

# *Public Paper*

## Big Data Cross Sector Project

*PwC's Skills for  
Australia*

*November 2017*

# Foreword

As more industries recognise the potential of Big Data, employees with skills in capturing, interpreting and taking advantage of that data are growing in importance. The Big Data Cross Sector Project will look to understand industry support for developing Big Data related units to be used across multiple industry sectors; relationship mapping with existing training products; and State/Territory government support to validate that units are appropriately contextualised to the specific industry circumstance.

The Australian Industry and Skills Committee (AISC) has taken the opportunity to strategically address common skills needs across multiple industries through eight cross sector projects. These eight common skills areas have been identified by various Industry Reference Committees (IRCs) in their Industry Skills Forecasts and Proposed Schedules of Work, which set out the emerging industry trends, skills needs and training priorities over a four year period.

The Big Data Cross Sector Project, led by PwC's Skills for Australia, seeks to understand industry support for developing common Big Data units that can be contextualised across various industries. This project also aims to better understand what these units might look like, how they might be delivered, and what benefits or risks need to be considered with any potential changes to existing vocational training. The Big Data Project Reference Group (PRG), consisting of IRC members and/or subject matter experts, is responsible for the direction of this Cross Sector Project. They provide governance and make decisions based on the industry and stakeholder groups they represent. Members of the Big Data PRG are listed below.

**Table 1. Big Data Project Reference Group members**

Name	Location	Training Package	IRC Representation
Craig Moss	QLD	RII Resources and Infrastructure	Civil Infrastructure IRC
Jaesen Jones	ACT	Not applicable, Defence subject matter expert	Nominated by Lynda Douglas (Deputy Chair of Public Safety IRC)
Jodie Davis	ACT	HLT Health	Enrolled Nursing IRC
John Roydhouse	NSW	LGA Local Government	Local Government IRC
Judy Brooker	ACT	BSB Business Services	Business Services IRC
Kevin Cottrill	NSW	AMP Australian Meat Processing	Meat IRC
Kevin Harris	NSW	ICT Information and Communications Technology	Information and Communications Technology IRC
Meg Parkinson	VIC	AHC Agriculture, Horticulture and Conservation and Land Management	Agriculture and Production Horticulture IRC
Michelle Lees	NSW	ICP Printing and Graphic Arts	Printing and Graphic Arts IRC
Nigel Haywood	WA	MSL Laboratory Operations; MSM Manufacturing; PMA Chemical, Hydrocarbons and Refining; PMB Plastics, Rubber and Cablemaking; PMC Manufactured Mineral Products	Process Manufacturing, Recreational Vehicle and Laboratory IRC
Noel Hamey	ACT	CPP Property Services	Property Services IRC
Richard Harvey	VIC	UEP Electricity Supply Industry - Generation Sector	Electricity Supply Industry Generation IRC
Stuart Johnston	ACT	UEP Transmission, Distribution and Rail Sector	Electricity Supply Transmission Distribution and Rail IRC
Wayne Wilson	NSW	FNS Financial Services	Financial Services IRC
Yvonne Webb	NT	CUA Creative Arts and Culture	Culture and Related Industries IRC



This document is a synthesis of findings from a literature review and stakeholder consultations conducted during August through to October 2017. The literature review includes a scan of domestic and international research focussing on emerging industry trends, skills needs and training priorities for Big Data. Stakeholder consultations include input from different stakeholder types (employers, industry associations, training providers, subject matter experts) from all States/Territories in Australia and from a range of industries. Insights from research and consultations will feed into a Case for Change document, which will present a concise, evidence-driven justification for change to the AISC for proposed training product development. The Case for Change will be developed under the steer of the Big Data PRG, and is the final deliverable due to be submitted to the AISC by the end of November 2017.

For questions about this paper or the Big Data Cross Sector Project, please contact PwC's Skills for Australia at [info@skillsforaustralia.com](mailto:info@skillsforaustralia.com).

# Executive Summary

As more industries recognise the potential of Big Data, employees with skills in capturing, interpreting and taking advantage of this data are growing in importance. Yet, in many industries, new hires lack the requisite skills in Big Data and employers are increasingly turning to formal and informal training to help address these skills gaps.

In order to better understand the challenges, issues and opportunities with vocational education and training surrounding Big Data related skills, PwC's Skills for Australia conducted a literature review and extensive stakeholder consultations from August to October 2017. In total, we received input from 113 stakeholders across 27 different industries, and all states/territories. Key findings from our research and consultations are outlined below.

