# DIGITAL SKILLS ANALYSIS

TRAINING PACKAGES, INDUSTRY SKILLS FORECASTS AND OCCUPATIONAL TRENDS

## FINAL REPORT

MAY 2020

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*An abridged version of this report is available as an interactive digital report on the Expert Panel's website. This is to optimise the value of the analysis to readers by enabling them to view the animation of the charts and interrogate the data according to their particular industry or interest.*

# DIGITAL SKILLS ANALYSIS

## KEY OBSERVATIONS

There is strong evidence that occupations are becoming more **highly skilled, more general and more personal** over the last 30 years, features that are precisely those that are hard to automate.

**Automation is the most widespread digital anxiety in industry**

- Automation is a natural consequence of the strategic adoption of digital technologies and accordingly, a primary force in digital transformation. Automation was central to more than half of all funded digital training package development projects in 2019 and the most intensively and widely discussed digital challenge by far among most industry's Skills Forecasts.

**Digital skills are deliberately written into training packages without referencing specific technology**

- Digital skills are typically expressed within Units of Competency in broad, encompassing terms.  This is to future-proof the training package and broaden the applicability of the unit within industry but it may contribute to perceptions of training packages as being 'out of date' with current technology.  Interpreting those broad terms, consistent with the evolution of the relevant technology, is currently the responsibility of registered training organisations.

**Higher skills are resistant to automation, soft skills provide resilience**

- Higher skills are hard to automate. An incremental increase in skill level of an occupation results in about a 17% reduction in automation susceptibility;
- The effects of automation are felt disproportionately by younger people, since historically they hold more of the lower skilled jobs than older age groups, which has implications for industries' established entry level pathways;
- Among training packages, the higher the qualification level, the greater the demands of soft skills;
- In the long-term occupational data, the workforce is becoming more highly skilled;
- On the demand side, employers are increasingly looking for higher skills and the workforce, comprising growing proportions of higher and soft skills, is becoming less susceptible to automation over time;
- The share of highly skilled and personal service workers is increasing at the expense of the lower skilled workers, but at almost every skill level the most numerous occupations are those that are less automatable.

## 1. CONTEXT

The Digital Transformation Expert Panel has been established to provide advice on *'how Australia's Vocational Education and Training (VET) system can most effectively respond to digital change underway across industry and its impact on the nation's workforce'*.

The work of the Expert Panel is guided by a two-stage methodology, the first stage being research and analysis, the second stage focussing on consultation and engagement with key stakeholders.

This report represents the key findings from two activities in the first stage:

- An analysis of **training package** content to identify the existing coverage of digital skills and how this relates to supply and demand in the economy; and
- An analysis of the 2019 **Industry Skills Forecasts** to identify future trends and priorities for digital skills and how they propose to meet this need.

## 2. INTRODUCTION

Digital transformation is the change associated with the application of digital technology in all aspects of human society. Whilst far from a new trend, the pace of digital transformation change is increasing and has substantially quickened over the recent period as businesses seek to build operational resilience to, and recovery from, COVID-19.

Nationally endorsed training packages are the mechanism by which industry codifies the skills and knowledge needed by the workforce in Australia and enables the VET system to deliver training focussed on meeting those needs. Each Training Package comprises a suite of 'Units of Competency' (sometimes referred to as occupational standards), a qualification framework which sets out how the Units are packaged together to form qualification outcomes, and a set of assessment guidelines which articulate the conditions and approach for assessment against the units of competency.

Training Packages are regularly updated to ensure they continue to meet evolving skill needs. Driving this process are Skills Forecasts which are prepared once every three years by each Industry Reference Committee (IRC) with an update provided in the intervening years. The Forecasts identify each industry's trends, opportunities and challenges, and the skills gaps and emerging skill needs that need to be dealt with through the training package. These changes are typically actioned through a range of projects resulting in the incorporation of revised or new Units of Competency, Skill Sets or qualifications.

This report captures the findings from analysis of the 57 training packages currently listed on the national register to determine the prevalence of digital skills within 16,000+ units of competency and 190,000+ performance indicators.  At the Panel's request, the analysis also considers the occurrence of soft skills within training packages which acknowledges their growing importance for existing workers as technology and automation makes jobs 'more human' and their fundamental role in enabling people to engage in learning.

The analysis also identifies the primary digital challenges included in the 55 individual Industry Skills Forecasts prepared by IRCs and how they propose training packages respond to those issues.

Finally, and to further inform the Panel's deliberations on how priorities for digital skills are shifting over time and the challenge that is facing the VET system, the analysis considers the shifting occupational profile of Australia's workforce over the last thirty years[1].

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[1] Due to the interrelated nature of different industries, there is no one-to-one correlation between the number of Industry Reference Committees (66) and the number of training packages (57) and Skills Forecasts (55)

## 3. DIGITAL PRIORITIES AMONG INDUSTRY SKILLS FORECASTS

In seeking to determine how the VET system is currently responding to digital skill needs and the digital skill priorities to which the VET system will need to respond in the future, the Panel first endeavoured to answer two questions; how digital skills are currently represented in Australia's training packages and the key digital skills priorities for the future as identified by IRCs in their Skills Forecasts.

Among Skills Forecasts we found that automation was the paramount digital concern and that technology skills, far from being of universal importance, were considered most important in only certain industries and considerably less so in others.

In some industries, automation represents a new or near future challenge where in others automation technologies are mature. Anxieties stem from the fear of losing jobs and routine tasks and workflows being automated. Other Skills Forecasts discuss the possibility of workers being 'de-skilled' by such technologies or acknowledge the challenge in retraining workers to move into new roles. In certain cases, the impetus for automation is meeting a skills gap but the common rationale is improved safety, reliability and reducing costs.

## TEXT MINING SKILLS FORECASTS

While Skills Forecasts contain considerable variation, they do contain common sections and standardised questions that are asked of each IRC.

Within each Skills Forecast, one of the most relevant sections relates to generic skills and requires each IRC to rank in order of importance a list of 12 'Key Generic Skills'.

1. Learning agility/ information literacy/ intellectual autonomy and self-management
2. Communication/virtual collaboration/ social intelligence
3. Design mindset/ thinking critically/ systems thinking/problem solving
4. Technology use and application skills
5. Language literacy and numeracy skills
6. Managerial/ leadership skills
7. Customer service/ marketing skills
8. Science, technology, engineering and mathematics (STEM) skills
9. Data analysis skills
10. Financial skills
11. Environmental skills
12. Entrepreneurial skills

Whilst there is a degree of overlap between several of the generic skills and there are notable limitations[2], the 'technology use and application skills' category was deemed most relevant to the work of the Panel because it is defined[3] as being the 'ability to:

- create and/or use of technical means, understand their interrelation with life, society, and the environment
- understand and apply a scientific or industrial processes, inventions, methods etc
- deal with increasing mechanisation and automation and computerisation
- do work from mobile devices rather than from paper.'

