewing the characteristics of the current engineering workforce across the sector, and how they compare to other jurisdictions
- exploring the possible futures for engineering; what is expected to change that we need to prepare for
- considering the skills that will be required, particularly those that are emerging and scarce
- examining the challenges that exist now or are on the horizon for the engineering workforce and for the ACT Government, and
- developing a potential view on the number of engineers likely to be required in the future to meet the infrastructure program.

Using the information gathered, the risks and potential implementation actions we can take are identified.

Note that the quotes presented throughout this paper were sourced from the consultation activities, unless otherwise referenced.

WHAT WE ALREADY KNEW

Before developing the ACT Government Engineering Workforce Plan, there were several factors we knew would form part of our analysis:

- We expect to need to manage the future impact of an ageing workforce, particularly around exits from the ACT public service.
- There are likely to be some skill shortages in certain groups – the world is changing quickly, and it is likely that the demands on engineering capability will be shifting, too.
- The ACT was seeing shortages of civil engineers. ACT filled the lowest percentage of engineering vacancies in 2019 (38%).

Data to inform the Workforce Plan has been collected through workshops, a survey and existing public and ACT Government data.

75%

of jobs in the fastest growing industries require workers with STEM skills



PURPOSE OF THE WORKFORCE PLAN

The purpose of this Workforce Plan is to enable the ACT Government to build the engineering capability required to meet the future needs and growth of the Territory. The Plan serves as a link between the Government's strategic objectives and initiatives and the engineering capability required for these to be achieved.

The Workforce Plan provides:

- an assessment of the current capability supporting the engineering requirements of the ACT Government
- the associated skills and qualifications of the current engineering workforce
- the current and future challenges and risks facing the engineering workforce, and
- actions to address these challenges.

The Workforce Plan is focused on attracting, developing and retaining the workforce for the future. It will be brought to life through the implementation of a range of actions that will see us:

1. Boost the recruitment of engineers, targeting entry-level and diverse groups
2. Optimise our existing ACT Government engineering workforce
3. Strengthen the engineering profession in the ACT, and
4. Collaborate with key stakeholders to implement the Workforce Plan.

We are confident that the Workforce Plan will enable the ACT Government to build and maintain a leading engineering workforce into the future.



FINDINGS



Though the cohort of ACT engineers are highly-qualified and experienced, they are predominantly in an age group that could leave the workforce in the next ten years.



The changing external environment – particularly around the impact of technology – will change the expectations of engineers. There will be greater emphasis on thinking skills, such as systems thinking, holistic problem solving, and creativity, as well as digital and environmental knowledge.



Challenges that will influence the capacity and capability of engineers include; the ACT's population growth and planned infrastructure program, the impact of digital transformation, the need to address climate change, how to help engage future engineers, and looking beyond traditional sources for the right engineering staff.

CHALLENGES, OPPORTUNITIES AND ACTIONS

A series of challenges and opportunities that reflect the findings have been explored.

Key challenges include a gap between the engineering workforce numbers and the demand created by the infrastructure program (with flow on impacts to the infrastructure projects and the decisions around them), a potential slowing of available engineering graduates, and the likely larger attrition rate due to the age profile of the current engineering cohort.

Opportunities include the strong position the ACT Government is in with a very low gender pay gap (1.5%), our infrastructure program offering exciting work for engineers to contribute to, and the benefits of living and working in Canberra.

KEY ACTIONS



Assist the ACT Government Graduate program to improve the attraction and retention of engineering graduates and ensure engineering positions are identified and available within each cohort



Develop an ACT Government engineering cadet and internship program to support young people to undertake formal engineering studies with practical working experience



Work with ACT Government Directorates and Agencies to incorporate engineering requirements into their workforce plans, including identifying current skill shortages



Introduce a professional development program for ACT Government engineers to enhance knowledge and maintain up-to-date technical skills

IMPLEMENTATION

Implementation of the ACT Government Engineering Workforce Plan will include ongoing review from 2020 to 2025, to ensure activities are implemented efficiently and effectively.

“The cost of investing in engineering workforce will require some funding from tight budgets, but the cost of substandard infrastructure outcomes for ACT would likely be higher.”

A COMMITMENT TO ENGINEERING IN CANBERRA

Canberra is already a great place to live, work, start a business and raise a family. We want to make sure it keeps getting better in the years ahead by taking a long-term view of our community's needs and delivering the physical, social and digital infrastructure and technology necessary to meet them.

Our vision is to deliver infrastructure for our community that helps make Canberra one of the world's most liveable and competitive cities.

As Canberra grows toward a population of 500,000 people by 2030, the ACT Government is investing in infrastructure and technology that supports our city's prosperity, liveability and social inclusion.

The Government is committed to significant social and environmental reforms to increase our city's inclusiveness and maintain our position as a leader in the transition to a zero emissions future.

These reforms include the development and delivery of key infrastructure projects such as stage 2 of the city-wide light rail network, upgrades at the Canberra Hospital precinct and the capital works program in ACT schools.

Developing and promoting an innovative and skilled engineering workforce across the ACT Government is key to getting the best strategic advice across these important projects.

We will be under increasing pressure as governments, including the NSW Government, make significant infrastructure commitments in the years ahead. There will be competition for quality engineers, and we need to attract those engineers to the ACT.

In releasing the Workforce Plan we are directly supporting the four key themes from the ACT Statement of Ambition, that is, to attract and retain talented people, diversify our local economy, deliver better metropolitan infrastructure and embrace the digital mindset.

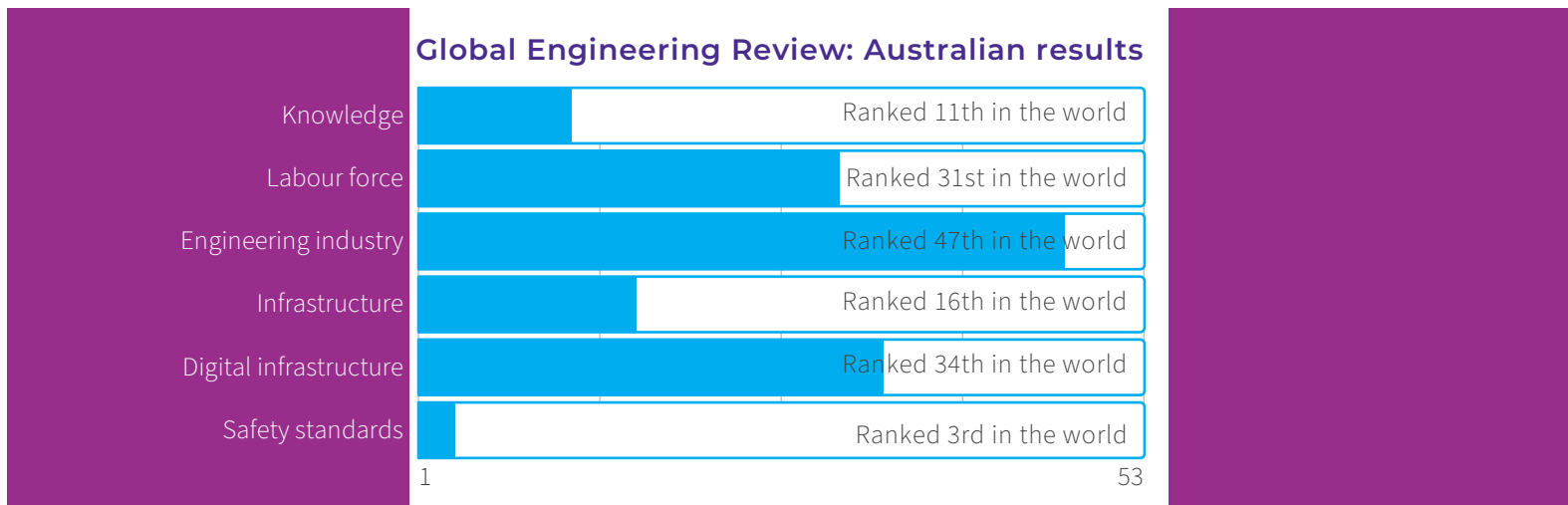


“Canberra will be a smart city. To do this we need smart government with smart people.”

WHY A WORKFORCE PLAN FOR ENGINEERING?

With the social and environmental reforms planned for the ACT, it is important that we consider how we can deliver on these commitments. As engineering is critical to many of the reforms, it is essential that we take a sector-wide view on capability and capacity, informed by the broader environment in which we operate.

A recent study on global engineering has identified areas where Australia excels, and areas where we need to improve ¹.



