



FYA's New Work Order
report series



THE NEW WORK SMARTS

Thriving in the New Work Order



The Foundation for Young Australians (FYA) is committed to young people, their futures and the contribution they can make to Australia. At FYA, we believe young people are ambitious, creative and capable of rethinking the world and solving tomorrow's problems today. FYA is a national for-purpose organisation that is all about backing the next generation of young people who are going to rethink the world and create a better future. At FYA we connect and inspire young changemakers - the innovators, the makers, the dreamers, the thinkers, the doers and the creators.

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This report is part of FYA's series the 'New Work Order'.

This report was prepared by the Foundation for Young Australians in partnership with AlphaBeta.



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THE NEW WORK SMARTS

BY 2030, AUTOMATION, GLOBALISATION AND FLEXIBILITY WILL CHANGE WHAT WE DO IN EVERY JOB. WE URGENTLY NEED TO PREPARE YOUNG PEOPLE WITH THE WORK SMART SKILLS THEY WILL NEED MOST.

Since 2015, The Foundation for Young Australians' (FYA) New Work Order research series has explored the ways in which automation, globalisation and flexibility are changing the way we work, and the implications of these shifts for young Australians.

Through four key reports, the research has revealed that traditional, linear career trajectories are rapidly becoming an antiquated notion. It's more likely that a 15-year-old today will experience a portfolio career, potentially having 17 different jobs over 5 careers in their lifetime. They might be self-employed, working for other people or doing both - whilst also collaborating with people on the other side of the world.

FYA's research has also shown that our young people aren't being properly prepared for these shifts - in fact many are already being left behind. Nearly one in three young people are currently unemployed or underemployed and on average it takes 4.7 years to transition from full-time education to full-time work.

The future of work, especially its inherent risks, need not be cast in stone for young Australians. Accurate information about and preparation for the different work of the future is essential to building the portfolio of the right portable skills and capabilities required to succeed in an automated and globalised workplace.

Analysing more than 2.7 million job advertisements our research revealed 7 job clusters in the Australian economy. This research showed that jobs are more closely related than we thought and suggested we need a new mindset towards how we approach our working lives where the focus is on skills and capabilities, not just jobs.

Our fifth installment in this series, **The New Work Smarts** has analysed over 20 billion hours of work completed by 12 million Australian workers each year to predict the skills and capabilities that will matter most in 2030. The report shows that as technology reduces the need for workers to complete routine, manual tasks they will spend more time focusing on people, solving more strategic problems and thinking creatively.

In particular, by 2030 it is predicted that we will, on average, spend 30 per cent more time per week learning skills on the job; spend double the time at work solving problems, spend 41 per cent more time on critical thinking and judgment, and 77 per cent more time using science and mathematics skills; utilise verbal communication and interpersonal skills for 7 hours a week each (up 17 per cent); and develop an entrepreneurial mindset due to having less management (down 26 per cent), less organisational coordination (down 16 per cent) and less teaching (down 10 per cent).

To navigate this changing world of work our understanding of what it means to be 'smart' needs to shift. Young Australians

will need to not only acquire foundation and technical skills, but be able to use these in increasingly enterprising and creative ways and apply them in diverse environments. Traditional education and training institutions will be required to transform their approaches well before 2030 to become the smart learning partners of these lifelong learners.

Through identifying the skills that will be in most demand across the economy in 2030, this report seeks to increase the match between the skills workers possess and the skills they will need. The OECD has recently estimated that improving the skills match to best practice can drive a 2% to 7% increase in productivity in countries like Australia. Skills that the OECD measured include written communication, maths, problem solving and digital literacy.*

By 2030, Australia's current primary school students will be close to finishing their school education and our high schoolers will be entering the workforce. To prepare them we must urgently invest in immersive, enterprise education and careers management strategies where the new 'work smart' skills are core to teaching, learning and assessment across all school and higher education systems.

To ensure young Australians are prepared and equipped for their futures, FYA is calling for a renewed, comprehensive and inter-generational investment in Australia's young people.

Such an investment would encompass:

- A nation building education strategy to redesign the learning system and curriculum from preschool through higher education (and beyond);
- A new commitment to skills, training, careers education and real jobs for young Australians; and
- A promise and plan for the equitable intergenerational transfer of knowledge, resources and power in the new economy.

At FYA we engage with hundreds of thousands of young people each year. We know that young Australians want to grasp opportunities in the future of work, to drive our nation's economic, social and sustainable development and contribute to solving complex global challenges. Our collective role is to back our young people; harnessing their passions and abilities, and growing their skills and capabilities as lifelong learners to be new work smart.



Jan Owen AM

CEO, Foundation for Young Australians

* OECD, (2015), "Labour Market Mismatch and Labour Productivity: Evidence from PIAAC Data". Available from: <https://www.oecd.org/eco/growth/Labour-Market-Mismatch-and-Labour-Productivity-Evidence-from-PIAAC-Data.pdf>

OVERVIEW

By 2030 what we do in every job will change

There will be



A reduction in
the need for workers to complete routine, manual tasks



An increase in
the time workers spend focusing on people, solving strategic problems and thinking creatively

The change in work means young people will need to be equipped with the New Work Smarts

In 2030 the New 'Work Smarts' will be:



Smart Learning



Smart Thinking



Smart Doing



The education system needs to prepare today's young people for the New Work Smarts in 2030:

Workers will spend...



30%

more time learning on the job

Workers will spend...



Almost **100%** more time at work solving problems



41% more time on critical thinking and judgment



77% more time using science and mathematics skills



17% more time per week using verbal communication and interpersonal skills

Workers will use...

Workers will need to develop an entrepreneurial mindset due to



26% less management



14% less organisational coordination



10% less teaching

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EXECUTIVE SUMMARY

Work is Changing

In the past, building a successful career required young people to learn core technical skills for an occupation, and gradually broaden their skills and experience over time. This is what it meant to be 'work smart'. Today, automation and globalisation have led to a loud and compelling narrative about the future of work, and career paths appear more complicated. Media reports warn, almost daily, that "robots are coming to take your jobs"¹. Parents, carers and young people read these reports with rising concern: what occupations will be around in 2030 that a student today can train for?

Today's 15-year-olds will likely navigate 17 changes in employer across 5 different careers². They will sometimes be self-employed, at other times working with and for others. We need a new understanding of what it means to be 'work smart'.

Our *New Work Order* research series shows that while some occupations will no doubt decline or emerge as technology and globalisation advance, too much of the focus has been on which jobs will disappear and which will remain³. The truth is, automation is going to impact what we do in every job, in every occupation. It is wrong to assume that only some occupations will be affected while others may be "safe".

This report makes a unique contribution to the discussion on automation and the future of work by predicting how the everyday activities that Australians do in more than 20 billion hours of work each year will change by 2030. Some of this shift is already underway.

For example, the skills required for early-career jobs have already changed. Think of classic early-career jobs like a pharmacy assistant, electronics technician (think of your Apple store technician) or a teacher. Thanks to advances in technology, these jobs have traded some of their more tedious, manual tasks with tasks that people enjoy doing most, such as working with others and thinking creatively.

- **Future pharmacy assistant:** New technology will likely cut the time spent on store admin (like stocktaking and ordering) from 22 hours a week in 2006 to 6 hours in 2030, allowing assistants to spend substantially more time on digital tasks, such as updating the business website, developing an online shopping app and analysing monthly sales data⁴.
- **Future electronics technician:** The local computer store worker in 2030 will trade time spent inspecting equipment (down from 9 hours a week in 2006 to 3 hours a week in 2030) and scheduling work (down from 11 hours to 1 hour) for time spent interacting with customers or colleagues (from less than 1 hour to 4 hours) and analysing product data (from 0 hours to 2 hours).
- **Future teacher:** The growing use of automation and digital learning tools will notably change how teachers do their jobs, giving teachers more time to interact with students (up from 29 hours in 2006 to 33 hours in 2030). By 2030, teachers will routinely use digital technology to make classroom education a more interactive, student-centred experience. They will likely spend less time grading (down from 5 hours in 2006 to 1 hour in 2030) and more time facilitating self-directed learning (up from 4 hours in 2006 increasing to 14 in 2030).

These trends will determine the skills young people need to succeed in our future workplaces. Rather than responding to automation by choosing the 'right' job, young people need to acquire the 'right' skills that allow them to succeed in an automated and globalised workplace.

This report uncovers the 'new work smarts'. It explores which critical skills today's young people need to thrive in the future world of work. By matching the work-related skills required in more than 400 occupations with the actual activities performed in those jobs, this report offers unprecedented insights into how many hours we currently use our skills at work and which skills will likely matter most in 2030. Its key conclusion is that the 'new work smarts' in 2030 will involve smart thinking, smart doing and smart learning.

¹ For example see Bloomberg (March 2017), "The robots are coming for a third of UK jobs". Available at: <https://www.bloomberg.com/news/articles/2017-03-24/the-robots-are-coming-for-a-third-of-u-k-jobs-pwc-says>. SMH (April 2017) "Rise of the machines: robots are coming for middle class jobs". Available at: <http://www.smh.com.au/federal-politics/political-news/rise-of-the-machines-robots-are-coming-for-middleclass-jobs-next-20170413-gvkj3j.html>. CNN (April 2017) "The robot scabs are coming to take your jobs". Available at: <http://edition.cnn.com/2017/04/15/opinions/the-robot-scabs-are-coming-to-take-your-jobs-howard-opinion/index.html>

² See Foundation for Young Australians (2016), "The New Work Mindset". Available at: <http://www.fya.org.au/wp-content/uploads/2016/11/The-New-Work-Mindset.pdf>

³ See Foundation for Young Australians (2015), "The New Work Order". Available at: <http://www.fya.org.au/wp-content/uploads/2015/08/fya-future-of-work-report-final-lr.pdf>

⁴ Based on an average 40-hour work week.



Smart learning

Work, in 2030, will be continually changing. Today's young people will need to spend more hours learning on the job than ever before. In fact, Australian workers will spend one-third of their hours at work learning, a 30 per cent increase from today. Continuous learning will be part of our everyday engagement in work. Learning on the job will require us all to constantly respond to new information and new technology when making decisions.

For example, a pharmacy assistant may need to more clearly interpret insights from customer data or learn how to use new diagnostic tools. School principals may need to update their teaching methods to capitalise on and integrate new technologies in classrooms.