Analysing how important IRCs consider 'technology use and application skills' to be in relation to the other 11 generic skills revealed one key takeaway; that 'technology skills' were regarded highly in 12 Skills Forecasts (below) but that for the remaining Skills Forecasts, it was deemed a middle order priority.
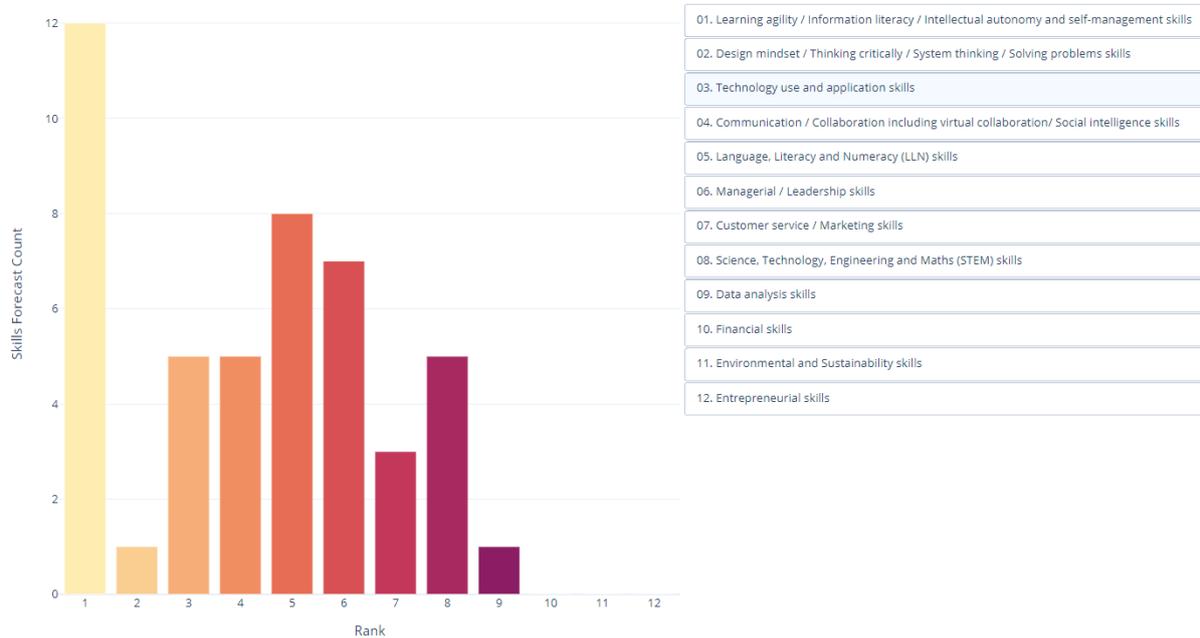
- Electricity Supply Industry Generation
- Electrotechnology
- Forest and Wood Products
- Gas Supply
- Information and Communications Technology
- MSL Process Manufacturing, Recreational Vehicle and Laboratory (Laboratory operations)
- MSM Process Manufacturing, Recreational Vehicle and Laboratory (Manufacturing)

- PMA Process Manufacturing, Recreational Vehicle and Laboratory (Chemical, Hydrocarbons and Refining)
- PMB Process Manufacturing, Recreational Vehicle and Laboratory (Plastics, Rubber and Cablemaking)
- Textiles, Clothing and Footwear
- Transmission, Distribution and Rail Sector
- Water

So rather than being a universal trend, the primacy of technology skills is highly concentrated in certain industries and progressively less important in others (Figure 1).

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[2] While the ranking of Generic Skills may be meaningful for a specific industry the means through which the data is gathered prevents it from being more reliable at a system wide level. Were the data to be collected through a central survey, rather than separate surveys run through each Skills Service Organisation (SSO), the results might be more meaningfully aggregated.

[3] https://docs.employment.gov.au/documents/irc-skills-forecast-and-proposed-schedule-work

## FIGURE 1. TECHNOLOGY SKILLS RANKING DISTRIBUTION (GENERIC SKILLS) IN SKILLS FORECASTS



| | |
|---|---|
| 01. Learning agility / Information literacy / Intellectual autonomy and self-management skills | |
| 02. Design mindset / Thinking critically / System thinking / Solving problems skills | |
| 03. Technology use and application skills | |
| 04. Communication / Collaboration including virtual collaboration/ Social intelligence skills | |
| 05. Language, Literacy and Numeracy (LLN) skills | |
| 06. Managerial / Leadership skills | |
| 07. Customer service / Marketing skills | |
| 08. Science, Technology, Engineering and Maths (STEM) skills | |
| 09. Data analysis skills | |
| 10. Financial skills | |
| 11. Environmental and Sustainability skills | |
| 12. Entrepreneurial skills | |

*Source: Skills Service Organisation (SSO) websites (various)*

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*How to use the chart in Figure 1*

*You can click on any of the skills in the table of Generic Skills on the right and the chart will display how many IRCs chose that skill at each rank level.*

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### KEY INSIGHT: AUTOMATION IS THE MOST WIDESPREAD DIGITAL ANXIETY IN INDUSTRY

The second question for the Skills Forecast data was to identify trends and priorities for digital skills and how IRCs propose to meet these needs. Among the 55 published Skills Forecasts for 2019 (Appendix B), a total of 28 proposed projects contained some form of digital skill[4].  Seventeen of these proposed projects resulted in funded training package development. Projects relating to automation technologies dominated in these results, appearing in almost half of all funded digital projects (eight out of 17) and appearing twice as often as projects with the next highest digital term.

Funded projects relating to automation were granted in the areas of food production and processing, electricity generation and transmission and the use of dynamic positioning technology in the maritime industry.

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[4] Adding a tagging system to the National Schedule would allow areas of cross sectoral interest such as Automation and Digital Skills to be more easily analysed at a system level.
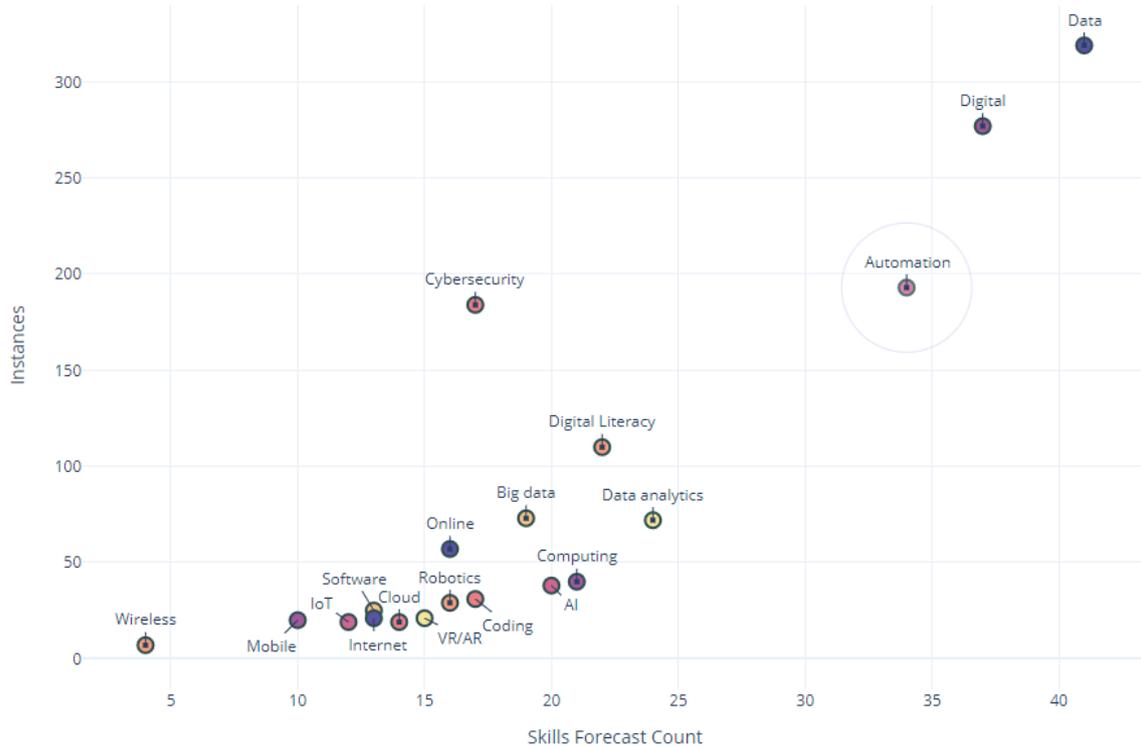
Though the projects vary considerably, the training response is similar.  Since many of the previously manual tasks are taken care of, the primary focus is on monitoring automated systems where the operator is responsible for ensuring the smooth operation of a process. Monitoring activities range from the interpretation of data readouts and dashboards to external factors, such as in dynamic positioning where the operator may monitor the movement of supply vessels or helicopters around the vessel. In the fishtech and aquabotics sphere, the impact of automation and remote operations is widely recognised, with proposed training response to automation focussed on the planning and operational adjustments required for compliance purposes in the industry.