One area of concern is the Australian engineering labour force, where we ranked 31st in the world. The survey's labour force ranking considers the strength of a country's workforce by considering indicators such as the availability of scientists and engineers, graduates (and specifically, female graduates) in related programs, and the mean performance of 15-year olds in science and mathematics.

These results highlight that we must continue to take stock of the factors that impact our engineering workforce, in the short, medium and long-term.

The Workforce Plan identifies the broad areas senior leaders across the ACT Government need to focus on to ensure they have a skilled engineering workforce to boost effective and evidence-based decision making.

Importantly, the Workforce Plan provides the means for industry, government, education and training leaders and decision makers to understand the critical workforce issues facing the engineering profession.

“Getting workforce planning right is a critical step in helping build a future fit workforce that can meet the long term demands of the ACT Government's Infrastructure Plan, as well as developing practical decision frameworks for directorates and managers to build capability in staff now.”

¹ Royal Academy of Engineering, Global Engineering Capability Review, <https://www.raeng.org.uk/publications/reports/global-engineering-capability-review>

WHAT IS ENGINEERING?

Engineering is about the creation or application of technology to investigate problems and offer scientifically-based solutions to these problems. It uses scientific principles to investigate a human or environmental problem that is presented or identified, and developing, implementing and managing the solution to that problem.²

Engineers are involved in the research, design, production, operation and maintenance of many things that we take for granted in our everyday lives.

A related and important concept is **STEM**, which is an approach to learning and development that integrates the areas of **science, technology, engineering and mathematics**.

Engineering draws on all of the STEM fields and applies them to create innovative devices, structures, and software applications used to solve problems.

From an engineering design perspective, there are three fundamental pillars:

1. quality
2. safety, and
3. environmental sustainability.

Great engineers pursue these three pillars in all of their work.

ENGINEERS PLAY CRITICAL AND DIVERSE ROLES IN HELPING THE GOVERNMENT DELIVER ON THEIR PRIORITIES, PARTICULARLY INFRASTRUCTURE PROJECTS. THIS INCLUDES HOW WE WILL USE DIGITAL TECHNOLOGY TO INNOVATE AND TRANSFORM

The key skills developed through STEM education include:



PROBLEM SOLVING



CREATIVITY



CRITICAL ANALYSIS



TEAMWORK



INDEPENDENT THINKING



INITIATIVE



COMMUNICATION



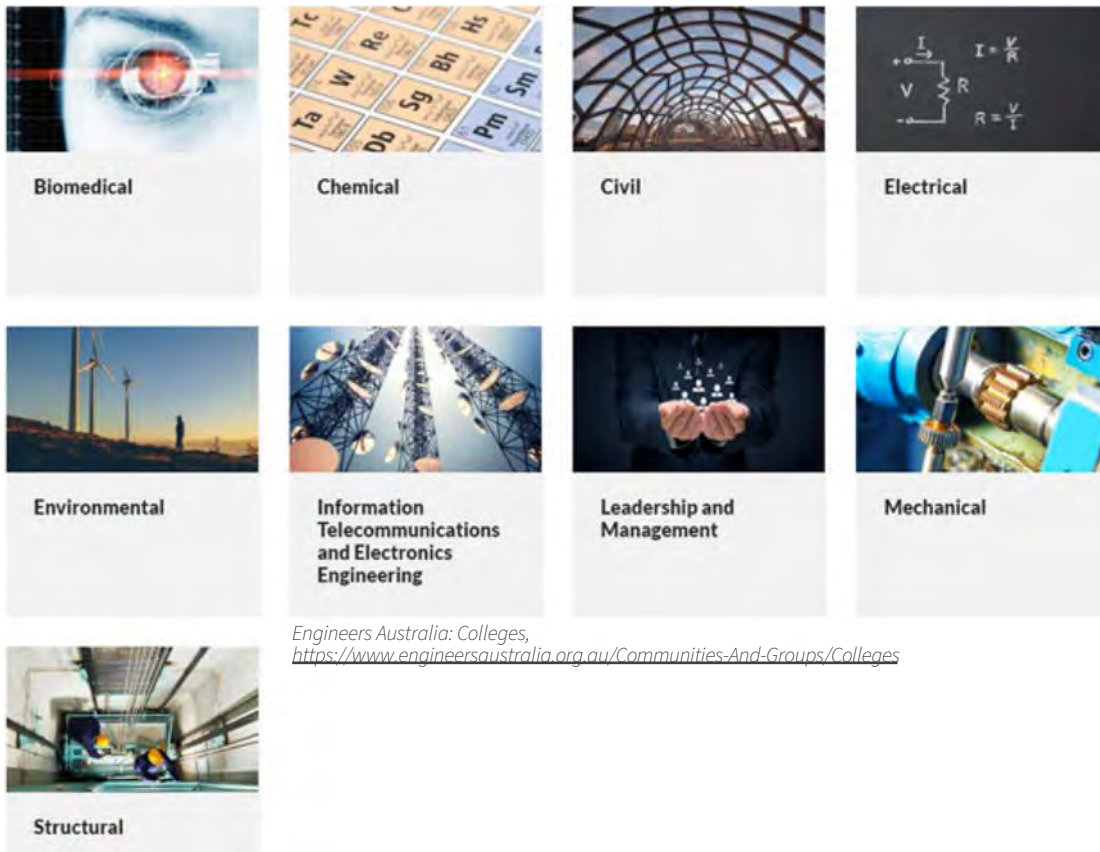
DIGITAL LITERACY

Engineering practice in Australia

Engineering in Australia is based around nine engineering 'colleges' reflecting all areas of engineering practice.

Engineering in 2020 encompasses a broader range than ever before in terms of areas of practice, specialisations and interfaces with other disciplines and professions. The colleges will continue to be updated and prioritised with digital engineering becoming a focus.

² *Engineering Futures 2035: A scoping study*, http://www.aced.edu.au/downloads/Engineering%20Futures%202035_Stage%201%20report%20for%20ACED_May_16_2019.pdf



Engineers Australia: Colleges,
<https://www.engineersaustralia.org.au/Communities-And-Groups/Colleges>

The engineering profession is also organised into three levels: Professional Engineers, Engineering Technologists and Engineering Associates.

The groups differ by their educational qualifications, and the different roles they play in designing, adapting, and applying their engineering skills.

Professional Engineers	Engineering Technologists	Engineering Associates
Apply analytical skills and their grasp of scientific principles and engineering theory to design solutions to complex problems	Within their specialised area, use an understanding of theoretical and practical application of engineering and technical principles to adapt established technologies to new situations	Apply detailed knowledge of standards and codes of practice to manage a complex asset across its lifecycle, in familiar operating situations

“Engineering helps meet today’s challenges by making “..the world not only a more technologically advanced and connected place, but also a more sustainable, safe, healthy, and joyous — in other words, better — place.”³”

³ THE ENGINEERING PROFESSION A Statistical Overview, Fourteenth Edition June 2019,
<https://www.engineersaustralia.org.au/sites/default/files/resources/Public%20Affairs/2019/The%20Engineering%20Profession%20A%20Statistical%20Overview%202014th%20edition%20-%2020190613h.pdf>

IN WHAT WAYS DO ENGINEERS SUPPORT OUR SOCIETY?

A functioning society relies heavily on the outputs of engineering work across a variety of applications, as does the economic prosperity of many developed countries like Australia. This is because essential infrastructure and services, such as power, water, housing, transport and communications underpin almost every aspect of our everyday lives.

ACT's Wellbeing Framework

In line with the ACT Wellbeing Framework, we have mapped the path from the foundation of engineering in STEM, through to the wellbeing outcomes we are seeking to achieve in the ACT.

As engineering capability is a critical foundation of many of the ACT's twelve domains for wellbeing, it is important that we have the appropriate engineering workforce and capability to support our community.

At each layer of the wellbeing pyramid, we can see the work of engineers helping Canberrans experience a good quality of life.



Building Canberra's future

The ACT Government has given specific focus to identifying investments needed over the next five years to:

- meet core service delivery needs
- support our ongoing economic growth, and
- drive Canberra's transition to a zero emissions future.

These infrastructure investments span all aspects of our life here in the Canberra region.

Decision-making about infrastructure considers factors such as the level of asset management, the level of service growth, broader growth parameters, community expectation, and risk assessment.

The ACT Government's Infrastructure Plan takes a long-term view of what our community needs, and identifies the physical, social and digital infrastructure necessary to make Canberra even more progressive and connected.