Smart thinking

Thriving in the new work order will involve a new way of smart thinking. It means today's young people need to become better:

- **problem solvers and communicators.** They will use the enterprise skills of problem solving for 12 hours each week (up 90 per cent) and critical thinking for 15 hours each week (up 40 per cent). Workers will also use the enterprise skills of verbal communication for 7 hours per week and interpersonal skills (like listening, empathy, and persuasion) for 7 hours per week, both up 17 per cent from today.

- **at drawing on science, maths and technology knowledge.** Workers will use the foundational skills of mathematics and science for 9 hours a week (up 80 per cent from today) and advanced technology skills for 7 hours a week (also up 75 per cent from today).

For example, the foundational skill of maths will remain critical to an accountant's role, but accountants also need strong enterprise skills in problem solving and communication. As more repetitive and administrative tasks become automated, future accountants will need to know how to solve a problem and communicate options to persuade others to take action.

Smart doing



Today's young people will also need to work differently to thrive in the future of work, developing their entrepreneurial mindset.

As people work more flexibly and independently, including through digital work platforms, they will need to rely less on being managed or told what to do. On average, they will work without a manager for 3 hours more a week, receive 1 hour less instruction and rely 2 hours less on organisational coordination with colleagues and superiors. This is a significant shift in how work will be managed, coordinated and delegated.

For example, carers – people working in jobs that promote health and wellbeing – will spend 5 hours less per week being instructed. Workers will be directly engaging with patients or clients, through online hiring platforms, rather than through large health providers.



Preparing young people for the future

To prepare for these changes the Australian education system will need to equip young people with the skills and capabilities required in the era of the 'new work smart'. It needs to ensure that young people not only acquire foundational and technical skills, but that they are able to deploy those skills in an increasingly enterprising way – as active problem solvers and communicators of ideas, equipped with a more entrepreneurial mindset and appetite for ongoing learning. Young people today will need to develop their cognitive and emotional skills to a much higher level.

We must grapple with the potential shortcomings of our education system – a system which continues to formally assess based on an old understanding of 'smart'. The looming changes to work will affect all jobs, regardless of the qualifications they require, and we must ask whether our current education systems equip young people with the skills most needed to thrive in the new work order.

For example, we now know that problem solving will be used for 12 hours a week at work in 2030, but do our schools, vocational and training institutions and universities spend enough time teaching and assessing this skill?

Around the world, the most progressive education systems are focusing on developing the 'new work smart' workforce of the future⁵. They offer immersive, project-based and real-world learning experiences that go beyond the classroom environment, such as working with local businesses or facilitating art and film projects in local communities. These learning experiences are best suited to developing the future-proof enterprising and career management skills that will be most in demand and most highly portable in the future of work, and instil in young people the enthusiasm for ongoing learning that will be critical for their future success.

Glossary



Hours of work: Total hours worked in the economy. In the past year, for example, 12 million people in Australia worked more than 20 billion hours.



Occupation/job: The specific role a person performs, such as hairdresser, teacher or factory manager.



Work activity: An activity is what someone does to perform an occupations/job, such as collecting information, moving objects, inspecting equipment or analysing data. Workers may use several skills simultaneously to perform a work task, which is why hours don't always add up to a 40-hour work week. For example, problem solving and management skills could be used at the same time.



Skill: The capacity required to perform an activity. For example, a plant manager requires skills in time management, communication, and troubleshooting.



Foundational skills: Foundational skills include literacy, language and numeracy.



Technical skills: Technical skills are often specific to a particular task, role or industry and can include qualifications such as licenses or certificates.



Enterprise skills: Enterprise skills are transferable skills such as problem solving, communication, teamwork, and creativity.

⁵ OECD, (2012), "PISA 2012 Results: Creative Problem Solving", Students' skills in Tackling Real-Life Problems, pp. 124. Available from: <http://www.oecd.org/pisa/keyfindings/pisa-2012-results-volume-v.htm>

1.

BY 2030, AUTOMATION AND GLOBALISATION WILL CHANGE WHAT WE DO IN EVERY JOB

Almost daily, we hear and read about the potential impact of automation and globalisation on our working lives.

We hear about the occupations that are most likely to be hit - the lawyer whose documents can be searched more quickly by a machine, or the warehouse worker who might be replaced with a robotic shelf-stacker or the rise of the online platforms and individuals working virtually across borders and timezones. But rather than causing individual occupations to boom and bust, this report shows that automation and globalisation will affect every job.

The economic and technological forces at play will change not only what jobs people do, but how people do all their jobs in the future.

1.1 Future workers will spend less time on routine tasks and more time with people and getting value from technology

People will spend less time on routine, manual activities and more time working with others and performing

cognitive tasks. By 2030 and across all jobs, the average Australian will likely spend 3 hours less per week carrying out manual tasks such as operating an assembly line, retrieving or stacking items from or for storage or building and cleaning. Likewise, Australians will spend 30 minutes less per week on routine and administrative tasks, such as data entry, filing a financial statement, or recording changes in weather patterns compared to a decade ago⁶. This decline will free us up to spend more time working with people and solving problems. In fact, across all jobs, it is estimated that the average employee will spend an extra 2 hours per week maintaining relationships with clients and co-workers and having close interactions with other people, and 1.5 extra hours on complex reasoning, decision making, and creative tasks.

Over the past 10 years, jobs have already undergone significant change. From jobs such as a pharmacy assistant, electronics technician to jobs that require higher levels of qualification, like a teacher or civil engineer, jobs have already and will continue to change. Advances in technology have allowed these jobs to trade some of their more tedious, manual tasks with tasks that require a higher level of engagement, like working with others and thinking creatively.

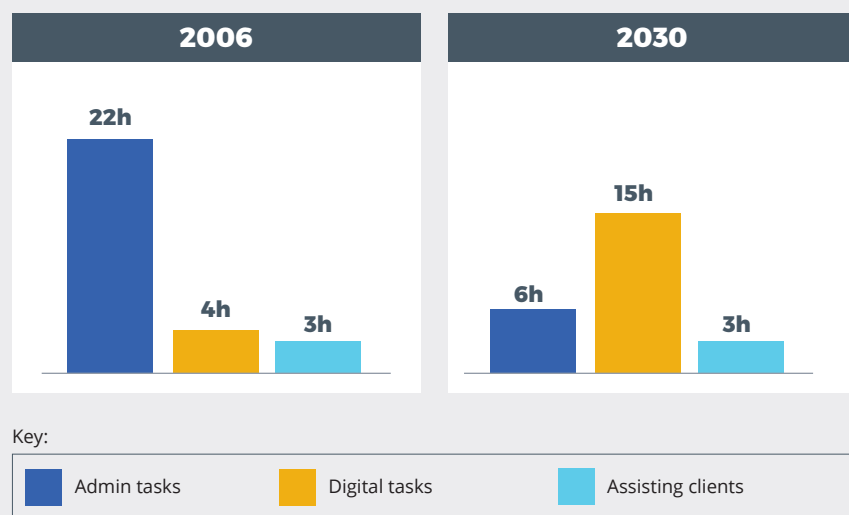


⁶ To estimate the time spent on activities in the economy, historical frequency of tasks performed at work data for every job in the Australian economy was converted to timeshares using a regularised least squares solution. Aggregated data was used to determine economy wide share of each activity. See Appendix for further details.

Future pharmacy assistant (Exhibit 1): New technology will likely cut the time spent on store administration (like stocktaking and ordering) from 22 hours a week in 2006 to 6 hours in 2030. This will allow pharmacy assistants to spend over four times more on digital tasks, such as updating the business website, developing an online shopping app and analysing monthly sales data⁷.

Exhibit 1: In 2030, pharmacy assistants will spend **less time on administration** and **more time digitally engaged**

These work activities will have the most significant shifts.



Key:

* Note: Comparison of time spent on key activities performed by a pharmacy assistant in 2030 versus 2006. Source: ONET, ABS, AlphaBeta analysis

ADMIN TASKS ↓ 16h

- Fill orders
- Compile pay slips
- Compile receipts
- Stocktake

DIGITAL TASKS ↑ 11h

- Develop store app
- Weekly store systems update
- Update business website
- Update online order form

ASSISTING CLIENTS — 0h

- Assist customers

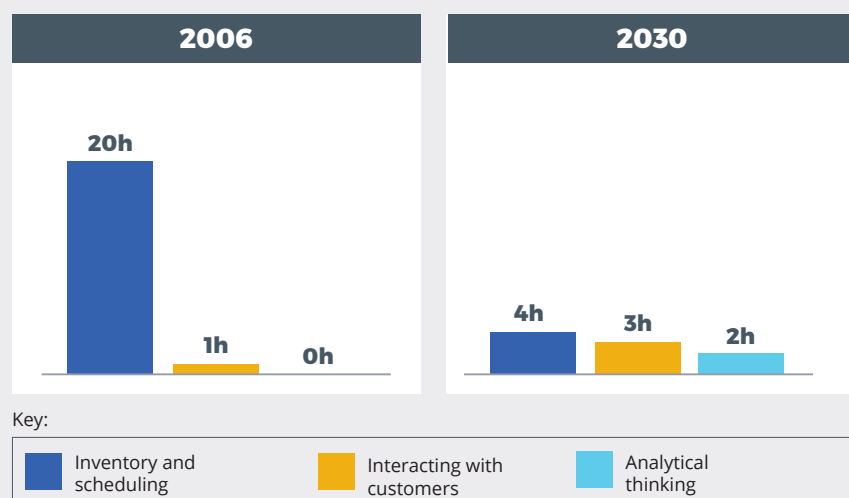
OTHER TASKS MAY INCLUDE:

- Supervise trainees (3 hours)
- Weekly team feedback (2 hours)

Future electronics technician (Exhibit 2): The average computer store worker will likely trade time spent inspecting equipment (down from 9 hours a week in 2006 to 3 hours a week in 2030) and scheduling work (down from 11 hours to 1 hour) for time spent interacting with customers or colleagues (increase from less than 1 hour to 4 hours) and analysing product data (increase from 0 hours to 2 hours).

Exhibit 2: In 2030, electronics technicians will spend **more face time with customers** and **thinking analytically**

These work activities will have the most significant shifts.