One limitation of looking at proposed projects in the Skills Forecasts is that the field of view is too narrow, that is, less than a quarter of IRCs had digital projects funded (15 of 66 IRCs).

To therefore identify what digital skills are being prioritised by industry more broadly, AIS carried out a text mining process on the 'Challenges and Opportunities' sections of each of the 55 Skills Forecasts to determine the frequency (that is, how many times a particular term was mentioned) and the extent (how many Skills Forecasts mentioned a term) of digital terms in all documents (Figure 2.).

Leaving aside general terms such as 'digital'/'data', the term 'automation' again dominates and aligns with the earlier analysis of proposed projects. While there may have been only eight funded projects relating to automation, the practice was mentioned nearly 200 times across 34 out of 55 Skills Forecasts (or 62%). This may suggest some level of discrepancy between the extent to which automation, and other digital skills, were discussed and the number of projects that eventuated in funding.

*Source: Skills Service Organisation (SSO) websites (various)*

The fact that automation formed the basis of a majority of all digital skills projects in the year does make intuitive sense given the ultimate promise of digital transformation is the seamless connection of devices and data, with a minimum of human input.

## 4. DIGITAL AND SOFT SKILL PREVALENCE IN TRAINING STANDARDS

The following analysis aims to identify the existing coverage of digital and soft skills in training packages and provide an insight into how well national training products are already positioned to help upskill and reskill the existing workforce.

The analysis found that whilst digital skills are widely prevalent within Units of Competency, there is rarely reference to specific software or tools. This is clearly a deliberate practice on the part of training package authors to enable flexibility in interpretation and to future-proof Units of Competency against rapid changes in technical terminology.

To better understand which training packages will need to respond to the increasing impact of digital transformation and automation, the analysis has drawn on work by the Office of the Chief Economist on the susceptibility to automation of Australian occupations[i]. Combining this data with qualification taxonomy reports from training.gov.au[ii] the analysis has determined the average automation susceptibility for each training package.

This data was further combined with the prevalence of digital skills results to investigate any relationship between digital skills and automation susceptibility. No such evidence was found. This means that a relative lack of digital skills in a training package does not necessarily correspond to an increase in automation susceptibility for occupations covered by that training package.

The analysis of soft skills among training packages, however, has found such a relationship, that the greater the presence of soft skills in a given training package the lower the likelihood of occupational susceptibility to automation. It also found a very strong relationship between soft skills and qualification level, that is, soft skills comprise a far greater share of the skills codified in higher qualifications than lower qualifications.

This result is logical given soft skills display two attributes that make them hard to automate; they often rely on social intelligence and they are by definition[iii] general.

Soft skills have been described elsewhere[iv] as 'transversal' skills, in that they are not particular to a specific job but instead have wide applicability across industries. In this sense, the presence of soft skills in an industry lessens the likelihood of automation.  It also offers an insight into the degree to which the workforce, at a basic level, is adaptable to changing circumstances and therefore less vulnerable to disruption in general.

## DIGITAL SKILLS PREVALENCE IN TRAINING PACKAGES

### KEY INSIGHT: DIGITAL SKILLS STANDARDS DROP THE DETAILS

The analysis of training packages included a text analysis of all Performance Evidence indicators (where available) inside all published Units of Competency. The goal was to determine the prevalence and nature of digital and soft skills in existing training packages. The underlying assumption in this work is that if the Performance Evidence section lists the skills required to demonstrate competency in a Unit, finding digital or soft skill **terms** among this list would amount to finding digital or soft **skills** in each Unit of Competency.

The analysis established 500 key digital terms[5] which were then searched for in the Performance Evidence of each Unit of Competency on the national register (16,772 Units of Competency as at October 2019).

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[5] This digital skills list was developed using an initial human-generated list of digital terms. To expand upon the list, we utilised a word embedding neural network (Word2Vec) to find related terms and synonyms of the initial list. The output list was then manually reviewed to remove incongruous results and passed again to Word2Vec to expand the list further. This process was repeated five times resulting in over 500 digital terms.

## FIGURE 3. FREQUENCY OF DIGITAL TERMS BY TRAINING PACKAGE



*Source: training.gov.au*

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*How to use the chart in Figure 3*

*You can click on any of the training packages in the table of training packages on the right and the chart will display how many digital terms were found in that training package. The chart is limited to display the top 20 results.*

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The top five results represent only 1% of search terms but account for 70% of digital skills found. It is important to recognise that three of the top five terms also happen to be verbs in addition to nouns (you can 'report' a 'report', for example) but this does not fully explain the results (Figure 3).

A prior digital skills content analysis by Gekara et al. in 2017[v] proposed the following;

> *Digital training content in the training packages is expressed broadly and generically, with little reference to specific tools and systems. This is done deliberately, with the aim of making the package flexible and adaptable to the wide variety of workplace tools and systems used by different industries across the sectors.*

The search results quantify Gekara's observation regarding the generic expression of digital terms among Units of Competency. The analysis found a high prevalence of non-specific terminology in relation to digital skills which is deliberate. Given the typical duration of the training package development cycle and the downstream impact on training providers of content changes to endorsed components, authors of the training package products tend to avoid, where possible, referencing specific technologies that might become obsolete.

What this analysis makes clear is that non-specific digital terms in the training package places a significant onus on individual practitioners to be both vocationally current in the specific digital skills used by industry, and on training providers to have access to the specific technologies or equipment.

The lack of specificity in the Units of Competency, may also go some way to explaining industry concerns with the capacity of Training Packages to stay 'up to date' with digital technologies.

The analysis also investigated whether the presence of digital skills among training packages had any relationship to the automation susceptibility of occupations. The prior assumption was that a training package with a *high* prevalence of digital skills would necessarily service a *highly* digitised workplace which would seem *highly* amenable to automation. No relationship was found.

Contradictory examples abound; Printing and Graphic Arts contains one of the highest proportions of digital skills among training packages but also has a high automation susceptibility score. On the other end of the scale, the Sport, Fitness and Recreation Training Package has one of the lowest digital skills proportions but also a low automation score. What this demonstrates is that the mere presence of digital skills is not an inoculation against digital disruption. To paraphrase, it's not the quantity of digital skills, but the quality that matters.

## SOFT SKILLS PREVALENCE IN TRAINING PACKAGES

### KEY INSIGHT: SOFT SKILLS ARE HARD TO AUTOMATE

The panel were also interested in the prevalence of soft skills currently in training packages and any potential relationship that might exist between soft skills and resilience to future disruption. The growing importance of soft skills appear often in literature (Bowles & Corrigan, 2017, p. 19)[x] (DeakinCo & Deloitte, 2017, p7)[vi] so it is of interest to see if this trend is apparent among training packages as a dataset.

The analysis found that the greater the use of soft skills in a particular industry/sector, the lower the automation susceptibility of that industry/sector (Figure 4.). The reasons for this relationship are obvious. Soft skills primarily relate to social or interpersonal skills which are highly non-routine and hard to automate. Critical thinking, another important component of soft skills, encompasses analytical, conceptual and problem-solving skills to assist judgement, another largely human domain.

Soft skills can also be considered as transversal skills, or skills that can be applied in a wide variety of settings. Since automation is typically built around an inflexible and narrow task set, the generality of soft skills further guards against the encroachment of

technology on human work. The identified relationship between soft skills and automation susceptibility, while moderate, justifies the increasing importance being placed on soft skills in the future jobs market.