BUILDING CANBERRA'S FUTURE

Our population is one of the fastest growing in the nation

We're investing in infrastructure now to meet the needs of our growing city into the future

Year	Population
2011	367,985 people
2018	420,856 people
2029	505,360 people

\$14 billion infrastructure blueprint in the areas that matter most

With **\$3 billion** worth of infrastructure spending already committed

A strong investment in our future

Infrastructure across our regions

The infrastructure plan will deliver for all Canberrans, no matter where they live

The plan is **not just about new infrastructure**, but **maintaining & upgrading** what's already there

Infrastructure that is well planned and thoughtfully delivered can improve people's quality of life, strengthen effective service delivery, support adaptation to a changing climate and break down barriers to social inclusion. These considerations are front and centre in the ACT Government's approach to planning, designing and delivering new projects in every sector and region across Canberra.⁴

<p>We're funding the projects & priorities that matter most to Canberrans</p> <p>Health</p> <p>Future proofing TCH with SPIRE & expanding Centenary Hospital for Women and Children</p> <p>2 more Walk-in Centres taking the network up to 5 in total across Canberra</p>	<p>Education</p> <p>More than 26% increase in students attending public schools since 2010 (from 38,853 to 49,152)</p> <p>Building 3 new schools & improving the existing 87 across Canberra</p>
<p>Community Services</p> <p>1,200 new public housing homes, including an additional 200 to grow the public housing portfolio</p> <p>Additional ACT Ambulance Service & ACT Fire and Rescue service stations in the city centre & the Molonglo Valley</p>	<p>Transport</p> <p>Extending Light Rail to Woden</p> <p>Investing in footpaths & cycleways, making it easier to walk & cycle</p>
<p>City Services</p> <p>Improving our great parks, sportsgrounds, local shops & playgrounds</p> <p>More trees in our streets to meet our 30% green canopy target by 2045</p>	<p>Cultural & Recreational Facilities</p> <p>Delivering a new Canberra Theatre</p> <p>Planning the future of the Canberra Stadium and EPIC</p>
	<p>City Planning & Land Release</p> <p>Meeting our commitment of 15% affordable, community & public housing in the targeted residential land releases</p>

Engineers are key to delivering quality infrastructure. They ensure effectiveness and quality in areas of planning, design, construction, operations and maintenance, and regulation.

⁴ Infrastructure Planning for the future. (2019). https://apps.treasury.act.gov.au/_data/assets/pdf_file/0009/1432449/act-infrastructure-plan.pdf

WHY BE AN ENGINEER IN THE ACT GOVERNMENT?

There are many good reasons for an engineer to choose to work in the ACT Government.

Engineers have always played a pivotal role in driving our economic and social development and continue to do so by designing and delivering safe systems that facilitate education and healthcare, enhance quality of life and safeguard critical infrastructure.

With the ACT Government's ambitious and exciting Infrastructure Plan, we will see significant infrastructure investments right across the ACT over the coming decades. The Infrastructure Plan will be delivered by the ACT Government alongside industry partners in the private sector.

Working in government offers opportunities for engineers to make a difference by contributing to a high-profile suite of major projects to improve living standards and ensure communities develop sustainably, while being offered diverse career development opportunities.

"What we need to say, to girls and to boys, is that engineers change the world and have interesting careers. If you want to have an impact on the big issues of our time, such as food security, energy security or water security in the Anthropocene, then do engineering. Ability in maths and science is just the prerequisite, not the reason."⁵

Exciting work for engineers moving forward



High tech and digital



Adapting to a changing climate



Improving resilience



Hydrogen revolution



The proportion of female engineers in the ACT Government exceeds the national average.



Canberra and its surrounds is a very liveable region and was identified by Organisation for Economic Co-operation and Development (OECD) data as the best place in the world to live in 2014, and as the third cleanest city in 2016.



The ACT Government has developed strong partnerships with the private sector and academia. These relationships are important for all parties and help to enhance engineering capability.



In terms of education, we have existing engineering undergraduate and post-graduate programs across our local universities. This makes it possible to advance your career through training.

⁵Schaffer, G., *Engineering gender equality*.
<https://pursuit.unimelb.edu.au/articles/engineering-gender-equality>

CONSULTING WITH STAFF AND STAKEHOLDERS

Development of the ACT Government Engineering Workforce Plan has been underpinned by significant research and consultation.

This research and consultation included:

- workshops with engineers across the service, engaging over 150 engineers
- an online survey of engineers working in the ACT Government, with over 90 responses
- consultation with peak representative bodies, and
- an extensive review of available and relevant literature and statistics.

The consultation process provided a strong evidence base and insights on the key challenges and opportunities available to support engineers and engineering practice in the ACT Government.

Our consultations identified issues such as:

- the need for engineering innovation such as smart cities and digital engineering
- a gap in engineering experience at the senior levels of the ACT Government
- the importance of engaging engineers at early stages in project development, and
- a need to attract and retain engineering talent.

It was anticipated that our cohort would represent a wealth of engineering experience, and this was supported by the data.

These findings support the need for the Workforce Plan to be targeted to support current engineers, ensure the mobility and greater use of our engineers and planning to ensure we have the right engineering skills to support the ACT Government's strategic directions.

Through the data collected from the survey respondents, a profile of a 'typical' engineer within the ACT Government is presented below.



Male

In their mid 40s

Civil engineer

Working in a project delivery role

Over 20 years' experience in engineering

Less than five years' experience working in the ACT Government

Bachelor of engineering with a post-graduate qualification

Member of Engineers Australia



The future needs and objectives of the ACT Government will start to shift this current state view, particularly around gender.

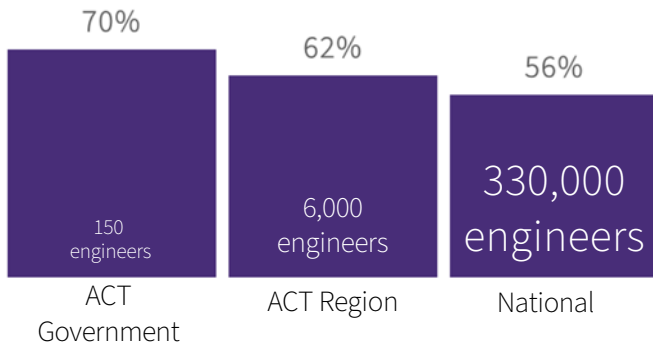
There are proven benefits to incorporating more diverse viewpoints from women and young people in the industry.

A SNAPSHOT OF OUR CURRENT ACT WORKFORCE

To understand what we need the future engineering workforce to look like, it is important to understand what it looks like now. The data over the following pages has been primarily sourced from the online survey of ACT Government engineers, supplemented with additional data to compare the ACT Government engineering workforce within the wider Australian context (where possible).

Engineering skills in the population

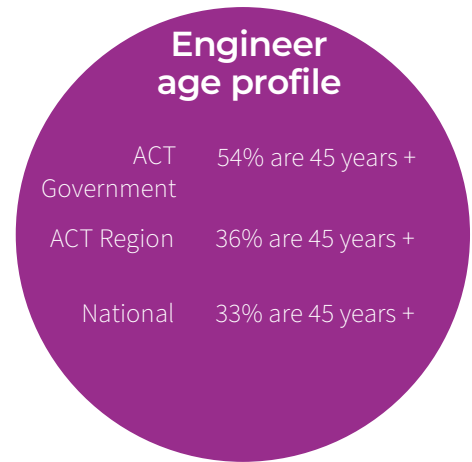
What percentage of skilled engineers work in engineering roles?