## Current and future industry trends

- Rapidly changing technologies such as the improvement of sensors,<sup>1</sup> the 'Internet of Things' and the rise of artificial intelligence (including machine learning) are all increasing the relevance of Big Data skills.
- These evolving technologies are also causing the amount of data that is being generated and stored to grow exponentially.<sup>2</sup>
- Despite this increasing reliance on Big Data, research and consultation feedback suggests that workforce entrants across many industries do not have the required Big Data related skills for their role.<sup>3</sup>

## Big Data skills needs

- Basic Big Data related skills demanded by industry include: a conceptual understanding of data driven decision making, Big Data awareness and improved data literacy.
- More advanced skills required include: data visualisation, using data for operational decision making, data analysis and data management.

## Effectiveness of existing vocational training

- Employers across a wide variety of industries are experiencing difficulty finding workers who possess sufficient Big Data related skills.
- A number of stakeholders believe that, despite impressive developments in Big Data, many people within industry are unaware of the benefits and potential of Big Data.
- Many employers are needing to invest time and money training their employees in Big Data related skills through private third-party providers.

## Benefits and risks of developing "common" Big Data units

- Benefits of implementing common units in Big Data include greater consistency in vocational training across industry sectors and a higher level of awareness of Big Data concepts amongst workers.
- One risk is that the proposed new training products could quickly become outdated due to the rapid pace of technological change and relatively slower process of training product development and review cycles.
- However, most stakeholders felt that the potential benefits of updating vocational education and training to include Big Data related skills far outweigh any potential negatives.

## Next steps

Since the establishment of the Big Data PRG in July 2017, we have presented a draft Case for Change report, which describes our evidence-based case for proposed changes to the VET system, including the potential development of new 'common' training products. This Case for Change will be shared with State and Territory Training Authorities (STAs) and endorsed by the Big Data PRG before submission to the AISC in November 2017.

---

<sup>1</sup> Australian Industry Standards, *Rail IRC Industry Skills Forecast and Proposed Schedule of Work* (2017)

<<http://www.australianindustrystandards.org.au/>>.

<sup>2</sup> Rick Osowski, *How big is big data?* (IBM Bluemix Blog, 2015) <<https://www.ibm.com/blogs/>>; PwC's Skills for Australia, *Business Services Industry Skills Forecast and Proposed Schedule of Work* (2017) <<https://www.skillsforaustralia.com/>>.

<sup>3</sup> Katherine Noyes, *How the skills shortage is transforming big data* (PC World, 2016) <<https://www.pcworld.com/>>.





# Contents

<b>1. Introduction</b>	<b>6</b>
1.1 Purpose of the Big Data Cross Sector Project	6
1.2 Approach to the Big Data Cross Sector Project	6
<b>2. Literature Review</b>	<b>8</b>
2.1 Introduction	8
2.2 Summary of key findings	8
<b>3. Stakeholder Consultations</b>	<b>11</b>
3.1 Consultation approach	11
3.2 Current and emerging industry trends	12
3.3 Skills needs in Big Data	13
3.4 Reviewing existing training	14
3.5 Risks and benefits of change	15
3.6 Training on different levels	17
<b>4. Appendices</b>	<b>18</b>
Appendix A - Terminology	18
Appendix B - Stakeholder consultations	19

# 1. Introduction

## 1.1 Purpose of the Big Data Cross Sector Project

The AISC has taken the opportunity to strategically address common skills needs identified in Industry Reference Committee (IRC) Industry Skills Forecasts and Proposed Schedules of Work through eight cross sector projects. The aim of these projects is to develop training package components that address those skills needs across industries in a coordinated and efficient way. The Big Data Cross Sector Project, led by PwC's Skills for Australia, is looking to understand industry support for developing common Big Data units to be used across multiple industry sectors. It is expected that the outcomes of this project will lead to a significant reduction in duplication across the national training system, making the system more efficient and easier to navigate for users. It is also expected that, in some cases, the development of common units and skill sets will assist individuals to move more easily between related occupations.

### Key drivers of change

This project is proposed in response to the following drivers for change, identified through desktop research and stakeholder consultations:

1. **Emerging trends across many industries suggest a strong need for Big Data related skills**  
Emerging trends in technology are being used to augment or automate business processes, resulting in more data becoming available for analysis. However, the Australian economy lacks the necessary skills to fully capitalise on this opportunity.
2. **There are significant Big Data skills gaps in existing vocational training**  
Existing nationally endorsed training does not provide workers in all industries with the necessary Big Data skills and knowledge to succeed in the workforce. Stakeholders agree that there is difficulty finding workers with the appropriate Big Data skills.
3. **There is an opportunity for vocational training products to address Big Data skill needs**  
The majority of survey respondents believe that current education and training equips students “not at all well” with Big Data related skills. Implementation of common units provides an opportunity to increase data literacy of the workforce.

## 1.2 Approach to the Big Data Cross Sector Project

### 1.2.1 Project methodology

Our approach to the Big Data Cross Sector Project is a combination of literature review and stakeholder consultations.