Key:

* Note: Comparison of time spent on key activities performed by an electronics trades worker in 2030 versus 2006. ONET, ABS, AlphaBeta analysis

INVENTORY AND SCHEDULING ↓ 16h

- Inspect incoming orders
- Set weekly roster

ANALYTICAL THINKING ↑ 2h

- Analyse performance of new products

INTERACTING WITH CUSTOMERS ↑ 2h

- Meet potential customers

OTHER TASKS MAY INCLUDE:

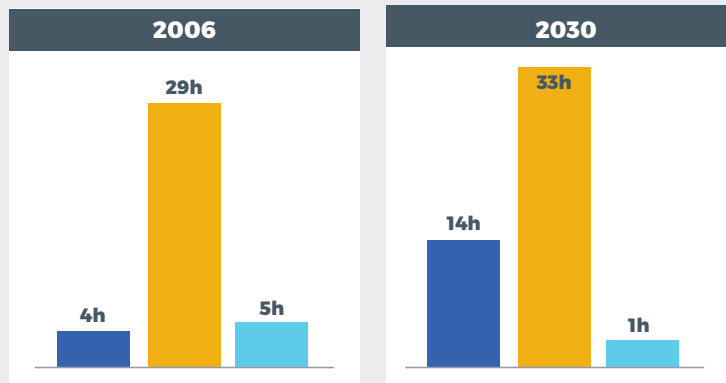
- Repair computers
- Sort pay slips
- Send completed repairs back to clients

⁷ O*NET occupational survey data on frequency of activities performed at work was used to estimate the time spent on over 2,000 activities for over 950 US occupations. The results were then converted from American occupations to equivalent Australian occupations using concordance tables mapping US SOC codes to ANZSCO codes. See Appendix for detailed methodology.

Future teacher (Exhibit 3): The growing use of automation and digital learning tools will notably change how teachers do their jobs. New software will take over an increasing volume of routine tasks, such as grading work. This will give teachers more time to interact with students. By 2030, teachers will routinely use digital technology to make classroom education a more interactive, student-centred experience. This means they will likely spend less time lecturing and more time facilitating self-directed learning.

Exhibit 3: In 2030, teachers will increasingly facilitate learning, and spend less time ‘lecturing’, as digital technologies enable more self-directed learning

These work activities will have the most significant shifts.



Key:

■ Facilitate student learning	■ Interacting with students	■ Repetitive information analysis
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* Facilitation tasks will incorporate interaction with students, such that tasks are not mutually exclusive
 Note: Comparison of time spent on key activities performed by a primary school teacher in 2030 versus 2006. ONET, ABS, AlphaBeta analysis

FACILITATE STUDENT LEARNING* ↑ 10h

- Facilitate digital exchange
- Facilitate ‘digital excursions’
- Plan lessons for the week

REPETITIVE INFORMATION ANALYSIS ↓ 4h

- Grading

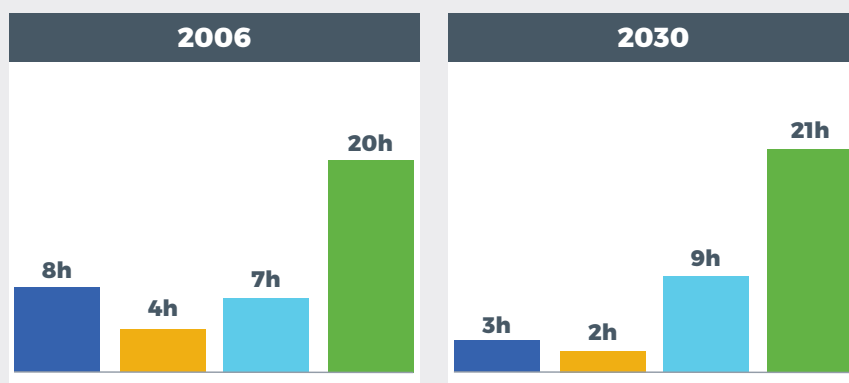
INTERACTING WITH STUDENTS ↑ 4h

- English
- History
- Maths
- Science
- Geography
- Private tutoring
- P.E
- Special needs tutoring

Future civil engineer (Exhibit 4): Civil engineers will be able to use design software to automate a large part of their routine technical tasks in coming years, such as drafting blueprints and specifying dimensions. This means they can spend more time interacting with clients, developers and architects. By 2030, civil engineers will also likely spend a greater share of their work week on tasks that require strategic thinking.

Exhibit 4: In 2030, the activities performed by civil engineers will require more face time with clients and making decisions, and less time spent on technical tasks

These work activities will have the most significant shifts.



Key:

■ Routine technical work	■ Managing others
■ Interacting with others	■ Strategy and decision-making

* Note: Comparison of time spent on key activities performed by a civil engineering draftsman and technicians in 2030 versus 2006. ONET, ABS, AlphaBeta analysis

ROUTINE TECHNICAL WORK ↓ 5h

- Specify blueprints
- Set weekly roster

MANAGING OTHERS ↓ 2h

- On-site survey
- Supervise workers on site
- Progress report due
- Sort pay slips

INTERACTING WITH OTHERS ↑ 2h

- Discuss project with architect
- Review project with property owners
- Revise building plan with developers

STRATEGY AND DECISION-MAKING ↑ 1h

- Client outreach
- Develop new firm portfolio
- Find new solutions to comply with architect specification

1.2 The challenge of forecasting which skills matter most

To understand which skills will be most important in the changing world of work, the analysis needs to go deeper than job level to explore how automation and globalisation will change the work activities we do everyday. Together, Australia's 12 million workers spend more than 20 billion hours in our jobs each year. Which

skills are we currently using to perform these jobs, and which skills will we likely need most in 2030? The new analysis in this report has made it possible to forecast future trends, based on the skills shift that has already occurred over the past decade (see detailed Methodology and Appendix).

Methodology-in-brief: Analysing over 20 billion hours of work to predict the skills that will matter in 2030

Measuring how often people use certain skills at work is challenging. Existing occupational data provides information on how much time workers spend on various job-related tasks (see Appendix for further detail). This data forms the starting point for our analysis. However, it does not reveal which skills were used to perform these tasks.

This report has overcome the challenge by combining data from various occupational surveys that indicate how workers themselves rate the importance of certain skills for their job performance. Further analysis of the correlations between tasks and the stated relevance of skills revealed which skills are required to perform specific work tasks.

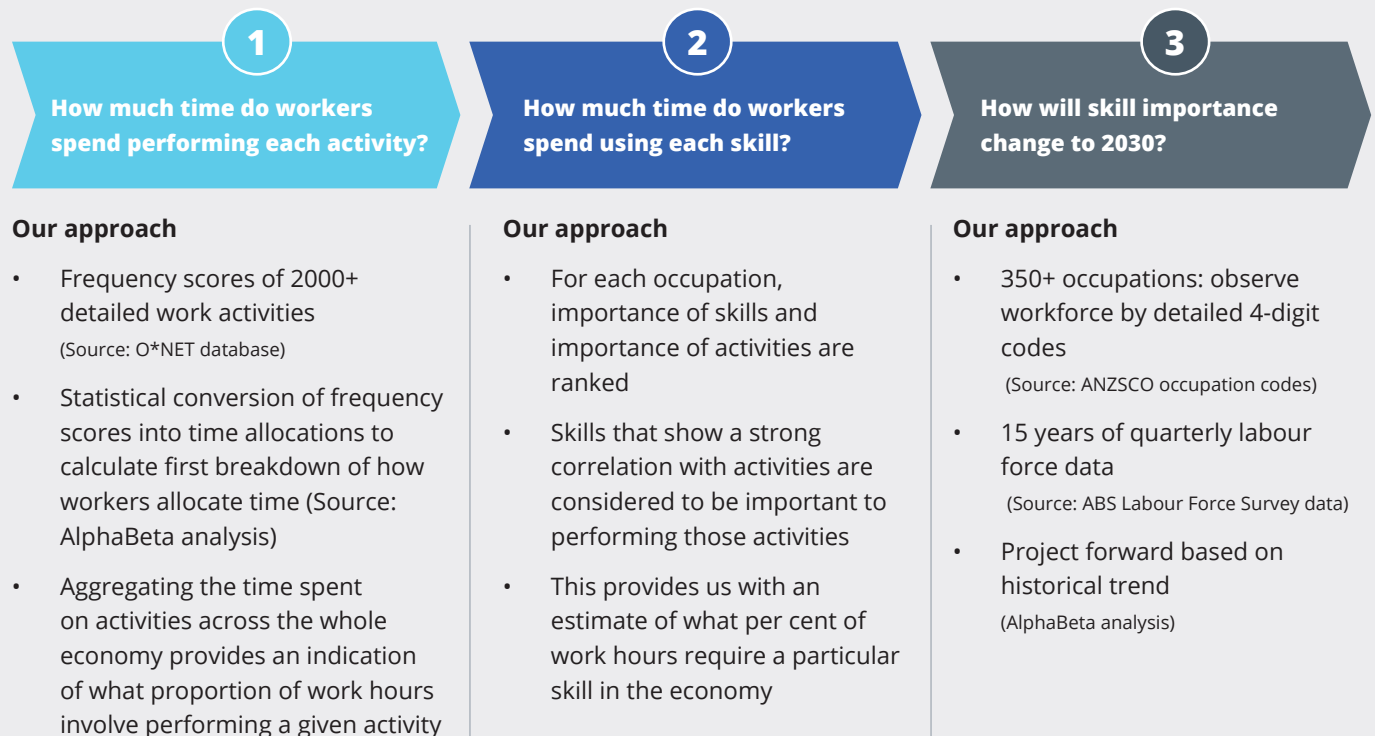
Repeating the analysis for various points in time over the past decade, helps unearth a trend: how the skills Australians use at work are changing. The results open a

remarkable window into the future and allow us to forecast which skills will likely matter most in 2030.

Data for this report was primarily sourced from O*NET. All shifts in skills use by hour are based on a 40-hour working week. This framework was chosen to simplify the presentation of findings, even as it does not strictly match the reality of working life in Australia, which has been influenced by a growing trend to part-time work⁸. Workers may use several skills simultaneously to perform a work task, which is why hours don't always add up to a 40-hour work week. For example, problem solving and management skills could be used at the same time.

For further information on methodology, please contact Sydney@alphabeta.com.

Technical challenges in this study were to answer three questions



⁸ See ABS Detailed Labour Force: On average, Australian workers don't work 40 hours. In 2016, 7.8 million workers worked an average of 43 hours per week and 4.1 million workers worked an average of 13 hours per week.

2.

IN 2030, WHAT IT MEANS TO BE 'WORK SMART' WILL CHANGE



Our rapidly changing world of work requires young people today to rethink the skills they need to build a successful career and thrive in the future.