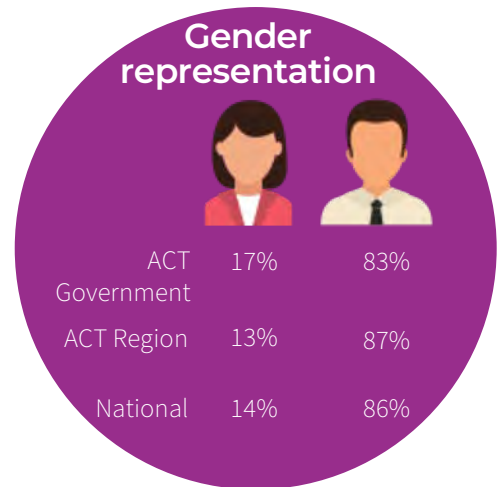
“When employers complain about skill shortages, they are really talking about a shortage of qualified engineers to work in engineering occupations”⁶



Though our engineers are very experienced, the average time spent in the ACT Government is a lot less in other sectors



With 54% of our ACT Government engineers being at least 45 years old, our cohort is older than engineers across the ACT and nationally



1.5%
gender pay gap in the ACTPS (2018-19)

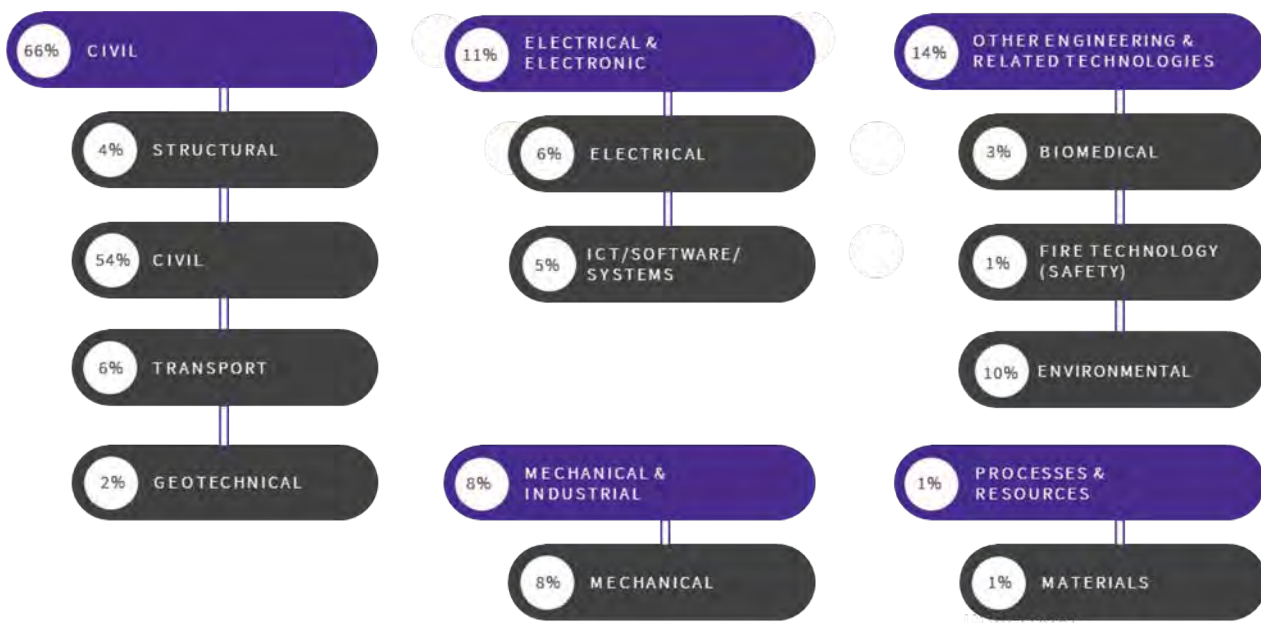
There is an opportunity to make the ACT Government an employer of choice for female engineers

⁶Engineers Australia, June 2019

A SNAPSHOT OF OUR CURRENT ACT WORKFORCE

Engineering disciplines

This diagram shows the spread of engineering disciplines across the ACT Government. This confirms the large number of civil engineers but also demonstrates that other 'colleges' are emerging, such as environmental engineering. The shift to digital and environmental also reflects the need for knowledge in these areas to extend beyond any specific discipline.



“ Growth areas for engineering disciplines will be digital and environmental engineering. ”

86% of ACT engineers are in a role that requires them to undertake **complex problem-solving**

96% of ACT engineers are in a role that requires them to have **knowledge of legislation, regulation and codes**

82% of ACT engineers are in a role that requires them to have **knowledge of technical specifications and standards**

64% of ACT engineers have opportunities to **share their expertise on the scope and development of projects**

A SNAPSHOT OF OUR CURRENT ACT WORKFORCE

Infrastructure classifications

The ACT Government introduced Infrastructure Officer (IO) and Infrastructure Manager / Specialist (IM/S) classifications to recognise the skills, competencies and expertise required by certain positions in the ACT Public Service in the delivery of infrastructure and associated works.

Classifications apply to roles where staff are predominantly engaged in the development, delivery, management, operations and/or maintenance of major/significant (non-ICT) infrastructure projects, including engineering roles.

Infrastructure Officer (IO) Classification

For engineers in IO roles, the pre-requisite is holding a relevant professional qualification or accreditation with a professional body recognised in Australia.

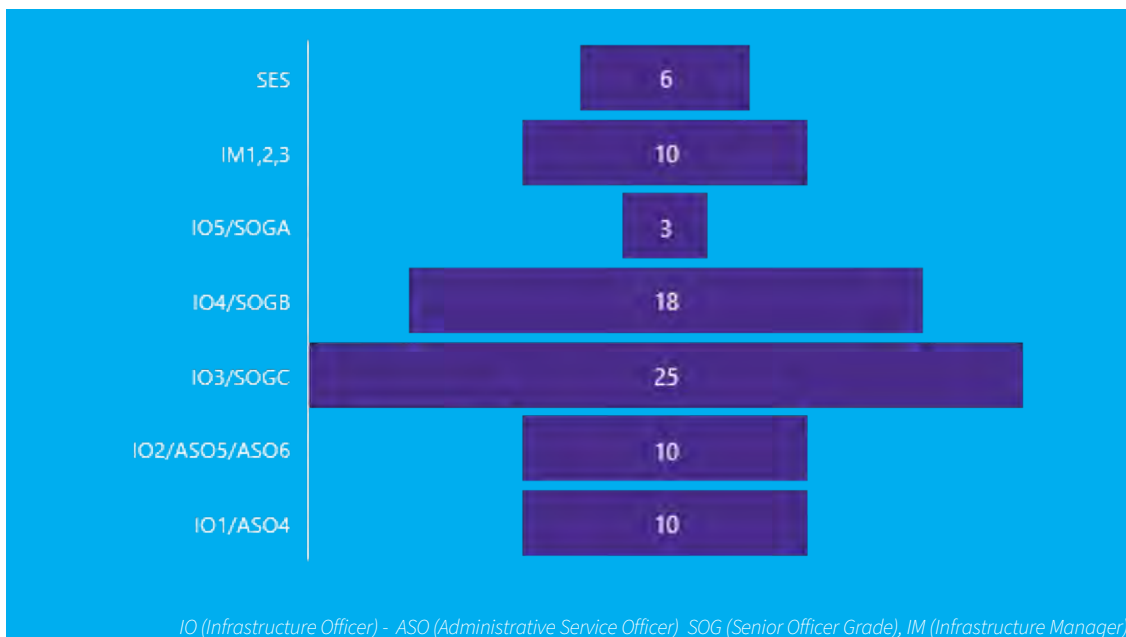
Infrastructure Manager / Specialist (IM/S) Classification

For engineers in IM/S roles, the pre-requisite is a four-year engineering degree or higher that is accredited by Engineers Australia or Professionals Australia for recognition as a Professional Engineer. In addition, the engineer needs to have extensive relevant experience in engineering.

Staff profile

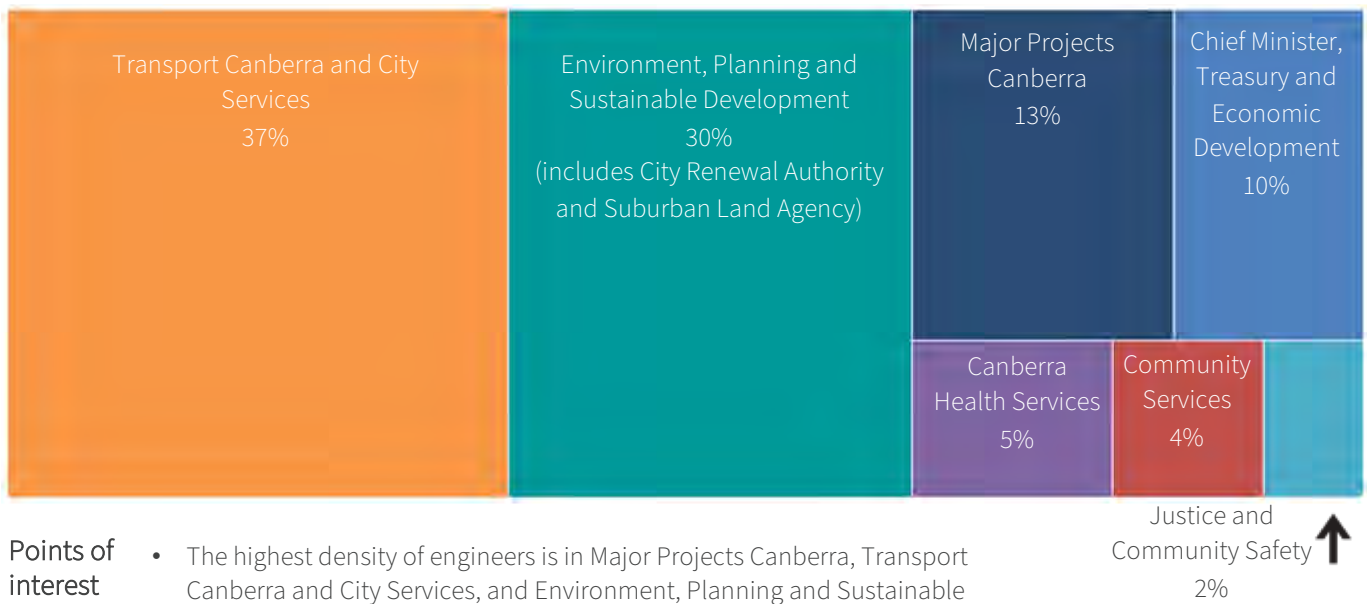
This diagram identifies the substantive classification of engineers across the ACT Government. It indicates the low number of staff at entry-level and lower classifications.