## FIGURE 4. SOFT SKILL PREVALENCE BY AUTOMATION SUSCEPTIBILITY OF INDIVIDUAL TRAINING PACKAGES



*Source: training.gov.au | industry.gov.au, Mechanical boon - will automation advance Australia - data table | SpringerLink, Table 13 Soft skill taxonomy in English (modified)*

The complete list of individual Training Packages by automation susceptibility and by soft skill prevalence is at Attachment A

The analysis also looked at how the prevalence of digital and soft skills within Units of Competency changes with skill level.

Individual Units of Competency are not prescribed a skill level. This enables a Unit to be packaged into qualifications at a range of skill levels in accordance with the needs of individual industries. It is however, possible to identify the notional skill level of a Unit (AQF level) by finding the average AQF level of all the qualifications that contain that Unit.

Among the five most prevalent digital terms, 'data', 'software' and 'document(s)' generally increased in prevalence with skill level where 'record(s)' and 'report(s)' declined. By way of example, 'data' is about six times as prevalent at the Advanced Diploma level than at the Certificate I level, however there is further variance depending upon how 'data' is used at these levels. Looking at the closest verbs surrounding 'data',

terms like 'analyse data' and 'control data' again increase as the AQF level rises while terms like 'use data' decline.

The results also show a very strong correlation between soft skills and higher skills meaning that the prevalence of soft skills increases linearly as the qualification level rises. By way of example, the soft skills content of a given Certificate II Unit is about half that of a Graduate Diploma, even accounting for the typically longer content of the higher qualification (Figure 5).

## FIGURE 5. SOFT SKILLS BY AQF LEVEL (UNIT COUNT AND SOFT SKILL PREVALENCE)



*Source: training.gov.au | SpringerLink, Table 13 Soft skill taxonomy in English (modified)*

But not all soft skills are created equal. Among the most common soft skills, communication, reading/writing and teamwork do not increase in prevalence with skill level while more advanced soft skills such as goal setting, analytical and conceptual skills, grow strongly. This finding supports the broader results of the analysis. Certain soft skills are not just common to everyone but of common importance at every skill level. Others such as planning, applying principals and analytic skills grow in importance with skill level and will grow in importance alongside increasing demand for higher skills.

Reiterating an earlier point, the prevalence of soft skills of both sorts in a training package can be considered not just a potential measure of that industry's resilience to automation (by association with higher skills) but also a measure of adaptability to changing circumstances by virtue of shared competencies with other industries and across skill levels.

## 5. OCCUPATIONAL CHANGE OVER TIME – THE CHALLENGE AHEAD FOR VET

To further inform the Panel's deliberations on how priorities for digital skills are shifting over time and the challenge that lies ahead for the VET system, the analysis considers the shifting occupational profile of Australia's workforce over the last three decades. This includes structural exchanges between major occupational groups, skill level movements and how these changes relate to occupational susceptibility to automation.

Among the largest occupational groups, the analysis found an obvious trend towards higher skilled and more human service workers, with an increasing share of Professionals, Managers and Community and Personal Service workers in Australia over the last three decades and a decrease in share for all other groups, particularly Labourers.

It also found an increase in demand for higher level skills (Diploma and above) and the relative decline in lower level skills over the last 14 years. The analysis also looked at the education profile of each of the occupational groups and found evidence that within most skill levels the top occupations (30) are progressively becoming less susceptible to automation over time.

### EXPLAINER - ANZSCO: AUSTRALIAN NEW ZEALAND STANDARD CLASSIFICATION OF OCCUPATIONS

ANZSCO is a skill-based classification used to classify all occupations and jobs in Australia and New Zealand.  In ANZSCO, occupations are organised into progressively larger groups on the basis of their similarities. The structure of ANZSCO has five hierarchical levels - major group, sub-major group, minor group, unit group and occupation. This analysis illustrates changes to the workforce at the major and sub-major group level but analysis is conducted primarily at the unit group level. For more

*https://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/FCC055588D3EBA19CA2584A8000E7889?opendocument*

### THE EVER-CHANGING AUSTRALIAN WORKFORCE – A BIRD'S EYE VIEW

### KEY INSIGHT: THE WORKFORCE IS BECOMING MORE HIGHLY SKILLED

At the occupational group level, a clear picture emerges, one where highly skilled labour is comprising an ever-increasing share of the workforce and lower skilled work is in decline. Professionals, Managers and Community and Personal Service workers are increasing as a share of the workforce while other occupational groups shrink in comparison (Figure 6.). Most obviously, the share of Professionals in the workforce has nearly doubled from 16% in 1986 to 27% in 2019, now comprising more than one in

four working Australians.  The share of Community and Personal Service workers, similarly, has also nearly doubled from 4% to 7% of the workforce. The greatest decline can be seen among Labourers whose share of the workforce has fallen by nearly 40% from 12.2% in 1986 to 7.6% in 2019.

FIGURE 6. THE CHANGING FACE OF THE WORKFORCE – OCCUPATIONAL GROUPS AS A SHARE OF THE TOTAL WORKFORCE – 1986-2019
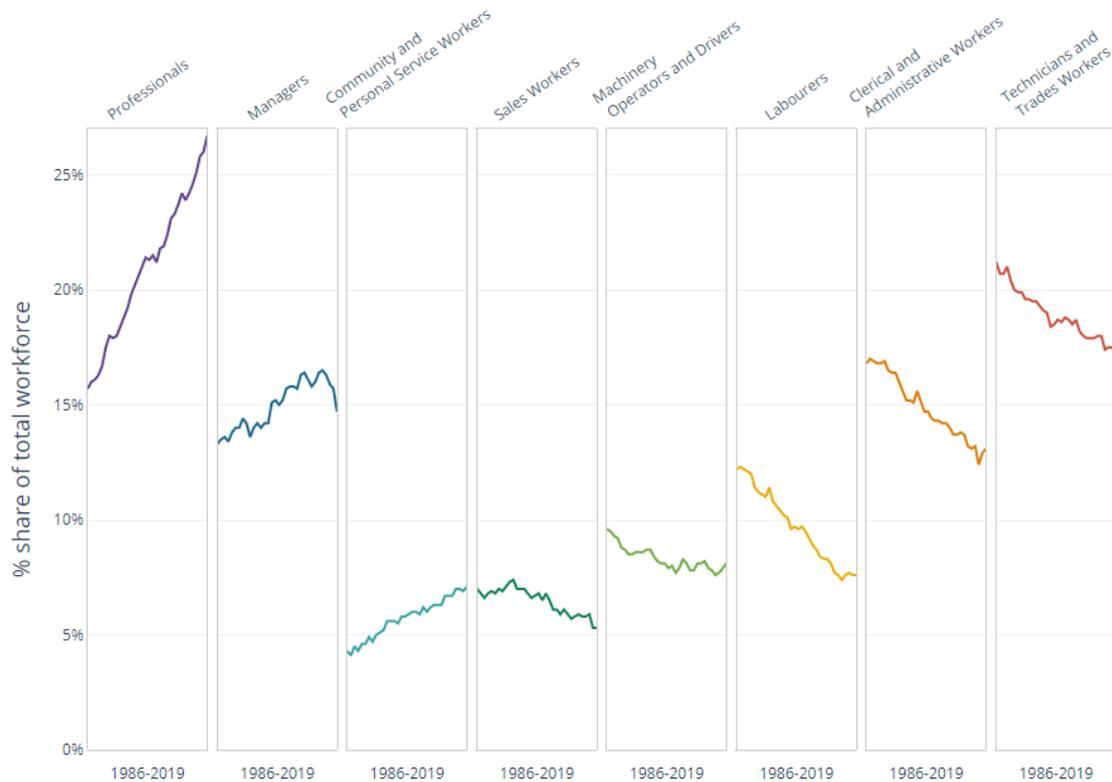


*Source: Australian Bureau of Statistics (ABS) 6291.0.55.003 Table 07. Employed persons by Occupation major group of main job (ANZSCO) and Sex*

This trend does not necessarily spell disaster for vocational occupations. While Professionals are more likely to hold tertiary qualifications, a Manager is about as likely to hold a VET qualification as tertiary and a clear majority of Community and Personal Service workers hold a vocational qualification (Figure 7.).