Their parents' generation may have used a simple recipe to succeed in their jobs: choose a profession, acquire foundational knowledge and slowly become an expert throughout their working lives. But as career paths are becoming less predictable, future workers will need to be more flexible. Instead of training for a particular occupation and working in that area for life, studies have estimated that Australians will make 17 changes in employers across 5 different careers.

The traditional employment relationship is also likely to become more fluid with people holding portfolios of activities, including paid employment, unpaid employment (internships or volunteering) and self-employment.

Young people will need to be prepared for a journey of lifelong learning and be confident to work autonomously. They need to be critical thinkers and problem solvers, but even more importantly have strong communication skills to interact with people.

This chapter shows what it means to be 'work smart' in the future. It presents three core attributes that today's young people will need to have in 2030: smart learning, smart thinking and smart doing.

2.1 Today's young people will need to be Smart Learners

Work, in 2030, will be continually changing. Today's young people will need to spend more hours learning on the job than ever before (Exhibit 5). In fact, Australian workers will spend one-third of their hours at work learning, a 30 per cent increase from today. Continuous learning will be part of our everyday engagement in work. Learning on the job will require us all to constantly respond to new information and new technology when making decisions (Exhibit 5).

Up until now 'smart' people were those who made the fewest mistakes and had highest achievement in formal learning. But technology has and will continue to change that. Automation and artificial intelligence will require a greater focus on our thinking and interpersonal skills and we will need to learn, and relearn these skills again and again on the job.

Smart technology will process, store, and recall information and produce alternatives increasingly faster and better than we can. That shift will enable us to focus on taking our foundation, technical and enterprise skills to ever-higher levels. At work young people will need to spend more time developing their critical thinking and honing their communication skills; absorbing new information and working with new technologies; learning to consistently update their thinking in response to new data; and investing in the development of their portable enterprise skills.

Young people's smart learning journey must begin early in their formal education and progress through their working lives. It will be essential to build both their learning skills and capabilities and an understanding that they will need to be active smart learners through their working lives.

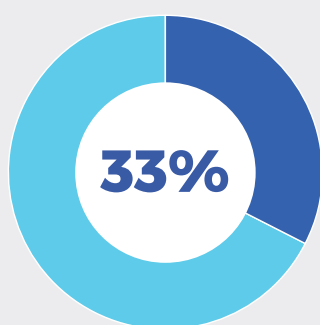
Exhibit 5: By 2030, young people will need to be smart learners, as new data and technology constantly change how we perform our jobs



We will need to be **smart learners**

Advances in technology and access to data will lead to a constantly changing work landscape, resulting in workers needing to spend:

Percentage is the proportion of the working week



13h learning
per week

↑ 3h = 80 Days per year

Workers will use learning to:

Update and use new knowledge ↑ 100%

Carrying out tasks such as...

- Learning how to use new apps
- Updating business strategy
- Developing new technical skills

Analyse and interpret information ↑ 150%

Carrying out tasks such as...

- Developing insights from data
- Interpreting consumer demand

Note: Discrepancies between hours and days due to rounding

Source: ONET, ABS, AlphaBeta analysis

2.2 Today's young people will need to be Smart Thinkers

Thriving in the New Work Order will involve a new way of smart thinking. The importance of science, maths, engineering and technology (STEM) skills is well documented⁹. However, young people can't rely on these skills alone to thrive in the future of work. To activate and fully utilise STEM skills effectively, enterprise skills including problem solving, critical thinking and communication are of prime importance.

Even in occupations with a heavy reliance on science and mathematics, communication and interpersonal skills will be more important. The example of a doctor's working week demonstrates that, while science and maths have foundational importance, these skills are used in a surprisingly small number of hours (see case study: "Science + Communication Skills in a doctor's week").

Likewise, the foundational skill of maths will remain critical to an accountant's role but as more repetitive and administrative tasks are being automated, the analytical skills of accountants will become more important. Future accountants will need to know how to *solve a problem and communicate* options to persuade others to take action (see Exhibit 9).

To lay the foundations for the future of work Australia's training and education system must prioritise skills that workers will likely need most in their future jobs with a strong focus on enterprising skills and STEM skills. STEM skills alone will not be enough; well developed enterprise skills will be necessary to activate and communicate ideas and solutions.

Exhibit 6:

Case study: Science + Communication Skills in a doctor's week

The average week of a doctor provides a compelling example of the importance of science and mathematics within a much broader skill set. By 2030, doctors could spend 9 hours a week using their maths and medical-science knowledge on the job. They need maths and science to process and analyse information, to diagnose illness and to develop treatment plans. But without crucial interpersonal skills, they cannot perform these tasks. Doctors will spend most of their time interacting with patients to elicit the information they need to diagnose, and prescribe the most effective individualised treatment plans. In 2030, doctors will likely spend almost half their work week (18 hours) using their verbal communication and interpersonal skills when interacting with patients.

Foundational skills take up less work time than enterprise skills



⁹ For example, see: CSIRO Blog (8 September 2016) "What is STEM and why is it important?"; Chief Scientist (2015) "Science, Technology, Engineering and Mathematics: Australia's Future"; Office of the Chief Scientist (March 2015) "STEM Skills in the Workforce. What do employers want?"

In 2030, today's young people will need to build a portfolio of skills to thrive in the new work order. They will need to be:

- problem solvers and critical thinkers.** The skills that will matter most in the workplace of the future are, by a wide margin, problem solving, judgment and critical thinking (Exhibit 7). The average Australian worker will likely spend double the time at work solving problems (12 hours each week, up from 6 hours today). The need for judgment and critical thinking at work - such as coming up with innovative ways of doing things differently and experimenting with new ideas and testing hypotheses - will likely increase by 40 per cent, consuming an estimated 15 hours each week by 2030, up from 11 hours today.
- communicators and engagers.** Today's young people will need to be good at working with people to succeed in their future jobs (Exhibit 7). The average Australian worker will likely spend two hours more per week on written communication (15 hours in 2030, up from 13 hours today) and one

hour more per week using verbal communication and interpersonal skills (both up to 7 hours from 6 hours today). Shop assistants may spend, on average, an hour more time per week talking to customers and providing them a great service experience. Accountants may spend an hour more time per week negotiating, persuading and listening intently to client briefs (Exhibit 9).

- versed in science, maths and technology knowledge.** The workplace of the future will require strong foundational skills in science and mathematics, and strong technical skills in advanced technology (Exhibit 8). This includes better programming skills, as well as skills to design technology and adapt it to customer needs¹⁰. Past trends signal that the average Australian will use 80 per cent more science and maths at work (from 5 hours per week today to 9 hours in 2030). In an average working week, the time spent on tasks requiring advanced technology skills is set to increase by 75 per cent from 4 hours today to 7 hours in 2030.

Exhibit 7: In 2030, young people will need to be Smart Thinkers... ...who are problem solvers and communicators



We will need to be **smart thinkers**

In 2030, workers will use these skills on average:

Percentages are the proportion of the working week



* Note: Discrepancies between hours and days due to rounding

Source: O*NET, ABS, AlphaBeta analysis

¹⁰ O*NET skill glossary. See Appendix for further details.

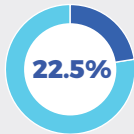
Exhibit 8: In 2030, young people will need to be Smart Thinkers... ...who can draw on science, maths and technology knowledge



We will need to be **smart thinkers**

In 2030, workers will use these skills on average:

Percentages are the proportion of the working week

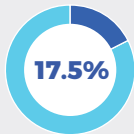


Maths and science
9h per week

↑ **4h**



58 Days per year



Advanced technology
7h per week

↑ **3h**



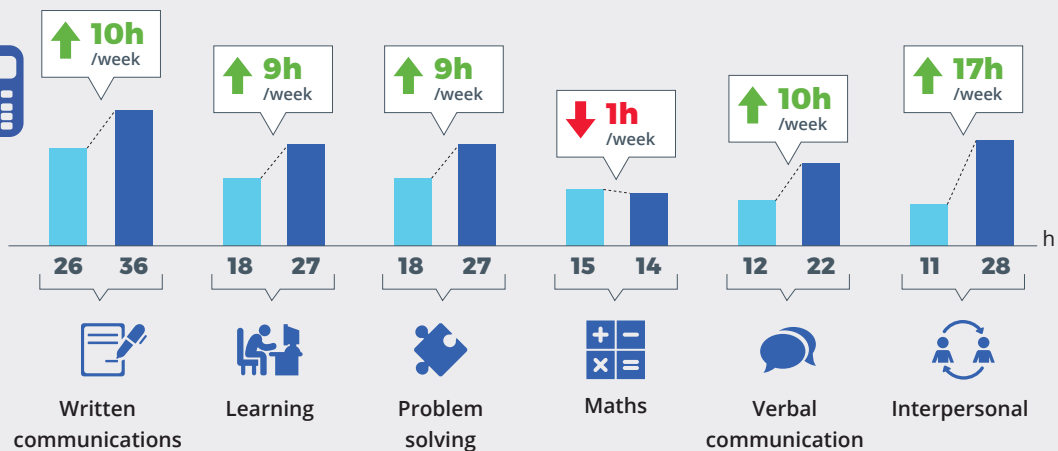
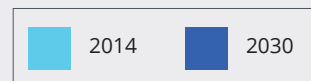
40 Days per year

* Note: Discrepancies between hours and days due to rounding
Source: O*NET, ABS, AlphaBeta analysis

Exhibit 9:

Case study: problem solving and communicating in an accountant's week

In 2030, accountants will spend more time communicating, learning and problem solving



Source: O*NET, ABS, AlphaBeta analysis

2.3 Today's young people will need to be Smart Doers

By 2030, today's young people will need to work with a more entrepreneurial and independent mindset. In an average week, there will be less management (8 hours per week, down from 11 hours), less organisational coordination (8 hours per week, down from 10 hours) and less teaching (7 hours per week, down from 8 hours).

The future workforce will need to be more autonomous and self directed, working on tasks independently with less supervision and support from managers or supervisors. Many more people will work externally, from home or a remote office. Young people of today will need to manage their own time more, make more decisions about priority and importance of tasks and be more personally motivated and driven.

Management in the future of work won't be someone watching over your shoulder to make sure you are working, or giving you tasks to complete, one at a time. The employees of the future are going to have to motivate

and drive themselves to succeed - a common quality among entrepreneurs.