We need to increase the number of engineers at these lower levels as well as the IO5/SOGA level, shifting with our engineering cohort to be more representative of a 'pyramid' shape. This will assist the ACT Government in succession planning activities.



A SNAPSHOT OF OUR CURRENT ACT WORKFORCE

Allocation of engineers across the Directorates



Points of interest

- The highest density of engineers is in Major Projects Canberra, Transport Canberra and City Services, and Environment, Planning and Sustainable Development.
- These three directorates deliver much of the engineering projects across ACT Government.



HOW WILL TECHNOLOGY INFLUENCE THE INFRASTRUCTURE LIFECYCLE?

It has become compulsory for every organisation to remain relevant and competitive in today's digital economy. The **Internet of Everything (IoE)**, is transforming the way every organisation operates. Our use and application of engineering capability is no different.

Across the infrastructure lifecycle (planning, design, construction, operations and maintenance, regulation), the IoE will help us to improve the application of engineering capability across the ACT.

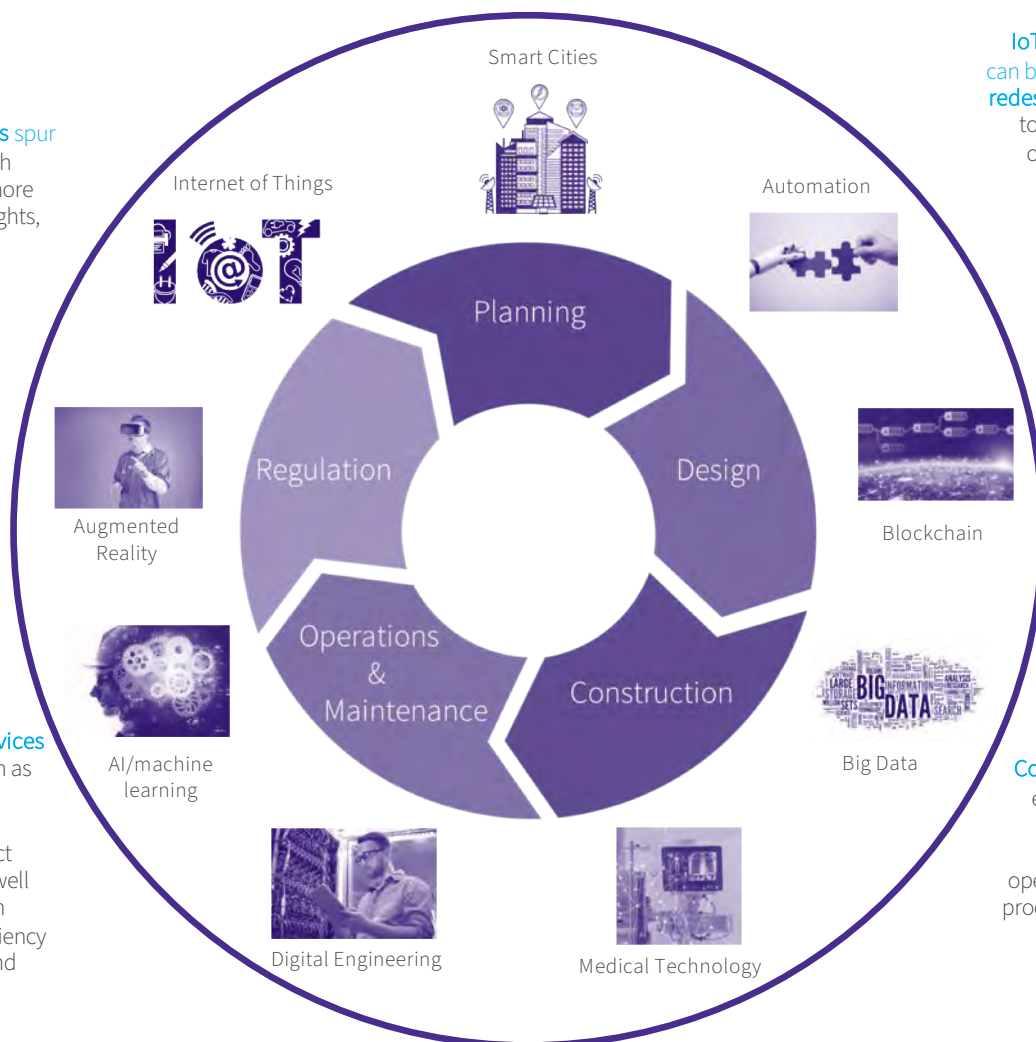
Our aspiration for Canberra is to be a smart city, which is both modern and sustainable. Our strong government workforce of engineering professionals will ensure that we build the infrastructure that will bring this vision to reality, leading to improved outcomes for our community.

IoE is based on the idea that in the future, machines will have become smarter by increased access to data and expanded networking opportunities.

IoE applications range from digital sensor tools and interfaces used for remote appliances, to smarter and more well-connected mobile devices, industrial machine learning systems and distributed hardware that have become more intelligent and automated.

IoT data insights spur innovation, which results in even more refined data insights, spurring further innovation

There is growing demand for IoT engineering services for activities such as security, maintenance, analytics, product engineering, as well as rising focus on operational efficiency enhancement and risk moderation



IoT connectivity can be used to help redesign buildings to improve their operations and efficiency

Digital models and IoT data will help inform policy in the early stages of development