FIGURE 7. QUALIFICATION UTILISATION BY OCCUPATIONAL GROUP
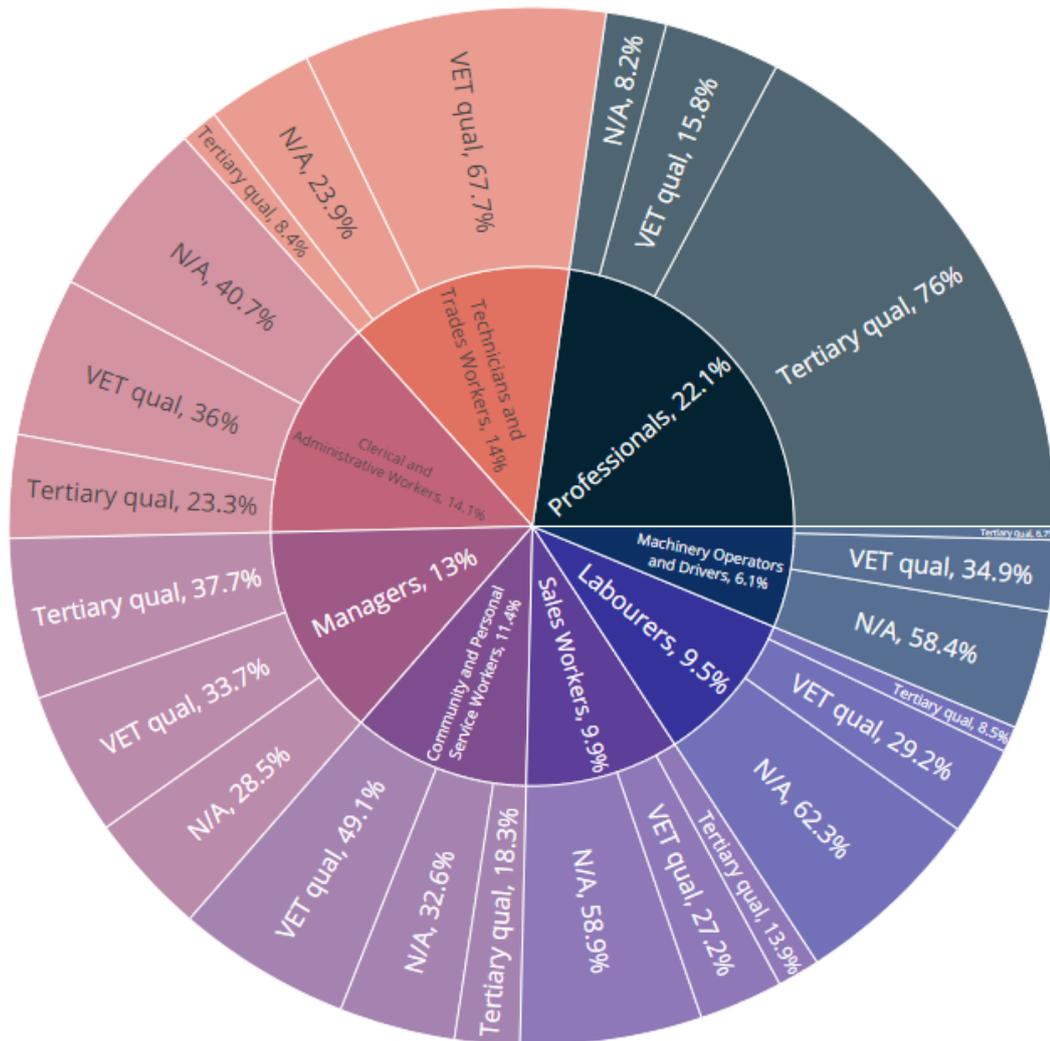


*Source: Australian Bureau of Statistics (ABS) 2016 Census - Employment, Income and Education*

*How to use the chart in Figure 7*

*Clicking on any of the occupational groups in the central circle drills down to that group only. Clicking on the group again, resets the displayed chart.*

The movement towards higher skills is also supported on the demand side of the jobs market equation. The Labour Market Information Portal (LMIP) provides data[vii] on the incidence of qualifications requested in job advertisement data. This analysis presents that data as a share of all advertised jobs over time (Figure 8.). Again, it shows a growing demand for higher level qualifications at the expense of lower level qualifications. Demand for bachelor's degrees and higher have increased by more than a quarter in the last 14 years while on the other end of the scale, demand for workers with a Certificate I or secondary qualification has halved from 20.9% of online advertisements to just 10.7% in 2019.
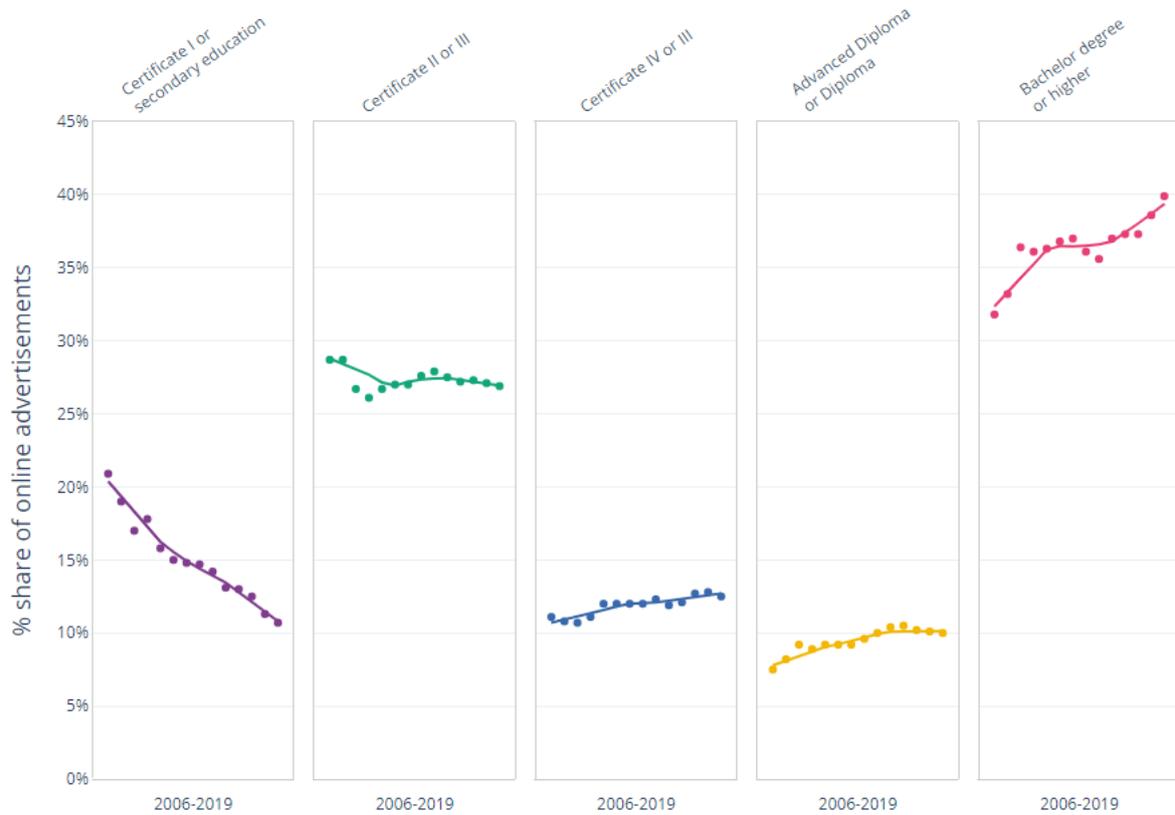
Source: Labour Market Information Portal, Internet Vacancy Index (IVI) data by skill level

## KEY INSIGHT: THE WORKFORCE IS BECOMING LESS SUSCEPTIBLE TO AUTOMATION

The trend towards higher skills can be represented as more than just a movement *between* occupational groups, with the analysis finding evidence that workers are moving away from automatable roles *within* skill levels.