Already, the economy is shifting towards more part-time and self-employment. Over the past 10 years, female part-time employment has increased 28 per cent by 578,000 people and dramatically, male part-time employment has increased 4 per cent by 371,000 workers. Likewise, self-employed males with no employees have increased 5 per cent by 39,000 people and self-employed females with no employees has increased 3 per cent by 113,000 workers¹¹. These shifts reflect changes to the traditional employment relationship which will continue to become more fluid with people holding portfolios of activities, including paid employment, unpaid employment (internships or volunteering) and self-employment. Individuals will need to employ an entrepreneurial mindset to manage their portfolio of work and other activities.

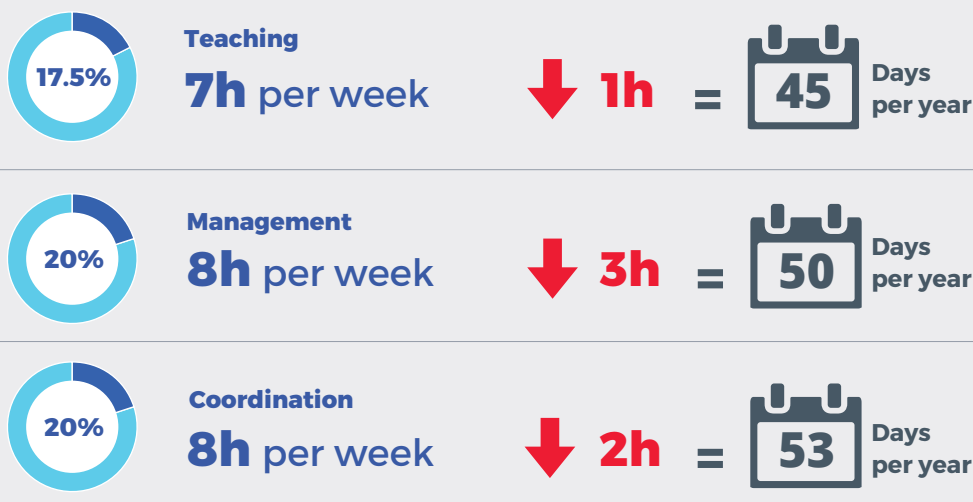
Exhibit 10: In 2030, young people will need to be Smart Doers... ...and work with a more entrepreneurial mindset



We will need to be **smart doers**

In 2030, workers will use these skills on average:

Percentages are the proportion of the working week



* Note: Discrepancies between hours and days due to rounding

Source: O*NET, ABS, AlphaBeta analysis

¹¹ ABS Detailed Labour Force latest release.

For example, in caring professions such as GPs, fitness instructors, and counsellors, tasks that require coordination and management skills (to perform administrative tasks) are increasingly replaced by tasks requiring communication, interpersonal and problem solving skills (to serve clients and patients better).

Exhibit 11: Case study

The Carers: By 2030 workers in health and wellbeing will be more autonomous problem solvers

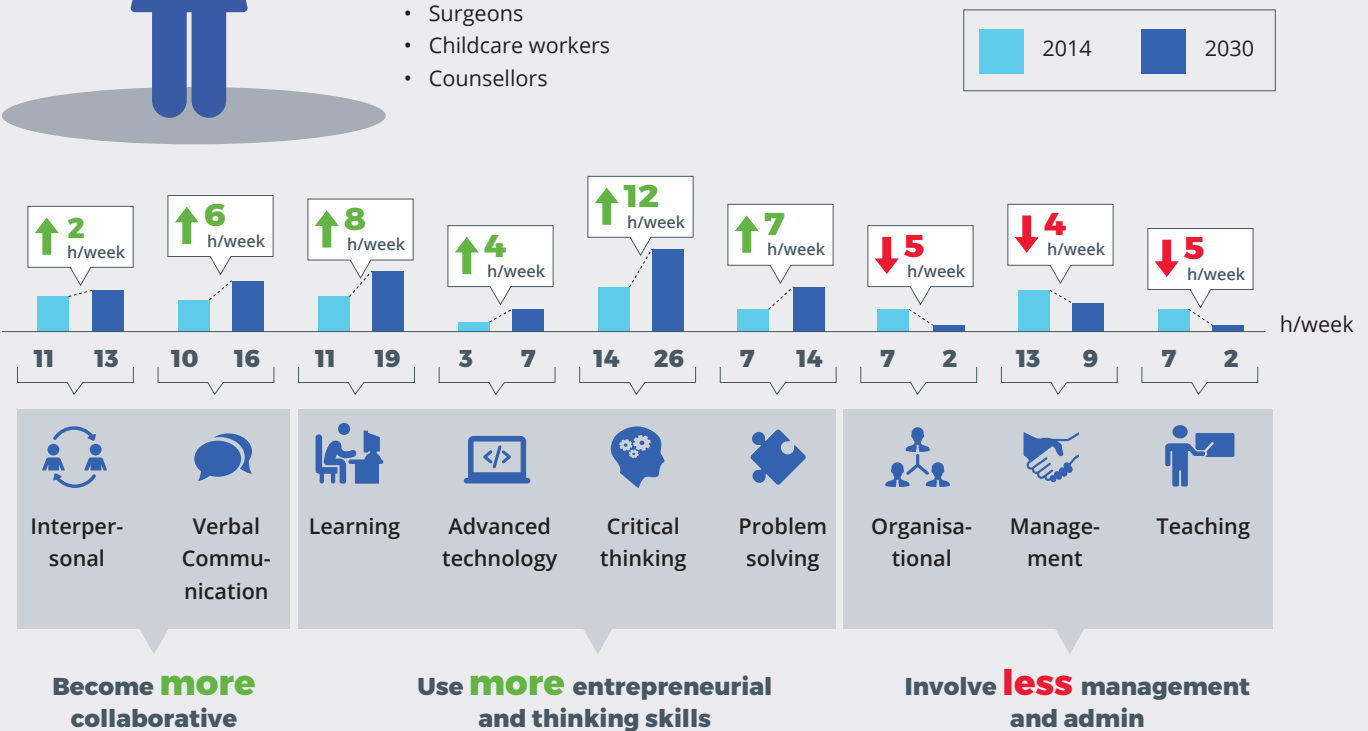
In our previous research we looked at the ways skills are closely related and are portable across jobs. We clustered those jobs into seven groups based on their common skills¹². The Carers is one of those clusters. Our research shows that caring professionals - people working in roles to improve the health and wellbeing of others - have a high degree of transferable skills. This means that training for one job in this professional field equips a worker with the skills for many other caring jobs. Even though many caring professions are considered at low risk of being impacted by automation in the near future, their skills profile will change by 2030. Automation is set to reduce the amount of time people in caring professions spend on management and organisation. By 2030 they will likely spend less than 2 hours a week using their organisational skills (down 5 hours a week compared to today) and 9 hours a week using their management skills (4 hours less than today). Carers will instead use more interpersonal skills (up 2 hours a week to 13 hours), more critical thinking (up 12 hours per week) and more problem solving (up 7 hours a week).

The Carers: By 2030 the jobs in health and well being will be more collaborative, entrepreneurial and intellectual



The Carers are comprised of jobs that improve our health and well being, examples include:

- GPs
- Fitness instructors
- Social workers
- Surgeons
- Childcare workers
- Counsellors



Source: O*NET, ABS, AlphaBeta analysis

¹² Foundation for Young Australians (2016) "The New Work Mindset: 7 new job clusters to help young people navigate the new work order"

3.

PREPARING YOUNG PEOPLE FOR THE FUTURE OF WORK

To be successful in the future world of work, young people need to start building their portfolio of skills and capabilities today.

We need to support and inform young people so they can make choices to be ready for the new 'work smart' and develop the skills that will likely matter most in coming years. This has implications for educators, schools, universities, vocational education providers and career advisers who need to ensure they prepare young people for the future, starting today.

Past workplace trends suggest that by 2030 the average Australian worker will likely spend 41 percent more time per week on written communication compared with today (a combined 8.9 billion work hours across the economy). On average, workers will also spend more than twice as much time on job tasks requiring science and maths (a combined 5.6 billion work hours), and critical thinking (a combined 7.0 billion work hours).

The outlook presented through this analysis reflects the change that is set to occur during an average working week across all jobs in the Australian economy.

However, jobs and industries will no doubt change more rapidly than others, causing some workers to adapt faster than others. Education providers would also be mistaken

to think that only jobs requiring a certain qualification, like a bachelor's degree, are affected. Rather, the looming changes should have implications for everyone in the education system: school teachers and vocational education providers, tutors and university lecturers.

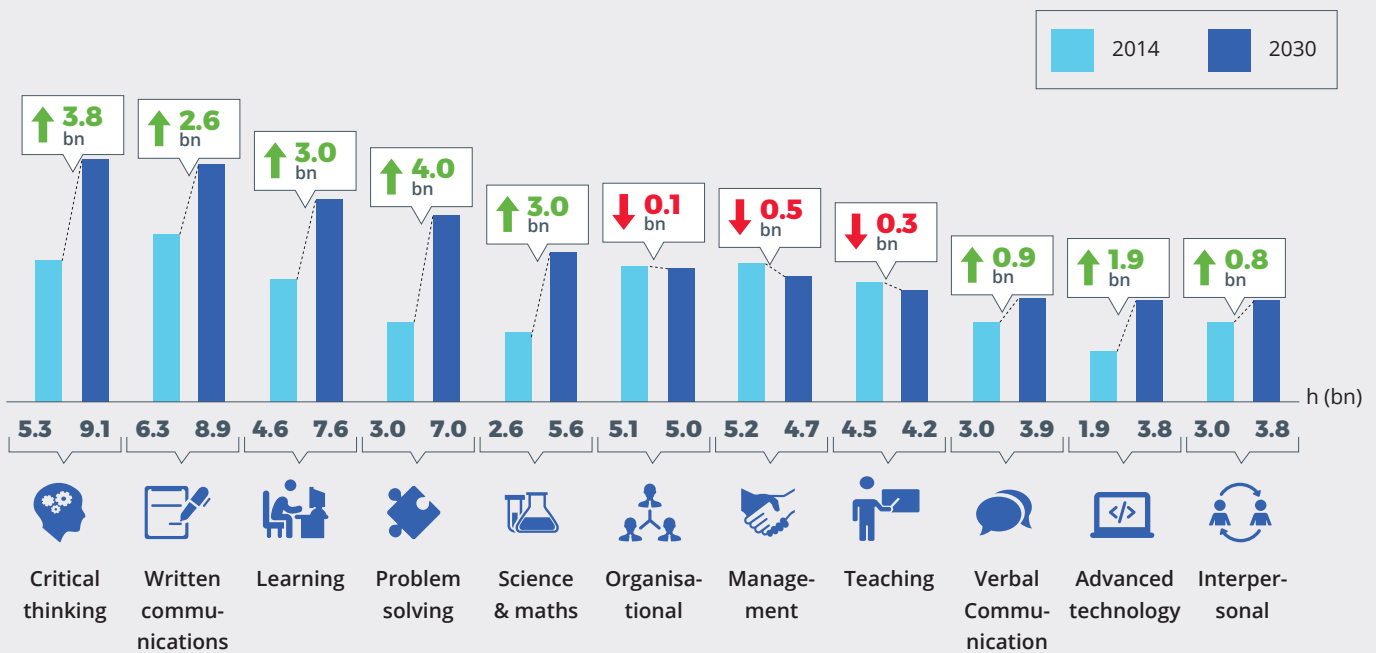
For example, the skills that will matter most in 2030 for workers in university-qualified occupations will become more significant across the whole economy. Judgment and critical thinking could be used for 17 hours a week in university-qualified jobs, but they are not just relevant to those positions. Rather, past trends suggest that these skills will be used for 15 hours a week across all jobs in the future.