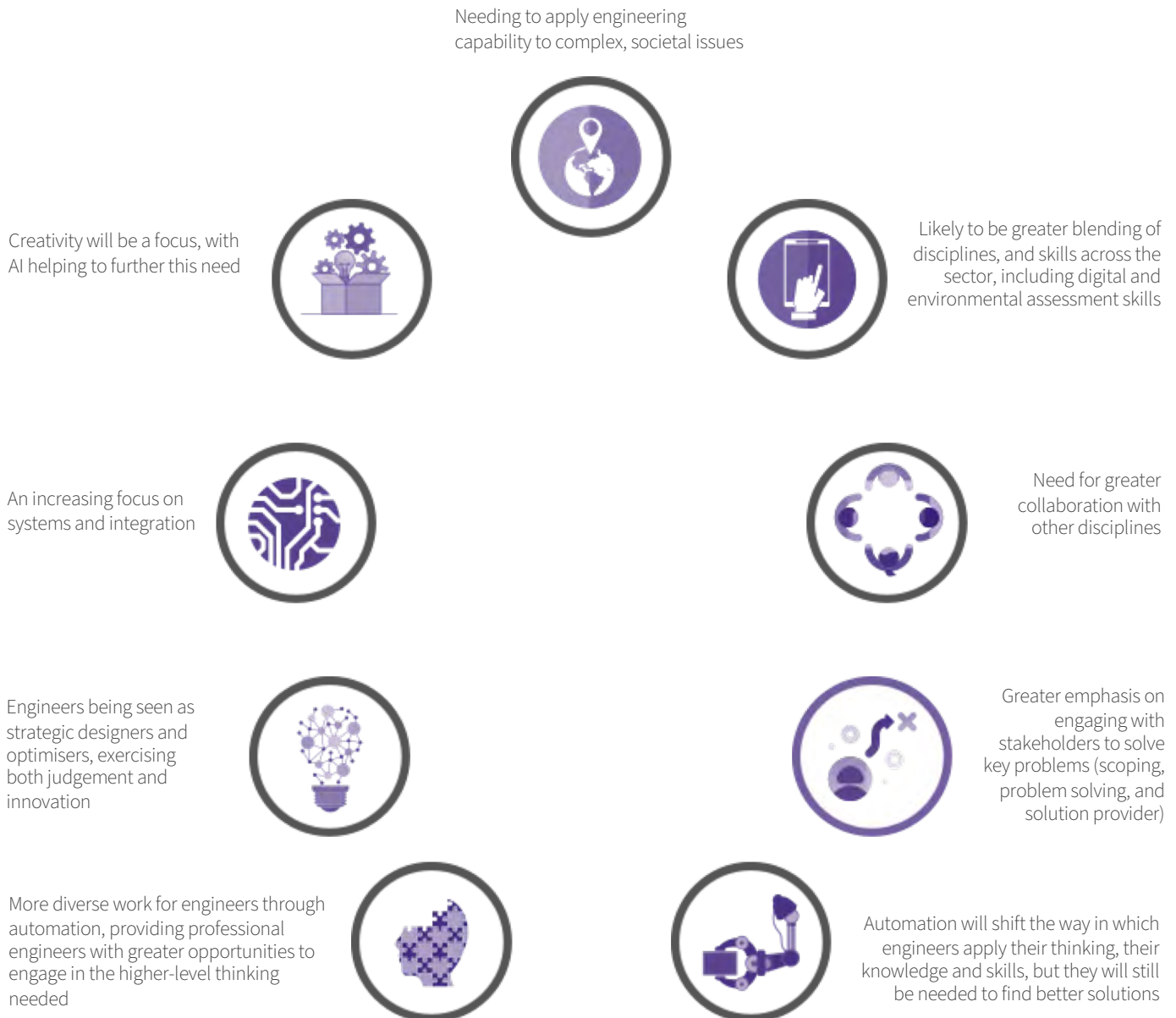
Connected devices enable healthcare organisations to streamline operations, business processes, and aid in real-time patient care

Digital engineering, which connects emerging technologies with reliable, structured data, enhances product delivery and asset management across the lifecycle: **planning** – improved cost estimation and concept modelling; **design** – improved accuracy and consultation; **construction** – improved safety, improved cost estimation, and reduced rework; **operations and maintenance** – quicker understanding of faults and incidents, more targeted and preventative maintenance, and better asset-specific data.

WHAT DOES THE FUTURE LOOK LIKE FOR ENGINEERING?

Looking ahead, there are many potential shifts - many related to technology, digital transformation and societal shifts as a whole - that will have an impact on the work of engineers.

To help us better understand the future state for our engineering workforce, we have identified the most likely shifts below that will change what we ask our engineers to do and how they will do it.



Many of these possible futures have been sourced from Engineering Futures 2035: A scoping study, http://www.aced.edu.au/downloads/Engineering%20Futures%202035_Stage%201%20report%20for%20ACED_May_16_2019.pdf

WHAT SKILLS WILL ENGINEERS REQUIRE IN THE FUTURE?

As the future is presenting an evolving landscape for engineering, there is a need to augment existing engineering capabilities with a set of broader skills needed to meet this new landscape.

The broader skills revolve around critical thinking and problem-solving, which all engineers share. They are described below using the concept of six 'engineering habits of mind' ⁷.

Six engineering habits of mind					
1	2	3	4	5	6
Systems thinking Seeing whole systems and parts (and how they connect), pattern sniffing, recognising interdependencies, synthesising	Problem finding Clarifying needs, checking existing solutions, investigating contexts, verifying	Visualising Moving from abstract to concrete, manipulating materials, mental rehearsal of physical space and of practical design solutions	Improving Trying to make things better through experimenting, designing, sketching, guessing, conjecturing, thought experimenting, prototyping	Creative problem solving Applying techniques from different traditions, generating ideas and solutions with others, generous but rigorous critiquing, seeing	Adapting Testing, analysing, reflecting, rethinking

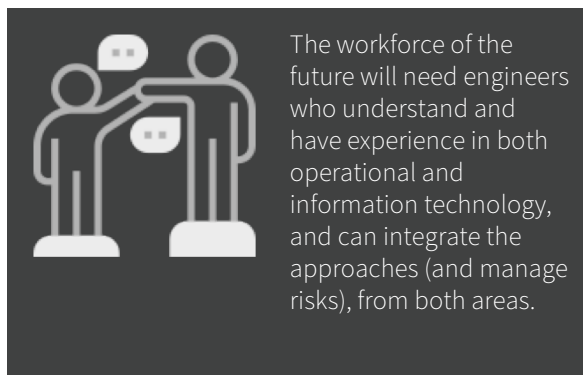
These habits are at the core of successful engineers' thinking, as they reflect the characteristics of the thinking and doing of engineering work. They need to be able to challenge assumptions and apply commonsense thinking.

We will use these habits of mind to inform the professional development of our engineers.

Tertiary education institutions must ensure that future engineers are provided with a thorough grounding in 'First Principles Thinking'. It's essential for engineers to have the ability to think critically and cut to the core of a problem, as well as to be able to really think about the essence of what is being asked of the engineer.

Two fundamental skills of future engineers were emphasised by participants:

- The ability to think
- The ability to communicate and collaborate. ⁸



⁷ Royal Academy of Engineering, Global Engineering Capability Review, <https://www.raeng.org.uk/publications/reports/global-engineering-capability-review>

⁸ Engineering Futures 2035: A scoping study, http://www.aced.edu.au/downloads/Engineering%20Futures%202035_Stage%201%20Report%20for%20ACED_May_16_2019.pdf

WHAT ARE THE CHALLENGES FOR ENGINEERING IN THE ACT?

Given what we know about the profile of the current ACT Government engineering workforce, we recognise that there are challenges ahead that influence the number of engineers needed in the ACT Government, the types of engineering skills required, and the opportunities available to address both engineering capability and capacity.

1. Population growth and supporting infrastructure needs

ACT's population will grow to over 500,000 people by 2029. This will require new physical, digital and social infrastructure like improved transport, communications, cultural and recreational facilities and energy production and storage. The ACT Government is investing now to support the infrastructure needs of this population growth.

The focus will remain on delivering infrastructure and technology that makes life better for Canberrans.

2. Being an informed asset owner

As a significant infrastructure owner, the ACT Government is facing increased demands for improved service, longer asset life and greater accountability. ACT's challenges require a data driven approach, one focused on improving performance and reducing cost of ownership during the entire asset lifecycle.

3. Infrastructure planning now and into the future

Infrastructure that is well planned and thoughtfully delivered can improve people's quality of life, strengthen effective service delivery, support adaptation to a changing climate and break down barriers to social inclusion.

Infrastructure for ACT's future needs to improve people's quality of life, strengthen effective service delivery, drive Canberra's transition to a zero emissions future and break down barriers to social inclusion. Robust planning and thoughtful delivery will be required. Engineering disciplines including digital and environmental engineering are increasingly important as technological advances increase opportunities to change and improve infrastructure.

4. The demand for and supply of engineering skills

Australia ranks 31st globally in terms of availability and diversity of engineers in the economy. Engineering organisations today are already struggling with recruiting and hiring new talent to fill critical engineering roles, including civil engineers, structural engineers and engineering managers. The supply of engineering university graduates is also declining.

The ACT government will need to find new ways to increase numbers of engineers and draw on engineers currently working in non-engineering roles.

5. Assuring quality in engineering and infrastructure outcomes

To make the most of the opportunities that technology and digital bring, we need engineers who can embrace this shift and use their creativity and problem-solving skills to ensure that our infrastructure investment is sound from an engineering viewpoint.

“ The level of investment is dictated by available talent. With higher volumes of activity (\$93bn in NSW & \$54bn in VIC) occurring in neighbouring states, retaining or growing resources to have the right skills will be essential to maintaining capacity and capability to deliver as part of the ACT Government's Infrastructure Plan. ”

WHAT ARE THE CHALLENGES FOR ENGINEERING IN THE ACT?

“ The problem doesn’t lie in the pipeline of prospective students, contrary to common belief. A recent report has shown that Year 12 participation in Australia in Intermediate Mathematics is around 20 per cent for boys while for girls it is around 18 per cent.