There appears to be a clear trend of the 30 most common occupations in each skill level tending to have lower automation susceptibility over time, or in other words, the more numerous roles over time appear to be those that are less automatable (Figure 9.).

The effect is not apparent at the highest and lowest skill levels since at the highest levels there are relatively few occupations with high automation susceptibility and at the lowest levels there are very few occupations with low susceptibility.

## FIGURE 9. AVERAGE AUTOMATION SUSCEPTIBILITY OF TOP OCCUPATIONS BY SKILL LEVEL
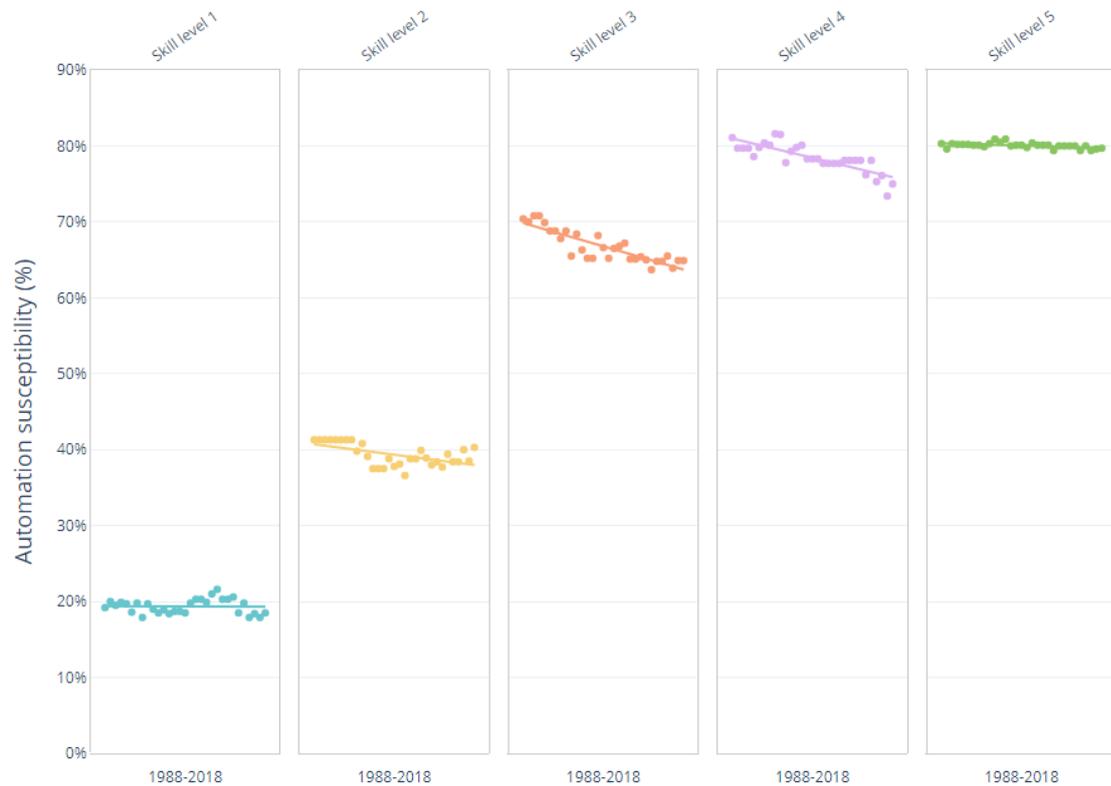


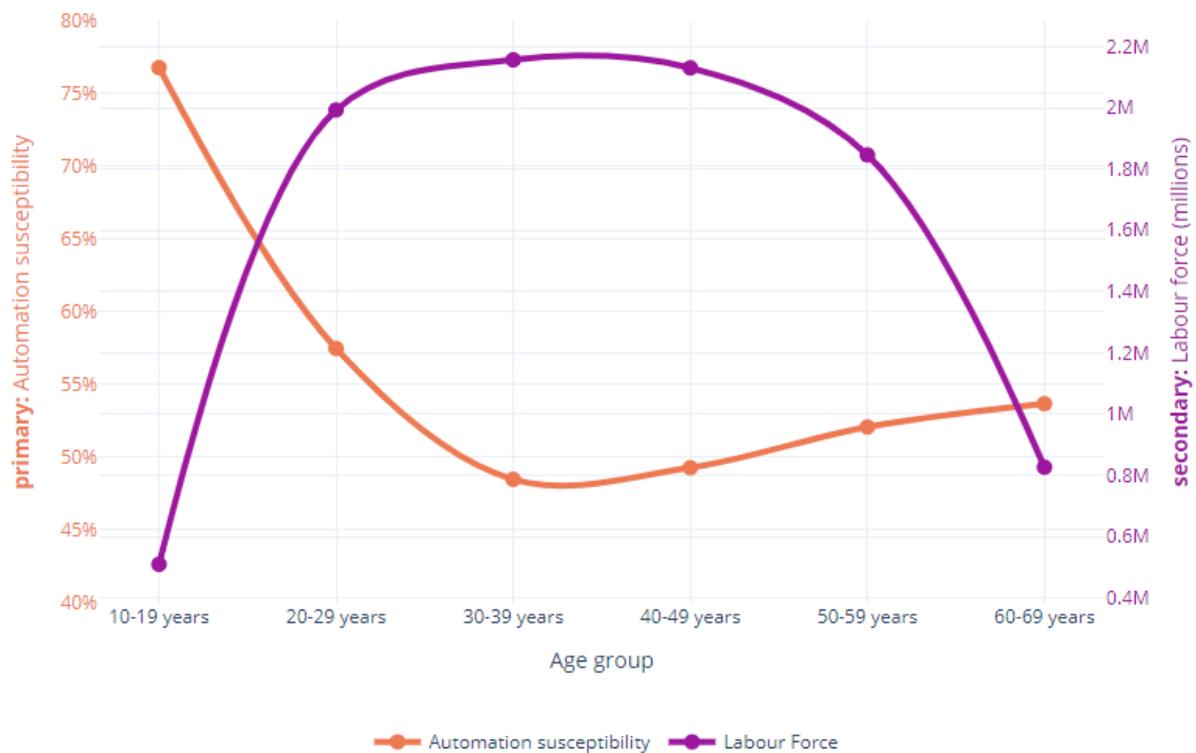*Source: Australian Bureau of Statistics (ABS) 6291.0.55.003 EQ08 - Employed persons by Occupation unit group of main job (ANZSCO), Sex, State and Territory, August 1986 onwards | ABS Cat. No. 1220.0 ANZSCO – Australian and New Zealand Standard Classification of Occupations, Version 1.3 | industry.gov.au, Mechanical boon - will automation advance Australia - data table*

## KEY INSIGHT: SKILL LEVEL AND AUTOMATION SUSCEPTIBILITY ARE HIGHLY CORRELATED

The fact that the workforce is becoming more highly skilled while becoming less susceptible to automation is not a coincidence. The analysis found a strong relationship between automation susceptibility and skill level; with a 17% reduction in automation susceptibility for each increase in skill level.

This has several immediate implications and poses a major challenge for VET, since vocational occupations in general are more at risk of automation than tertiary level qualifications. It also means that the effects of automation are felt disproportionately by younger people, since historically they hold more of the lower skilled jobs than older age groups (Figure 10.).

## FIGURE 10. AUTOMATION SUSCEPTIBILITY BY AGE GROUP



*Source: Australian Bureau of Statistics (ABS) 2016 Census - Employment, Income and Education| industry.gov.au, Mechanical boon - will automation advance Australia - data table*

Over the 30 years to 2019, the composition of Australia's workforce has significantly evolved.  To illustrate this change over the period, the interactive chart below (Figure 11.) can be used to explore several parameters (including automation susceptibility) for nearly all occupations in the economy.