- **Literature review:** to understand current industry trends, skills needs and training priorities for Big Data. This involved a review of various Industry Skills Forecasts, analysis of existing units relevant to Big Data, and desktop research of domestic and international practice. Key findings from the literature review are provided in Section 2 of this report.
- **Extensive multi-channeled stakeholder consultations:** to get input from a diverse range of stakeholders (industries, geographic locations, stakeholder groups) through a variety of different channels, including one-on-one interviews, group discussions, an online nationwide survey, and webpage updates. Key findings from the stakeholder consultations are provided in Section 3 of this report.

To maximise the breadth and depth of our stakeholder reach, we leveraged our existing PRG and IRC member network, the broader PwC network, other Skills Service Organisations (SSOs) and Department contacts, training providers, subject matter experts and thought leaders. We also consulted with second degree contacts who were referred to us through the course of this Cross Sector Project. There were four key channels by which stakeholders could contribute to this work:

- Interviews
- Nationwide industry survey



- Focus group discussion
- PwC's Skills for Australia webpage and social media channels (e.g. LinkedIn)

These are discussed further in Section 3 of this report.

### *1.2.2 Guiding principles for training product development*

Our approach to the project has been guided by our principles for training product development, which determine that our work should be:

1. Industry-led;
2. Encourage broad and transparent stakeholder consultation;
3. Respond quickly to industry skills needs and priorities;
4. Be efficient and cost-effective; and
5. Produce high quality and independently validated training products.

We have also sought to align our objectives to meet the Council of Australian Governments (COAG) Industry Skills Council principles for reforms to Training Packages:<sup>4</sup>

1. Ensure obsolete and superfluous qualifications are removed from the system;
2. Ensure that more information about industry's expectations of training delivery is available to training providers to improve their delivery and to consumers to enable more informed course choices;
3. Ensure that the training system better supports individuals to move easily from one related occupation to another;
4. Improve the efficiency of the training system by creating units that can be owned and used by multiple industry sectors;
5. Foster greater recognition of skill sets; and
6. Ensures that new training courses can be developed as quickly as industry needs them and available to support niche skill needs.

### *1.2.3 Collaborating with industry and key stakeholders*

The cross sector projects present an exciting opportunity for a more innovative approach to training package development. As the lead SSO, PwC's Skills for Australia is working collaboratively with industry and key stakeholders including other Skills Service Organisations and their IRC members, Commonwealth and State/Territory departments and government representatives, training providers and technical experts and researchers.

The Big Data PRG is primarily comprised of representatives from IRCs who have nominated to represent their training package. The role of the PRG is to provide guidance and expertise throughout the training product development process and are the decision-making authority regarding potential training product development. PwC's Skills for Australia works closely with the Big Data PRG members to ensure that the views and opinions of industry are accurately reflected in the Case for Change report.

---

<sup>4</sup> *Communiqué for the COAG Industry and Skills Council Meetings Skills Ministers*, (Communiqué, 2015) <<https://docs.education.gov.au/>>.



## 2. Literature Review

### 2.1 Introduction

The influence of Big Data continues to be felt across a wide variety of organisations and industries. Organisations are generating larger amounts of data and are looking for employees with data analytics skills who can leverage this data to create business value and derive actionable insights. However, current education and training is largely not leaving workers equipped with the Big Data related skills required by industry, contributing to a nationwide Big Data skills shortage.

Data analytics can be used to improve organisational outcomes across a wide range of different organisations and business functions. Organisations that are effectively leveraging data analysis are enjoying more efficient operations, deeper insights to drive decision making, and ultimately increased competitiveness and better organisational outcomes.

### 2.2 Summary of key findings

**Big Data is playing an increasingly important role in many organisations.**

The amount of data being generated is rapidly growing, with many sources estimating that around 90% of the world's data has been created in the last two years alone.<sup>5</sup> This is primarily driven by the increased adoption of technology by business. Key business processes that are becoming augmented or automated by technology include stock management, finance and human resources, resulting in the generation and storage of more business data. However, many organisations are not using their data as effectively as they could. Research firm Forrester estimates that just 5% of data is utilised effectively by firms.<sup>6</sup>

As larger and larger amounts of data are generated and become available, leaders of many organisations are increasingly acknowledging the value of data analysis, and incorporating it into their strategy. An increasingly diverse array of organisations are making use of data analytics, including banks,<sup>7</sup> manufacturers,<sup>8</sup> local governments,<sup>9</sup> transport,<sup>10</sup> and military organisations.<sup>11</sup>

**Organisations that are successfully leveraging data analytics are seeing improved organisational outcomes.**

Across many industries and types of organisations, data analytics can be utilised to create value and improve performance across a variety of business functions. Examples of possible benefits include more efficient and cost effective processes, better utilisation of resources, and better business intelligence to drive decisions. Detailed examples of the applications of data analytics can be found in Section 2.2.3.