This suggests that the pipeline for girls into engineering isn’t too dissimilar to that for boys, yet girls don’t go on to choose engineering at the same rate.⁹ ”

6. The potential impact of technology and digital transformation

Engineering knowledge and skills can help deliver infrastructure improvements through technology changes and digital engineering practices, to name just two ways in which engineers can contribute. For example, in transport, technology could change our demand for roads through using autonomous and shared vehicles, smarter road pricing and scaled remote working opportunities. The production of energy and its storage and distribution technologies could provide consumers more choice and control over how they meet their energy needs.

The ACT Government’s Digital Strategy adopts a ‘digital by default, digital by design’ approach, which means embedding digital service delivery into new projects. The project pipelines in key sectors like health, education and community services include significant investments in new ICT infrastructure to support more effective, digitally-led service delivery.

7. How climate change is driving our work

Building on the good progress on climate change action in recent years, the ACT Government has set ambitious targets which require urgent ongoing action.

Engineers will need to collaborate with others in the sector to innovate and design new ways to reduce emissions. With our aim to be net zero by 2045, this will require an ongoing commitment to achieve.

This is an exciting time to be an engineer.

8. Diversity across our engineering workforce

The value of diversity in the workforce, including the positive impacts on business performance, is now widely recognised. Research shows that diverse teams perform better and deliver higher quality outcomes. Individuals from different genders, races, background and experiences bring different perspectives that can lead to innovative solutions.

The quality of the solutions we deliver is enhanced by diversity. To deliver the best outcomes for Canberra, our workforce needs to reflect the society it is supporting.

Engineers possess valuable critical thinking and problem-solving skills regardless of identity or background. However, engineering is the most male-dominated field in STEM. Less than 14% of the Australian engineering workforce is female.

We are slightly ahead of these figures, with 17% of engineers in the ACT Government identifying as female.

9. Being able to fully understand our infrastructure

When infrastructure is lacking, people can experience congestion, rising bills, outages, and declining service standards. Engineering expertise is instrumental in providing an evidence base to guide infrastructure decision making and focus attention on the investments and reforms that will improve citizens’ living standards.

10. Engaging engineers in the early phase of design

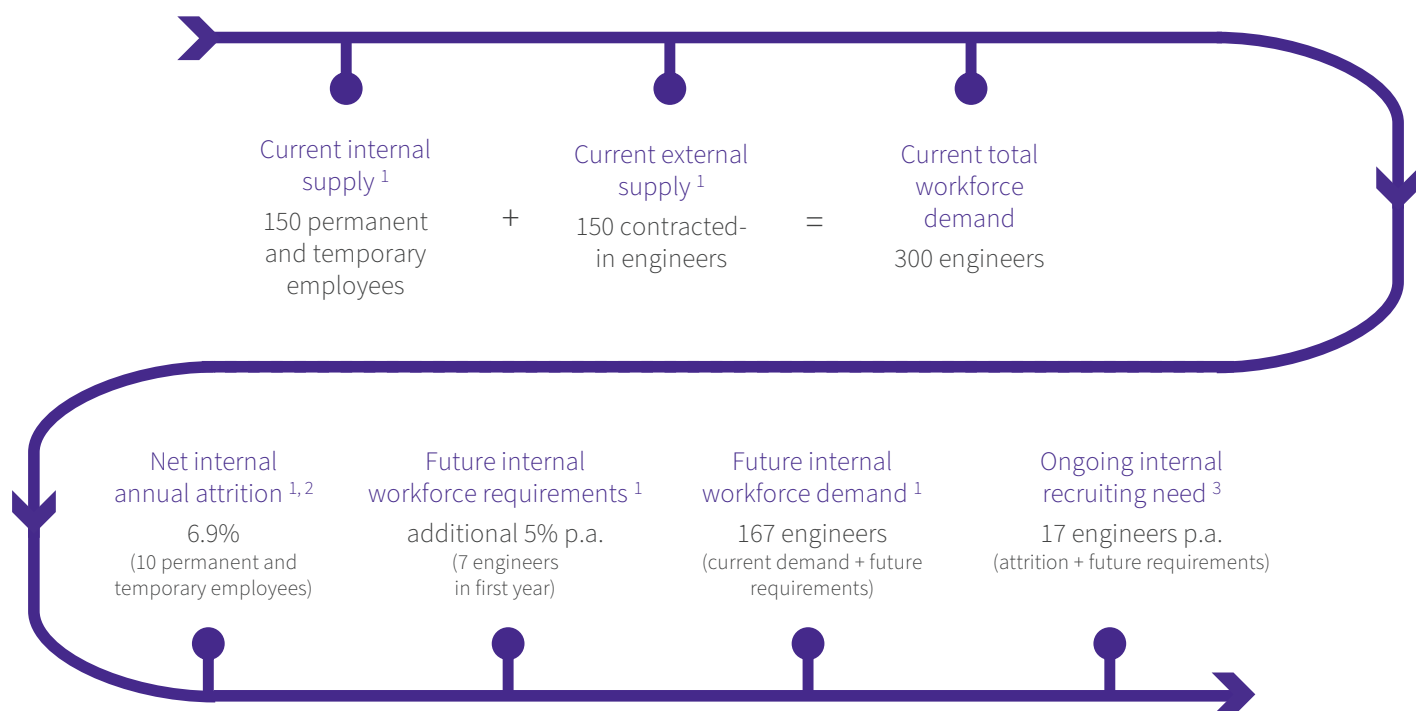
The expertise of engineers is valuable at all stages of infrastructure design – particularly in relation to safety, cutting edge possibilities, limitations and sound decision making. It is critical that engineering expertise is valued and is present in the earliest phases of design, before design parameters and elements become difficult to change.

⁹ Schaffer, G., *Engineering gender equality*.
<https://pursuit.unimelb.edu.au/articles/engineering-gender-equality>

WHAT IS THE SIZE OF THE ENGINEERING WORKFORCE WE WILL NEED?

To help inform the opportunities to maintain and grow the engineering workforce across the ACT Government, we have developed a scenario that identifies potential recruitment needs for the ACT Government.

This scenario is based on an expected increase in engineering capability needed to meet the infrastructure plans for Canberra across the lifetime of the Workforce Plan.



Assumptions

- ¹ These are estimated figures based on FTE (full time equivalent). Total number of individuals (headcount) will be higher.
- ² Net annual attrition is all inflows (recruitment) less outflows (retirements, resignations) from current internal supply. If gaps are not addressed, this will accumulate.
- ³ There is likely to be a peak in attrition in approximately ten years when a significant number of engineers reach retirement age.
- * Internal refers to permanent or temporary ACT Government employees. External refers to contracted-in engineers.

These numbers are estimates and indicate the need for the public and private sector to employ an additional 25 engineers each year to maintain current capacity. Workforce planning activities at the Directorate level will be needed to confirm the likely picture for each organisation.

There may be a greater need for some engineering disciplines which may have low supply compared to others. These numbers are primarily infrastructure focused. The digital transition, for example, is expected to see a growing requirement for staff.

“ Attracting and retaining key talent with diverse thinking and specialised skills requires a targeted approach, tailored unique employee cohorts and critical capabilities. ”

WHAT ARE OUR ENGINEERING WORKFORCE RISKS AND HOW DO WE ADDRESS THEM?

To understand how we are positioned for the future, we have looked at:

- current engineering workforce demographics
- the future for engineering
- future skill requirements
- challenges for engineering, and
- the potential supply and demand for ACT engineers.

Given this expected future, there are several potential risks we need to consider and mitigate to ensure we have the right engineering capability for the future. The potential risks are described in the table below, with the rating of the risk ¹⁰.

The benefits we would expect to see if we can take the actions identified in the *Implementing the ACT Government Engineering Workforce Plan* section are also included below.