Some differences remain. Research shows that communication and interpersonal skills will become comparably more important in university-level jobs and other jobs that value problem solving, technological knowledge and organisational skills. University-level jobs will use interpersonal skills for 11 hours per week, compared with 7 hours on average across all jobs. Written communication will be used for 18 hours a week in university-level jobs compared with 16 across the economy. Verbal communication will matter in university-level jobs for 10 hours per week compared with 7 hours on average.





Exhibit 12: In 2030, some skills will need to be used in billions more hours of work across the economy



Source: O*NET, ABS, AlphaBeta analysis

Employers are already demanding many of the new smart skills. Analysis of millions of online job ads earlier in the research series, showed us that already employers are both expecting and paying a premium for transferrable enterprise skills in entry level roles. Demand for digital skills went up 212 per cent over three years, while critical thinking increased 158 per cent, creativity increased by 65 per cent and presentation skills by 25 per cent.

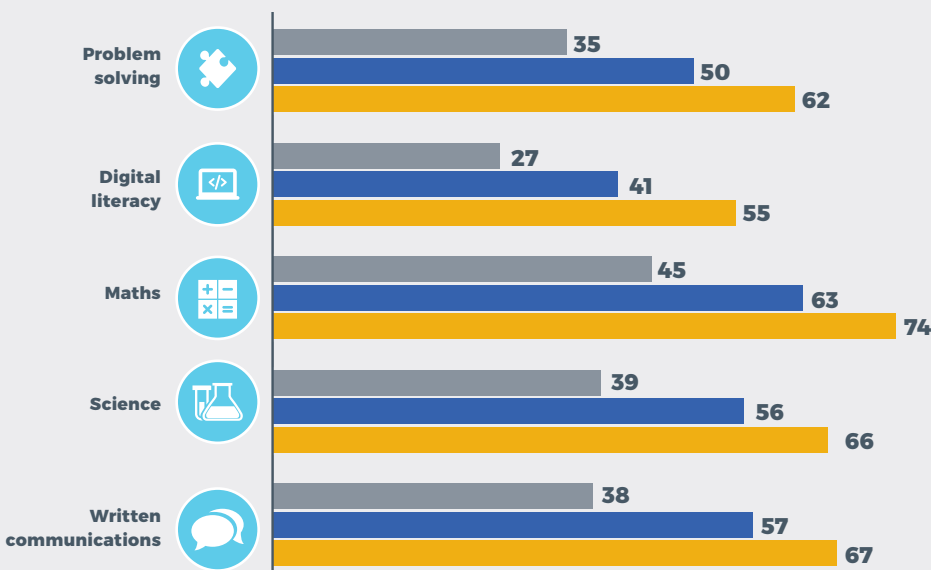
Equity Challenge

To set up young people to thrive in the future of work, we need to particularly address issues of equity: ensuring that all young people have access to opportunities to develop their technical, foundational and enterprising skills.

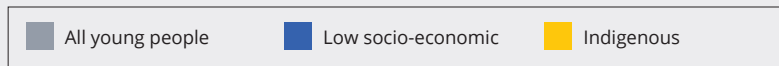
Data shows that the challenges are even greater for students from low socio-economic backgrounds and Indigenous students (Exhibit 13). There are significant gaps in problem solving, digital literacy, science, maths and written communication.

Exhibit 13: Low socio-economic and Indigenous students perform more poorly on problem solving, digital literacy, science and maths

Proportion of group in lower levels* of proficiency, %, latest data



Key:



Source: PISA 2015 for maths, science and written communication results. PISA 2009 for digital literacy. PISA 2012 for problem solving. AlphaBeta analysis.

* Lower proficiency defined as scoring Level 2 or below in most recent PISA testing



3.1 Effectively preparing young Australians for the New Work Order

FYA's *New Work Order*¹³ series has examined the key forces that will shape the future of work and how we can best prepare for this uncertain future. The series demonstrates through compelling evidence and new data analysis that the future of work will look very different. Automation, globalisation and more flexible working arrangements are rapidly reshaping our economy and work. Compounding the uncertainty is the reality that many jobs of the future don't exist today.

Within this future, young people are likely to be disproportionately affected. Many of Australia's young people are currently training for jobs that will significantly be changed by automation. For example, 60 per cent of students in vocational education are training for occupations that will be highly affected by automation. And 70 per cent of young people are entering the workforce in jobs that will be highly affected by automation.

Although much of the public narrative is a guessing game about which occupations will stay or go before 2030, the truth is that technological change is going to impact what we do in every job.

Portable Skills

Rather than focussing on jobs, if we want young people to capitalise on these opportunities and navigate the challenges brought by these changes, they need a set of transferrable skills. We must equip young people with the new work smart skills and capabilities: smart learning, smart thinking and smart doing. Employers are already demanding many of the new work smart skills and capabilities.

Analysis of millions of online job ads showed us that, already, employers are demanding enterprise skills and paying a premium for these skills. For example, demand for critical thinking has increased by 158 per cent in the

past 3 years¹⁴. Problem solving attracts an additional \$7,745 in early-career jobs, compared with jobs that don't request problem solving.

Through education, immersive learning and real world experience we can support young people to lay the foundations today to be successful at work tomorrow.

Early Career Experience

Not every work experience and entry-level job will prepare young people equally for the future. A look at the skills required in different roles shows that some early-career jobs appear particularly suited to help young people become ready for the 'new work smart' because they already rely on skills that will be most important in the future¹⁵. These jobs are as broad as advertising professionals, ICT sales assistants, pharmacy assistants, physiotherapists, statistical clerks, multimedia specialists, tourism advisers, office cashiers, ICT support technicians (Exhibit 14). What they have in common is the opportunity to gain experience utilising technical and foundation skills in conjunction with enterprise skills. In other words, smart learning, smart thinking and smart doing.

The average advertising professional, for example, already uses 2 hours of maths and science per week, spends 7 hours per week on written communication, 3 hours per week on verbal communication, 4 hours each on critical thinking and problem solving. They also spend an average of 2 hours per week using advanced technology skills. The average web developer spends 7 hours per week using problem solving, 7 hours using advanced technology skills, and 3 hours using written communication. We can help students choose jobs and find work experiences that develop relevant future skills. The case study "Rita uses her early-career work choices to help her become 'work smart'" shows how valuable such early-career experiences can be (Exhibit 15).



¹³ FYA has published five reports within its "New Work Order" series. For more information see: <http://www.fya.org.au/new-work-order-report-series/>








¹⁴ Based on analysis of 4.2 million online job advertisements from 2012 to 2015.

¹⁵ Time spent on skills within each job was determined by taking correlation between skills and activities, and applying these to time spent on activities at the 4-digit ANZSCO level, as opposed to the aggregate economy.




Exhibit 14: Some early-career jobs can help to equip young people with the skills that matter most

Jobs in which young people are highly represented and the share of future skills required

Intensity of skill use by job

Early-career jobs	 Maths and science	 Written communication	 Verbal communication	 Interpersonal	 Problem Solving	 Judgement and critical thinking	 Advanced technology
Advertising and marketing professionals	High skill use	Highest skill use	High skill use	High skill use	Highest skill use	High skill use	High skill use
ICT sales assistants	High skill use	Highest skill use	High skill use	High skill use	Highest skill use	High skill use	High skill use
Call or contact centre workers	High skill use	Highest skill use	High skill use	High skill use	High skill use	High skill use	High skill use
Physiotherapists	High skill use	High skill use	Moderate skill use	High skill use	High skill use	High skill use	High skill use
Actuarial clerks	High skill use	High skill use	Moderate skill use	Moderate skill use	Highest skill use	High skill use	High skill use
Survey interviewers	Highest skill use	Highest skill use	Moderate skill use	Moderate skill use	Highest skill use	Moderate skill use	Moderate skill use
Receptionists	High skill use	Highest skill use	Moderate skill use	Moderate skill use	High skill use	High skill use	High skill use
Multimedia specialists and web developers	Moderate skill use	High skill use	Moderate skill use	Moderate skill use	Highest skill use	Moderate skill use	Highest skill use
Sales assistants (general)	High skill use	High skill use	Moderate skill use	High skill use	High skill use	High skill use	High skill use
Pharmacists	High skill use	Highest skill use	Moderate skill use	Moderate skill use	High skill use	Moderate skill use	Moderate skill use
ICT support technicians	Moderate skill use	High skill use	Moderate skill use	Moderate skill use	High skill use	Moderate skill use	Moderate skill use

Key:

 Highest skill use	 High skill use	 Moderate skill use
---	--	--

Note: early-career jobs defined as the 25% of occupations with the highest proportion of workers under 29 years old

Source: O*NET, ABS, AlphaBeta analysis

Exhibit 15: Case study

Rita uses her early-career work choices to become ‘work smart’

Rita recently started working for a small marketing company. This is Rita’s first job after completing her studies, and already she has been given responsibility to develop a digital advertising strategy. Rita dedicates around half her work week to the project: she designs content and creates a new website for the campaign. She also regularly meets up with clients and colleagues to advance the project.