*How to use the chart in Figure 11*

*The occupations are grouped into ANZSCO skill levels (1 being highest) and major occupational groups. Double clicking on a major group in the chart's legend allows you to isolate that group of occupations and if you press the play button in the bottom left, you should see the occupations growing or shrinking over time. While the animation is playing, you can hover over any of the circles which provides an updating data table for that occupation. If you double click on the legend again, all occupations return into view. Holding your mouse down to drag and select an area of interest allows you to zoom into that area. Clicking on the home icon resets the axes back to the original setting.*

## FIGURE 11. CHANGE IN SHARE OF WORKFORCE BY SKILL LEVEL AND AUTOMATION SUSCEPTIBILITY



*Source: Australian Bureau of Statistics (ABS) 6291.0.55.003 EQ08 - Employed persons by Occupation unit group of main job (ANZSCO), Sex, State and Territory, August 1986 onwards | ABS Cat. No. 1220.0 ANZSCO – Australian and New Zealand Standard Classification of Occupations, Version 1.3 | industry.gov.au, Mechanical boon - will automation advance Australia - data table*

### KEY INSIGHT: AUTOMATION IS MAKING JOBS MORE GENERAL

One of the most obvious arenas for digital transformation over the last thirty years has been the office environment and as an example, it provides a clear illustration of the structural effects that automation can have on an industry.

As an occupational Major Group, the number of Clerical and Administrative workers has barely changed, increasing by just over 20% over the last thirty years but the constituent occupations within the Major Group have changed enormously.

Below are the top five performing** occupations among Clerical and Administrative workers.

| OCCUPATION | SKILL LEVEL | AUTOMATION SUSCEPTIBILITY | EMPLOYED 1988 | EMPLOYED 2018 |
|---|---|---|---|---|
| CONTRACT, PROGRAM AND PROJECT ADMINISTRATORS | 2 | 34.7 | 13,974 | 114,050 |
| CREDIT AND LOANS OFFICERS | 4 | 90.1 | 5,448 | 31,070 |
| PRACTICE MANAGERS | 2 | 60.2 | 5,022 | 22,889 |
| CONVEYANCERS AND LEGAL EXECUTIVES | 2 | 86.5 | 3,874 | 16,192 |
| GENERAL CLERKS | 4 | 96 | 76,383 | 251,117 |

*performance is a measurement of the percentage increase from 1988 to 2018

Below are the worst performing occupations.

| OCCUPATION | SKILL LEVEL | AUTOMATION SUSCEPTIBILITY | EMPLOYED 1988 | EMPLOYED 2018 |
|---|---|---|---|---|
| BETTING CLERKS | 5 | 76.9 | 4,257 | 1,577 |
| SECRETARIES | 3 | 95.4 | 129,984 | 41,708 |
| SURVEY INTERVIEWERS | 5 | 94 | 16,598 | 3,368 |
| SWITCHBOARD OPERATORS | 5 | 96.1 | 14,083 | 2,837 |
| OTHER CLERICAL AND OFFICE SUPPORT WORKERS | 5 | 96.7 | 42,616 | 6,377 |

The difference in skill level and automation susceptibility between the two tables is clear but there are further commonalities. With the exception of Secretaries, the worst performing occupations are all classified in the **Clerical and Office Support Workers** sub-major group which is described[viii] by the Australian Bureau of Statistics (ABS) as performing;

> '*a range of **routine** clerical and administrative tasks necessary to support the operation of organisations'.*

Conversely, two of the top five occupations are categorised as **Office Managers and Program Administrators[ix]**, a sub-major group that is expected to;

> '***plan** and undertake administration of organisational programs and projects, and **organise** and **manage** the activities of offices and practices'.*

The difference in terminology between these groups matches the numerical difference in skill level but the descriptions provide context to the contrast. The soft skills of planning, organising and managing are in the ascendancy while routine work is in decline. This result reflects the earlier work on the prevalence of soft skills among training packages, in particular, the paramount importance of goal setting/planning.

While the above data is ranked by *relative* change over the last thirty years, the greatest *absolute* increase in workers has been among General Clerks (which have more than tripled in number) while the greatest *absolute* decreases have been among Secretaries, Keyboard Operators, Bank Workers and Other Clerical and Office Support Workers (which have more than halved).

As identified in the table above General Clerks are both relatively unskilled and high on the automation susceptibility front.

Another factor appears to be at play. Routine work that is carried out by humans in the office environment (and elsewhere) is becoming less common which in practice which means occupations that previously contained a high proportion of routine tasks have a lot less to do. In terms of a net effect, it is true to say that automation has a structural impact on the workforce rather than a destructive one, but it is also true that

automation, like any other technology, creates winners and losers. The example of General Clerks suggests that the remaining tasks of once numerous occupations are being combined into more general roles. This effect can also be seen among Accountants and Accountancy Clerks where thirty years ago there were four Clerks for every three Accountants. That ratio is almost exactly inverted today. Put another way, the demand for supporting Clerks among Accountants has almost halved at the same time that reporting quantity and speed has increased.

Within the Clerical and Clerical and Administrative group, the importance of higher skills and soft skills to the long-term viability of the workforce is clear as is the relatedness of skill level to automation susceptibility. But the outliers are also instructive. Automation is best suited to specific, routine tasks and it appears that general tasks, requiring both soft and varied skills (even at a lower level) provide another refuge in an era of digital disruption.

## 6. CONCLUSION

It is clear from the analysis that automation is the cause of widespread anxiety since the term is generally understood to mean the technological replacement of human work. This sentiment was recently captured in a survey carried out for the Automation Skills Cross-industry Project[x] that found three out of every four respondents agreed that automation was perceived as a "major threat to job security".

The analysis does not dismiss this anxiety, but it may provide some comfort with the results suggesting that while automation has replaced specific tasks and workers in certain areas, there is little evidence of a net reduction in jobs for people over time. This provides the basis behind the claim that automation has historically had a structural rather than destructive effect on the workforce and the analysis points to this trend continuing.

Among training packages, performance indicators of digital skills are deliberately written so as not to date the content and to allow flexibility in the use of underlying technology. In a rapidly changing environment, continuing this practice should stand the VET system in good stead, but perhaps more can be done to assist training organisations to interpret those broad terms, through means that can keep pace with the evolution of technology. The presence of soft skills in training packages reflects how work is becoming more human and provides the skills foundation for much needed adaptability in changing times.

Contrary to popular belief, a key finding of this analysis is that the workforce is generally becoming less susceptible to automation over time and not more so. Much of the low hanging fruit of automation may already be picked since the workforce is becoming more highly skilled across the board. Should digital transformation indeed be accelerating, future demand for higher skills must rise in concert. The real test is not what to do in a world without work but how we rise to the challenge of an ever-changing and increasingly complex workplace.

It may indeed be helpful to characterise the workforce of the future as constrained to areas outside the expanding reach of automation capabilities. Higher order skills are non-routine and soft skills are both social and general, attributes which historically have proven difficult to automate. But this makes no promises of the future. If and when technology makes cost-effective inroads into these domains, the assumptions of this work will need to be revisited but for now, the overwhelming evidence is pointing to a future of work that is more human and not less so.