Potential risks	Risk rating	Expected benefits if we are able to address these risks
1 Planned investment in ACT infrastructure builds require more engineering capacity than is currently available in 2020	High	<ul style="list-style-type: none"> ▪ Major projects continue to be delivered to the standard required by the ACT Government ▪ ACT Government is seen as an employer of choice for engineers
2 Infrastructure projects are slowed, delayed or below standard due to a shortage of engineers		
3 Sub-optimal project outcomes are achieved where project decisions are made with inadequate engineering input	High	<ul style="list-style-type: none"> ▪ Engineering decisions are sound, can withstand scrutiny and continue to be delivered to the standard required by the ACT Government
4 Engineers are not engaged at early stages in project development		
5 Attrition accelerates over the next ten years, due to the ageing engineering workforce	Serious	<ul style="list-style-type: none"> ▪ A critical mass of ACT Government engineers is sustained
6 The supply of engineering graduates continues to slow, due to current disruption in the tertiary education sector	Serious	<ul style="list-style-type: none"> ▪ ACT Government is competitive in attracting graduates
7 Less opportunity for engineering experience to contribute towards meeting ACT Government commitments (infrastructure, digital, environmental)	Serious	<ul style="list-style-type: none"> ▪ Delivery of ACT Government commitments with a strengthened engineering contribution to outcomes
8 The supply in engineering disciplines does not match the disciplines required by the ACT Government	Serious	<ul style="list-style-type: none"> ▪ The right type of engineering capability can be applied to ACT Government engineering work
9 Not being a fully-informed client, or not being able to interpret what is required and what is delivered by the private sector	Medium	<ul style="list-style-type: none"> ▪ ACT Government can make better decisions when engaging with the private sector
10 Lack of gender diversity means our workforce does not reflect our Canberra community, and engineering advice and solutions are impacted	Medium	<ul style="list-style-type: none"> ▪ ACT Government is seen as an employer of choice for female engineers
11 ACT Government engineers become frustrated by insufficient engineering expertise applied in infrastructure decision making	Low	<ul style="list-style-type: none"> ▪ ACT Government engineers are better able to influence decisions ▪ ACT Government engineers are appropriately involved in decision making, contributing to sound, defensible decisions

¹⁰ Risk table sourced from: ADAPT - An ACT Public Service Strategic Workforce Planning Toolkit
https://www.cmtedd.act.gov.au/_data/assets/pdf_file/0004/1124329/ADAPT-Strategic-Workforce-Planning-Toolkit.pdf

IMPLEMENTING THE ACT GOVERNMENT ENGINEERING WORKFORCE PLAN

The actions identified in the following pages reflect ways in which the ACT Government will work across the public sector, and with the private and tertiary education sectors, to best position engineering for the emerging ACT context.

Taking these actions will place the ACT Government in a better position, by having engineers with the right skills available to meet the future needs of government and the Canberra community.

These actions are either unfunded and may seek future ACT Government budget funding or else will partner with current ACT Government processes to enable delivery within current resources.

1. Boost the recruitment of engineers, targeting entry-level and diverse groups	2. Optimise our existing ACT Government engineering workforce	3. Strengthen the engineering profession in the ACT	4. Collaborating with key stakeholders to implement the Workforce Plan
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The ACT Government has an ageing engineering workforce. Developing a pipeline of new engineers is a priority. Rich diversity amongst ACT's engineering profession will support sound decision making and quality infrastructure outcomes.

We need to proactively attract engineers from several sources.

Success measures

- Steady pipeline of quality, diverse engineering graduates.
- Greater than 25% female engineers by 2025 and the ACT Government is seen as an employer of choice for female engineers.
- The ACT Government employee value proposition (EVP) is highly attractive to prospective and existing engineers everywhere.

Actions	Timeframe	Responsibility
1A Assist the ACT Government Graduate program to improve the attraction and retention of engineering graduates and ensure engineering positions are identified and available within each cohort	Short-term	Chief Engineer; Directors-General
1B Develop an ACT Government engineering cadet and internship program to support young people to undertake formal engineering studies with practical working experience	Long-term	Chief Engineer; Directors-General
1C Target recruitment to encourage diversity, so the engineering workforce is more representative of the Canberra community	Long-term	Chief Engineer; Directors-General
1D Develop an employee value proposition (EVP) to show the benefits of working as an engineer in the ACT Government	Short-term	Chief Engineer
1E Engage with universities (for example, college open days) to talk about engineering opportunities in the ACT Government	Short-term	Chief Engineer

Short-term – one year | Medium-term – two to three years | Long-term – four to five years

1. Boost the recruitment of engineers, targeting entry-level and diverse groups	2. Optimise our existing ACT Government engineering workforce	3. Strengthen the engineering profession in the ACT	4. Collaborating with key stakeholders to implement the Workforce Plan
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The ACT Government highly values its existing engineering workforce and is committed to further investing in developing the workforce to its potential.

Engineers will have a range of growth opportunities in addition to foundational learning opportunities.

An increased focus on supporting ACT engineers in their professional careers will not only retain good engineers and inspire strong engagement, it will build an even stronger reputation and help to attract the highest quality recruits.

Success measures

- Turnover is low, but not zero. Good people are retained.
- Professional development is building pools of strong candidates for career progression.
- ACT engineers feel valued, and value their employment. High employee engagement drives discretionary effort.

Actions	Timeframe	Responsibility
2A Work with ACT Government Directorates and Agencies to incorporate engineering requirements into their workforce plans, including identifying current skill shortages	Short-term	Chief Engineer; Directors-General
2B Introduce a professional development program for ACT Government engineers to enhance knowledge and maintain up-to-date technical skills	Short-term	Chief Engineer
2C Introduce a mentoring program for ACT Government engineers to learn from internal and external experts	Medium-term	Chief Engineer
2D Introduce a government to industry secondment program so engineers can gain experience in both the public and private sector to better understand the working requirements of each sector	Medium-term	Chief Engineer; Directors-General
2E Work with professional associations to develop a pathway for ACT Government staff to become chartered/registered	Medium-term	Chief Engineer

Short-term – one year | Medium-term – two to three years | Long-term – four to five years

1. Boost the recruitment of engineers, targeting entry-level and diverse groups	2. Optimise our existing ACT Government engineering workforce	3. Strengthen the engineering profession in the ACT	4. Collaborating with key stakeholders to implement the Workforce Plan
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Deep knowledge, skills and capability are pivotal to the strength and value of an engineering workforce.

Tertiary qualifications and compliance with registration legislation are part of the picture. Ongoing professional development will further grow the breadth and depth of capability ACT needs to build its infrastructure for the future.

Support for research and innovation, and partnering with the education sector, will complement more traditional professional development programs.

Success measures

- The ACT engineering profession has established roots and grown branches and connections across the sector.
- ACT infrastructure is built efficiently and effectively through engineering involvement.
- Quality infrastructure outcomes in ACT build ACT Government reputation.
- A symbiotic relationship with the education sector is active, mutually beneficial and recognised.

Actions	Timeframe	Responsibility
3A Develop a Digital Engineering Strategy and associated training program	Medium-term	Chief Engineer
3B Develop policies and procedures to ensure compliance with engineers registration legislation	Medium-term	Chief Engineer; Directors-General
3C Support a review and ongoing implementation of the Infrastructure Officer and Infrastructure Manager positions classifications	Medium-term	Chief Engineer
3D Create an ACT Government-funded Technology and Innovation Fund to support research and innovation in the engineering and infrastructure sector	Medium-term	Chief Engineer; Directors-General
3E Work with the tertiary education sector to support growth and capabilities of civil engineering programs, feeding into curriculum and promoting the benefits of working with the ACT Government	Short-term	Chief Engineer

Short-term – one year | Medium-term – two to three years | Long-term – four to five years

1. Boost the recruitment of engineers, targeting entry-level and diverse groups	2. Optimise our existing ACT Government engineering workforce	3. Strengthen the engineering profession in the ACT	4. Collaborating with key stakeholders to implement the Workforce Plan
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The success of this Workforce Plan will be driven by closely tracking and reporting progress, and re-steering when necessary. Active and focused management will need to include mechanisms to collect data from and about the workforce. This data will include workforce metrics, and qualitative data regarding the perceptions, experiences and ideas of our engineers.

The strength of the engineering workforce will also be bolstered through supported collaboration between engineers and recognition of engineering excellence.

Success measures

- Ongoing tracking and reporting of the Workforce Plan provides evidence of progress and achievements, enhancing the reputation of engineering in the ACT.
- Healthy competition amongst ACT engineering providers is balanced with healthy respect and collaboration.

Actions	Timeframe	Responsibility
4A Establish an ACT Government Engineers network and online hub to share knowledge and collaborate on projects	Short-term	Chief Engineer; Directors-General
4B Recognise engineering excellence, leadership and innovation in the public sector through the introduction of an annual Chief Engineer award	Medium-term	Chief Engineer
4C Establish an annual engineering workforce survey to set a baseline of current engineering skills and assess progress towards the workforce required for the ACT	Medium-term	Chief Engineer
4D Undertake annual evaluation and reporting of the Engineering Workforce Plan to Cabinet and publicly, to track implementation of actions and respond to changes in the industry	Medium-term	Chief Engineer

Short-term – one year | Medium-term – two to three years | Long-term – four to five years