To develop a successful and tailored campaign, Rita needs to think critically, solve problems, and actively engage with the client. Combined with Rita’s other responsibilities around the office, she needs to spend 3 to 6 hours a week interacting directly with clients and colleagues, 4 to 9 hours a week using her problem-solving and critical-thinking skills. In the last stage of the project, just before presenting the final campaign to the client, Rita will draw on her technical skills and digital literacy for 2 to 4 hours per week.

After a year on the job Rita has greatly improved her verbal communication, written communication and interpersonal skills - thanks to the countless hours she spent meeting with retailers and managers, and even giving a few media interviews. She has also picked up some basic programming skills while joining a team to develop new websites for the launch of some campaigns. Even though Rita is no longer sure she wants to stay in advertising, her work experience has allowed her to develop critical enterprise skills and technical skills that will help Rita and her next job, which she hopes will be as a social media manager.



3.2 We need a new work mindset

Equipped with the skills to be new work smart, young people can also navigate the future of work by thinking about how their skills are portable for other jobs. Our mindset needs to shift to reflect a more dynamic future of work where linear careers will be far less common and young people will need a portfolio of skills and capabilities, including career management skills to navigate the more complex world of work.

On average, when an individual trains or works in 1 job, they acquire skills for 13 other jobs. This is because employers often demand very similar skills across multiple jobs. By understanding the skills and capabilities that will be most portable and in demand in the new economy, young people can work to equip themselves for the future.

It is helpful to think about jobs as part of a cluster of work that demands similar skills. We have found that there are 7 clusters of work in Australia: The Artisans, The Generators, The Coordinators, The Informers, The Technologists, The Carers and The Designers.

To support young people to navigate these changing labour markets Australia will need to invest to ensure they are innovative, creative and enterprising. Amidst this uncertainty, young people need to make choices that will affect their future options and need to have information that simplifies the complex world of work, helping them navigate work and learning throughout their lifetime.

We can all take action to ensure young Australians grasp opportunity in the future of work:

Policy makers can help to:

- **Prioritise the right skills:** Ensure policy design and incentives for the education system support the development of enterprise skills, science and maths, and more independent and entrepreneurial working. There is an urgent need for investment in a national enterprise skills and careers education strategy in schools that begins in primary school, is delivered in ways that young people want to learn, and provides accurate information about the skills that will be important in the future.
- **Support portability:** In recognition of portability of skills across occupations, consider designing VET incentives and offerings to match the core skills in key clusters of work rather than training for individual occupations. Provide information on occupations with a high overlap of skills and how individuals can move most efficiently from one occupation to another.

Educators can help to:

- **Prioritise the right skills:** Ensure enterprise skills are elevated in the curriculum and developed through the most effective teaching methods. This will require developing teachers and partnering with employers.
- **Recognise portability:** Consider designing curriculum to support the core skills requested in clusters of work. Tertiary course information can better identify the many jobs that courses prepare young people for, rather than single occupations.

Careers advisers can help to:

- **Deal with continual change and portability:** Work with schools and other educators to help equip young people with skills for managing multiple changes in employers and movement between occupations. Present information differently to students to include the clusters of work and the many jobs available to a young person if they add additional skills.
- **Prioritise the right skills:** Help students to find work experiences and make study choices that build the skills that will be in highest demand, and will grow most in demand.

Employers can:

- **Recognise portability:** Consider breadth of candidates with similar skills when recruiting for positions, not just candidates within an occupation.

And, most importantly, young people can:

- **Be comfortable with changing employers and occupations multiple times.** Think about your career as selecting a cluster of jobs that you are interested in and build on your strengths. Try to make study and work choices that help you to build enterprise skills that you can take to any job, and the core technical skills within your cluster of interest.
- **Be prepared to work more independently and entrepreneurially.**

APPENDIX A - DETAILED METHODOLOGY

A.1 Methodology overview

To answer the question of how important a skill is in the economy, this study uses data from O*NET, a database sponsored by the US Department of Labor. The database contains one of the world's richest sources of information on the different skills and activities undertaken in different occupations. Estimating how often a skill is used in the economy is the key challenge solved by the methodology of this study.

It is inherently difficult to think about how much time a skill is used on the job. As an example, surgeons are unlikely to think about how much time they spend solving problems, or how much time they spend using physical coordination. As such there is no data available that directly measures the use of skills in an economy.

This study uses an innovative approach to overcome these challenges. Whilst there is no data that attempts to measure how much time is spent using a particular skill, there is existing data indirectly measuring how much time is spent on different work activities, and how important skills and activities are to a job. Thinking back to the surgeons' example, whilst they may not know how much time they spend using physical coordination, they do know how much time they spend diagnosing patients, performing routine surgery, performing complex surgery etc. At the same time, surgeons also know how important different skills such as problem solving, physical coordination or mathematics are to their job. Likewise, they can also answer how important each activity such as operating surgical equipment, diagnosing patients or calculating billings are to their job.

This study links these three pieces of available information to determine how important skills are in the economy, using the following steps:

1. Calculating how much time is spent on all activities in each occupation
2. Calculating how much time is spent on all activities in the economy
3. Calculating which activities a skill is important for
4. Calculating how much time is spent using skills in the economy

A.2 How much time is spent on activities in each occupation?

The first step in this study requires estimating how much time is spent on different activities in each occupation. O*NET provides data on the frequency at which workers perform over 2,000 different activities, but not the time spent on these activities.

However, it is possible to estimate the time spent on different activities using these frequency scores if workers tend to take the same number of tasks to perform different activities, and that in general workers surveyed work full time. Below a simple example illustrates how it is possible to infer time spent on activities using only frequency scores and total weekly hours:

Assume two full time occupations involve the same 10 activities at work, and let t_i be the time spent on task i . Assume the total time spent is as detailed below:

$$\text{Occupation A: } 2 \times t_1 + 2 \times (x \times t_2 + \dots + y \times t_{10}) = 40 \text{ hours}$$

$$\text{Occupation B: } 1 \times t_1 + 6 \times (x \times t_2 + \dots + y \times t_{10}) = 40 \text{ hours}$$

In the above Occupation A performs task 1 twice a week, and Occupation B performs task 1 once a week. Each of the remaining 9 tasks are performed in the same relative proportions to the other 8 in both occupations. Solving simultaneously shows:

$$1 \times t_1 = 4 (x \times t_2 + \dots + y \times t_{10})$$

Therefore through substitution, we find that performing task 1 2.5 times a week would take 40 hours, and therefore task 1 takes 16 hours a week to perform. As more occupations are compared to each other, more simultaneous equations can be solved and the time spent on more tasks can be inferred.

The above example was constructed such that a simple solution flows out, whilst in the true dataset there are two issues that require a more robust method. Firstly, there are hundreds of occupations but thousands of activities, meaning that there can be infinite solutions. Secondly, if frequency scores do not align well due to differences in time taken to perform tasks between jobs, it may be impossible to find solutions for certain jobs. Consider the below example:

$$\text{Occupation A: } 2 \times t_1 + 2 \times (x \times t_2 + \dots + y \times t_{10}) = 40 \text{ hours}$$

$$\text{Occupation B: } 2 \times t_1 + 3 \times (x \times t_2 + \dots + y \times t_{10}) = 40 \text{ hours}$$

Here the only solution that is feasible would require the two occupations to take different amounts of time to perform the same task, contradicting earlier assumptions. Both the infinite solution and impossibility scenarios are overcome by using a regularised least squares solution, which allows a violation of prior assumptions regarding total work hours, but penalises large deviations in time taken to perform tasks and deviations from the total weekly work hours in an occupation. This part of the study is the most technically complex, and the methodology is highlighted in Exhibit A.1

Exhibit A1: Estimating activity timeshares by occupation

How much time does each worker spend on each activity?

Inferring timeshares from frequency scores:

- For each occupation O*NET frequency scores are converted to weekly frequency of task performance¹:

O*NET frequency scale	O*NET description	Assigned weekly frequency
1	Yearly or less	0.02
2	More than yearly	0.12
3	More than Monthly	0.5
4	More than weekly	2
5	Daily	5
6	Several times a day	20
7	Hourly or more	40

- The total amount of time spent on work by occupation j in a week is given by:

$$f_{1,j} \times t_1 + \dots + f_{N,j} \times t_N = h_j$$

- Where $f_{i,j}$ is the weekly frequency of activity i performed by job j , t_i is the time taken to perform task i , and h_j is the total amount of time spent working in a week is given by (assumed to = 40 hours per week)

- it assumed that US occupations within the same 1 digit SOC code all take the same amount of time to perform tasks

- Therefore to estimate the timeshares for J US occupations within a 1 digit code with N total activities, requires solving the linear system, where t_1, \dots, t_N are unknown

$$\begin{bmatrix} f_{1,1} & \dots & f_{N,1} \\ \vdots & \ddots & \vdots \\ f_{1,J} & \dots & f_{N,J} \end{bmatrix} \times \begin{bmatrix} t_1 \\ \vdots \\ t_N \end{bmatrix} = \begin{bmatrix} h \\ \vdots \\ h \end{bmatrix}$$

- Given that there are more unknowns than equations (as the number of activities is larger than the number of occupations), the system may have an infinite set of solutions

$$\min \|Ft - h\|^2 + \mu \|t\|^2 \text{ s.t. } t_i \geq \epsilon \forall i$$

where ϵ is arbitrarily small and > 0

- A regularised least squares solution is used which satisfies the following constraints
- In the above μ is a small number that penalizes large deviations in time taken to do tasks
- An estimate of the timeshares spent on given activities can then be computed for each occupation
- Lastly US SOC occupation codes are converted to Australian 4 digit ANZSCO codes using a concordance table
- The next step requires converting the activity timeshares into task group timeshares

Source: O*NET, ABS, AlphaBeta analysis

¹ O*NET scale converted to weekly frequency based on O*NET description e.g. a task which is performed yearly or less is assumed to be performed once a year which is equivalent to 0.02 times a week








A.3 How much time is spent on activities in the economy

The methodology in A2 provides an estimate of how much time is spent on every activity in every occupation in Australia. Estimating the total time spent on an activity in the economy is done by combining ABS data on weekly work hours with ‘timeshare’ data as calculated in Exhibit A2, across all 350+ 4 digits ANZSCO codes in the Australian economy. First, the 2000 different tasks are aggregated under 41 General Work Activities (GWAs) as defined by O*NET’s classification system. For example, moving cars, moving boxes, or moving other equipment can be bundled under the broader category of ‘moving objects’.