## 7. APPENDIX A

### TRAINING PACKAGES BY AUTOMATION SUSCEPTIBILITY AND SOFT SKILL PREVALENCE

| TRAINING PACKAGE | AUTOMATION SUSCEPTIBILITY | SOFT SKILLS PER PERFORMANCE INDICATOR |
|---|---|---|
| AUR AUTOMOTIVE RETAIL, SERVICE AND REPAIR | 70.7 | 0.08 |
| FBP FOOD, BEVERAGE AND PHARMACEUTICAL | 70.9 | 0.1 |
| UET TRANSMISSION, DISTRIBUTION AND RAIL SECTOR | 31.6 | 0.1 |
| ICP PRINTING AND GRAPHIC ARTS | 83.3 | 0.15 |
| UEE11 ELECTROTECHNOLOGY | 53.1 | 0.17 |
| SFL FLORISTRY | 40 | 0.17 |
| ACM ANIMAL CARE AND MANAGEMENT | 63.9 | 0.2 |
| FWP FOREST AND WOOD PRODUCTS | 68.2 | 0.2 |
| SIT TOURISM, TRAVEL AND HOSPITALITY | 55.1 | 0.2 |
| MSL LABORATORY OPERATIONS | 55.7 | 0.21 |
| SHB HAIRDRESSING AND BEAUTY SERVICES | 33 | 0.21 |
| AUM AUTOMOTIVE MANUFACTURING | 80.9 | 0.22 |
| LMT07 TEXTILES, CLOTHING AND FOOTWEAR | 65.8 | 0.24 |
| MSA07 MANUFACTURING | 62.9 | 0.25 |
| MEA AEROSKILLS | 52.4 | 0.25 |
| RGR RACING AND BREEDING | 50.6 | 0.25 |
| UEG GAS INDUSTRY | 48.5 | 0.25 |
| SIS SPORT, FITNESS AND RECREATION | 22.1 | 0.25 |
| UEP ELECTRICITY SUPPLY INDUSTRY - GENERATION SECTOR | 63.7 | 0.26 |
| PMB PLASTICS, RUBBER AND CABLEMAKING | 63.1 | 0.26 |
| MEM MANUFACTURING AND ENGINEERING | 67 | 0.27 |
| AHC AGRICULTURE, HORTICULTURE AND CONSERVATION AND LAND MANAGEMENT | 64.5 | 0.29 |
| PPM PULP PAPER MANUFACTURING INDUSTRY | 69 | 0.29 |
| HLT HEALTH | 50.5 | 0.29 |
| NWP NATIONAL WATER | 61.6 | 0.29 |
| RII RESOURCES AND INFRASTRUCTURE INDUSTRY | 56.7 | 0.29 |
| ICT INFORMATION AND COMMUNICATIONS TECHNOLOGY | 28.4 | 0.32 |
| CPP PROPERTY SERVICES | 61.8 | 0.34 |
| MST TEXTILES, CLOTHING AND FOOTWEAR | 65.5 | 0.34 |
| SIR RETAIL SERVICES | 59.7 | 0.34 |
| PMA CHEMICAL, HYDROCARBONS AND REFINING | 38.4 | 0.34 |
| DEF DEFENCE | 31.7 | 0.35 |
| SFI SEAFOOD INDUSTRY | 47.8 | 0.36 |
| PUA PUBLIC SAFETY | 24.6 | 0.36 |
| MSM MANUFACTURING | 70.1 | 0.37 |
| AMP AUSTRALIAN MEAT PROCESSING | 60.1 | 0.38 |
| MSS SUSTAINABILITY | 39.7 | 0.39 |
| AVI AVIATION | 41.7 | 0.44 |
| MAR MARITIME | 32.3 | 0.44 |
| CPC CONSTRUCTION, PLUMBING AND SERVICES | 64.9 | 0.49 |
| LGA04 LOCAL GOVERNMENT | 51 | 0.49 |

| TRAINING PACKAGE | AUTOMATION SUSCEPTIBILITY | SOFT SKILLS PER PERFORMANCE INDICATOR |
|---|---|---|
| FNS FINANCIAL SERVICES | 71.1 | 0.5 |
| MSF FURNISHING | 67.9 | 0.51 |
| TLI TRANSPORT AND LOGISTICS | 70.8 | 0.55 |
| TAE TRAINING AND EDUCATION | 5.3 | 0.56 |
| CHC COMMUNITY SERVICES | 18.1 | 0.58 |
| CUA CREATIVE ARTS AND CULTURE | 31.5 | 0.58 |
| SIF FUNERAL SERVICES | 44.8 | 0.6 |
| POL POLICE | 11.6 | 0.65 |
| BSB BUSINESS SERVICES | 50.3 | 0.66 |
| CSC CORRECTIONAL SERVICES | 38 | 0.83 |
| PSP PUBLIC SECTOR | 41.5 | 0.89 |

## 8. APPENDIX B

### INDUSTRY SKILLS FORECASTS

ABORIGINAL AND TORRES STRAIT ISLANDER HEALTH WORKER INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

AEROSPACE INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

AGRICULTURE, HORTICULTURE AND CONSERVATION AND LAND MANAGEMENT INDUSTRY SECTOR IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

AMBULANCE AND PARAMEDIC INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

ANIMAL CARE AND MANAGEMENT INDUSTRY SECTOR IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

AQUACULTURE AND WILD CATCH INDUSTRY REFERENCE COMMITTEE IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

AUSTRALIAN FOOD, BEVERAGE AND PHARMACEUTICAL PRODUCT MANUFACTURING INDUSTRY SECTOR IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

AUSTRALIAN MEAT PROCESSING INDUSTRY SECTOR IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

AVIATION IRC SKILLS FORECAST

CHILDREN'S EDUCATION AND CARE INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

CLIENT SERVICES INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

COMMUNITY SECTOR AND DEVELOPMENT INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

COMPLEMENTARY HEALTH INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

CONSTRUCTION, PLUMBING AND SERVICES IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

CORRECTIONS IRC SKILLS FORECAST

DENTAL INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

DIRECT CLIENT CARE AND SUPPORT INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

ELECTROTECHNOLOGY IRC SKILLS FORECAST

ENROLLED NURSING INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

ESI GENERATION IRC SKILLS FORECAST

ESI TRANSMISSION, DISTRIBUTION AND RAIL IRC SKILLS FORECAST

FIRST AID INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

FOREST AND WOOD PRODUCTS INDUSTRY SECTOR IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

FURNISHING INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

GAS IRC SKILLS FORECAST

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK AUTOMOTIVE

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK BUSINESS SERVICES

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK CULTURE AND RELATED INDUSTRIES

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK EDUCATION

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK FINANCIAL SERVICES

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK INFORMATION AND COMMUNICATIONS TECHNOLOGY

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK MINING, DRILLING AND CIVIL INFRASTRUCTURE

INDUSTRY SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK PRINTING AND GRAPHIC ARTS

LOCAL GOVERNMENT INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

MANUFACTURING AND ENGINEERING INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

MARITIME IRC SKILLS FORECAST

MSL PROCESS MANUFACTURING, RECREATIONAL VEHICLE AND LABORATORY INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

MSM PROCESS MANUFACTURING, RECREATIONAL VEHICLE AND LABORATORY INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

PERSONAL SERVICES INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

PMA PROCESS MANUFACTURING, RECREATIONAL VEHICLE AND LABORATORY INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

PMB PROCESS MANUFACTURING, RECREATIONAL VEHICLE AND LABORATORY INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

PROPERTY SERVICES IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

PUBLIC SAFETY IRC SKILLS FORECAST

PUBLIC SECTOR INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

PULP AND PAPER MANUFACTURING INDUSTRY SECTOR IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

RACING AND BREEDING INDUSTRY SECTOR IRC SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

RAIL IRC SKILLS FORECAST

SPORT AND RECREATION INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

SUSTAINABILITY INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

TECHNICIANS SUPPORT SERVICES INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

TEXTILES, CLOTHING AND FOOTWEAR INDUSTRY REFERENCE COMMITTEE SKILLS FORECAST AND PROPOSED SCHEDULE OF WORK

TOURISM, TRAVEL AND HOSPITALITY INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

TRANSPORT AND LOGISTICS IRC SKILLS FORECAST

WATER IRC SKILLS FORECAST

WHOLESALE AND RETAIL INDUSTRY REFERENCE COMMITTEE INDUSTRY SKILLS FORECAST

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