Exhibit A2 highlights the methodology for calculating how much time is spent ‘moving objects’ using illustrative numbers (true timeshares and work hours differ from the example). For example, if police officers work 5 million hours a week in the economy and spent 10 per cent of their time moving objects, then police offices spend 500,000 hours a week moving objects. Repeating this process across for each occupation, provides the aggregate weekly hours spent moving objects in the economy, which can then be expressed as a percentage of total work hours.

Exhibit A2: Estimating time spent per activity in the economy

How much time is spent moving objects in the economy

	 Police officers	 Managers	...	 Construction workers	 Doctors	 All occupations
Weekly hours worked	5,000,000	1,000,000		10,000,000	2,000,000	300,000,000
% of time spent moving objects	10%	2%		30%	5%	9%
Weekly hours moving objects	500,000	20,000		3,000,000	100,000	27,000,000

Note: Numbers in exhibit are purely illustrative.

The process is then repeated for each one of 41 GWAs to provide a complete picture of how much time is spent on each activity across the economy. The process was repeated using timeshare and employment data from different years between 2000 and 2015 in order to estimate how time spent on different activities has changed.

A.4 How important are different skills to different activities?

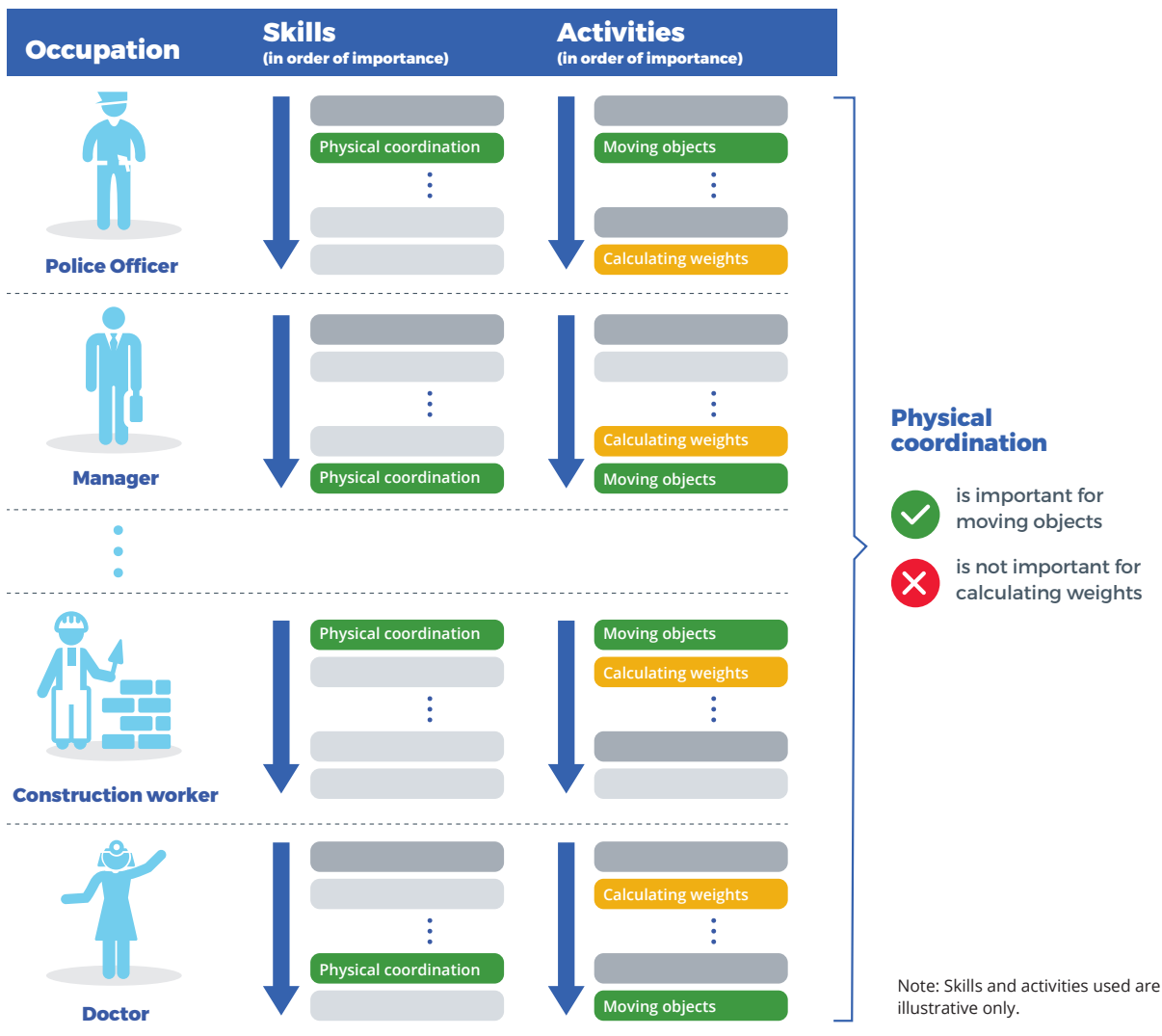
O*NET provides data on importance scores for different skills and activities across all occupations. Assigning direct significance to importance scores is difficult, given the subjective nature of such scores, however the data can still be interpreted in terms of rank. For example, whilst we cannot say how much more

important a skill that is scores as 8 on a 1-10 importance scale is compared to a skill that is scores a 7, we can safely assume that the skill scored as an 8 is more important than the skill scored as a 7.

Examining the ranking of skills and activities across occupations, can reveal which skills are important for performing which activities. To determine the relationship between skills and activities, a non-parametric correlation between rankings of skills and activities (Spearman's rho) is calculated and a Spearman's rho value of 0.6 or greater is interpreted as a sign that a given skill is important for carrying out a given activity. Exhibit A.3 illustrates the principle of the procedure. (true ranking of skills and activities may differ).

Exhibit A3: Estimating time spent per activity in the economy

What makes a skill important for an activity?



The above shows that as physical coordination varies in importance across occupations, the activity of moving objects varies in an analogous manner, implying a high value of Spearman's rho. When physical coordination is an important skill, moving objects is an important activity. In contrast, the activity of 'calculating weights' has no relation to the skill of physical coordination. Whether physical coordination is important or unimportant does not have a bearing on the importance of

calculating weights, reflected by a low value of correlation coefficient.

The above procedure is carried out for all 41 GWAs and all skills, to determine which skills are important for which activities. With some skills displaying importance for a wide range of activities, and some skills displaying importance of little or no activities

A.5 How much time is spent utilising a skill in the economy?






The final piece of the study is determining how much time is spent using a particular skill in the economy. To do this, the results in section A.3 and A.4 are combined. Using the above examples, physical coordination is important for moving objects, and moving objects constitutes 9 per cent of work time in the economy, then physical coordination is important for 9 per cent of total work hours in the economy. The above example assumes that physical coordination is only important for moving objects. However, since the performance of activities is mutually exclusive (a worker can only perform one activity at a time) it is not more complicated to estimate how much time is spent using a skill that is important to many activities in the economy: If physical coordination was important for moving objects, as well as another activity that takes up 11 per cent of work hours than, summing the two timeshares would indicate that physical coordination is important for 20 per cent of work hours in the economy.

The above methodology is repeated across different years between 2000 and 2015. This procedure provides a quantifiable estimate of how the relevance of different activities in the economy has been changing over time, and what the implied change in importance of skills has been. For example, we can observe that physical activities have been declining in importance, and therefore skills important to performing physical activities are declining. At the same time activities which require complex problem solving skills are increasingly taking up more work hours, suggesting that these skills are becoming more important in the economy.

A.6 How much time is spent utilising a skill in the economy?

All time spent on skills analysis was carried out by group O*NET skills under AlphaBeta's classification. These classifications were informed by prior work done by AlphaBeta, as well as incorporating O*NET description of skills in order to ensure appropriate matching. The full glossary of skills discussed in this report and corresponding O*NET skills are presented below:

Categorising skills using O*NET skill glossary (1/2)

AlphaBeta Category	O*NET skill	O*NET skill description
Technical		
 Machine analysis	Equipment Selection	Determining the kind of tools and equipment needed to do a job.
	Operations Analysis	Analyzing needs and product requirements to create a design.
	Quality Control Analysis	Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
	Troubleshooting	Determining causes of operating errors and deciding what to do about it.
 Operations and repair	Equipment Maintenance	Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.
	Installation	Installing equipment, machines, wiring, or programs to meet specifications.
	Operation and Control	Controlling operations of equipment or systems.
	Operation Monitoring	Watching gauges, dials, or other indicators to make sure a machine is working properly.
	Repairing	Repairing machines or systems using the needed tools.
Foundational		
 Written communication	Reading Comprehension	Understanding written sentences and paragraphs in work related documents.
	Writing	Communicating effectively in writing as appropriate for the needs of the audience.
 Verbal communication	Speaking	Talking to others to convey information effectively.
 Science and maths	Mathematics	Using mathematics to solve problems.
	Science	Using scientific rules and methods to solve problems.

Source: O*NET, ABS, AlphaBeta analysis

Categorising skills using O*NET skill glossary (2/2)

	AlphaBeta Category	O*NET skill	O*NET skill description
	Learning	Active Learning	Understanding the implications of new information for both current and future problem-solving and decision-making.
		Learning Strategies	Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things.
	Interpersonal	Active Listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
		Negotiation	Bringing others together and trying to reconcile differences.
		Persuasion	Persuading others to change their minds or behavior.
		Service Orientation	Actively looking for ways to help people.
		Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.
	Coordination	Coordination	Adjusting actions in relation to others' actions.
		Time Management	Managing one's own time and the time of others.
		Management of Material Resources	Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.
	Teaching	Instructing	Teaching others how to do something.
	Judgement and critical thinking	Systems Analysis	Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes.
		Systems Evaluation	Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.
		Judgment and Decision Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.
		Critical Thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
	Problem solving	Complex Problem Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
	Financial literacy	Management of Financial Resources	Determining how money will be spent to get the work done, and accounting for these expenditures.
	Advanced technology	Programming	Writing computer programs for various purposes.
		Technology Design	Generating or adapting equipment and technology to serve user needs.
	Management	Monitoring	Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.
		Management of Personnel Resources	Motivating, developing, and directing people as they work, identifying the best people for the job.

Source: O*NET, ABS, AlphaBeta analysis



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