A number of businesses, however, are still adapting to trends in Big Data, and are now beginning to equip themselves to implement data analytics into their business. As a result, demand for professionals with data analysis skills continue to rise.<sup>12</sup>

---

<sup>5</sup> SINTIF, *Big Data, for better or worse: 90% of world's data generated over last two years* (2013) <<https://www.sciencedaily.com/>>.

<sup>6</sup> Brian Hopkins, *Big Data Will Help Shape Your Market's Next Big Winners* (Forrester, 2011) <<https://go.forrester.com/>>.

<sup>7</sup> Telstra, *Analyse this, predict that* (Telstra Global, 2013) <<http://connect.telstraglobal.com/>>.

<sup>8</sup> McKinsey, *How big data can improve manufacturing* (McKinsey Global Insights, 2014) <<https://www.mckinsey.com/>>.

<sup>9</sup> Greg Hallam, *Diving into Big Data* (Local Government Association of Queensland, 2017) <<http://lgaq.asn.au/>>.

<sup>10</sup> Carl-Stefan Neumann, *Big data versus big congestion: Using information to improve transport* (McKinsey & Company, 2015) <<https://www.mckinsey.com/>>.

<sup>11</sup> Colin Wood, *How does the Military use Big Data?* (Emergency Management, 2014) <<http://www.govtech.com/em/safety/>>.

<sup>12</sup> Brad Howarth, *Rising demand for big data analytics skills triggers wage debate* (CMO, 2013) <<https://www.cmo.com.au/>>.



There is a global shortage of data analytics skills, with current education and training struggling to meet skills demands.

This means that professionals who possess data analytics skills can command higher wages,<sup>13</sup> increasing the cost for organisations to expand their data analytics capabilities. According to a global 2015 MIT Sloan Management Review, more than 40% of companies surveyed were struggling to find and retain data analytics talent.<sup>14</sup>

In Australia, a substantial skills shortage also persists.<sup>15</sup> A Commonwealth Employment Department report into IT Labour Market trends reveals that data scientists and data miners were both among the emerging areas of demand.<sup>16</sup> A number of Australian universities also offer a variety of qualifications for data science and analytics skills, however students are not graduating quickly enough to meet the growing demand.<sup>17</sup>

Basic data skills are useful for personnel who do not work directly with data.

Basic data literacy is important for employees in many organisations. For example, managers who have basic data literacy skills will be better equipped to draw basic insights from data and make data driven decisions, even in the absence of a dedicated data analytics professional.

A number of businesses, especially small businesses, lack the talent to effectively interpret and analyse their data. Many smaller organisations also lack the resources to hire personnel purely to analyse data.<sup>18</sup> This makes having data literate employees especially important for small to medium enterprises, as it enables them to draw meaningful insights and use data to make judgements and decisions.<sup>19</sup>

Some training packages already contain units related to Big Data.

We conducted a broad initial search for unit titles on training.gov.au using the keywords “data\*” (capturing the term “dataset” and “database”), “information”, “SCADA”, and “analytics”, and identified 454 units of competency.<sup>20</sup> These units were further filtered for material related to Big Data skills, yielding a total of 44 Units of Competency.<sup>21</sup>

### 2.2.2 Applications of Big Data

During our desktop research, we encountered a large amount of examples that show how Big Data related skills are being applied to solve a diverse range of problems. Several examples are listed below to demonstrate the different potential applications of Big Data related skills.

Predicting the failure of mining equipment

IBM is analysing in real time, sensor data from mining equipment operated by Thiess, in order to predict failure of components before it happens. By analysing and modelling past data, IBM has been able to assess risks and combine numerous data points to report real-time predictions of equipment lifespan and wear and tear. IBM estimates these insights could save a \$30 billion mining company in excess of \$1 billion per year.<sup>22</sup>

---

<sup>13</sup> Matt Asay (2014).

<sup>14</sup> MIT Sloan Management Review (2015).

<sup>15</sup> Katherine Noyes, *How the skills shortage is transforming big data* (PC World, 2016) <<https://www.pcworld.com/>>.

<sup>16</sup> Commonwealth Department of Employment, *Information Technology Professions Australia* (2016) <<https://docs.employment.gov.au/>>.

<sup>17</sup> Cynthia Karna, *Big data scientists, who needs them?* (Sydney Morning Herald, 2013) <<http://www.smh.com.au/>>.

<sup>18</sup> Maggie Chan Jones, *“It’s time for small business to embrace big data”* (Ad Age, 2017) <<http://adage.com/>>.

<sup>19</sup> SLA, *By Any Name, Data Literacy is Worth Teaching* (2017) <<https://www.sla.org/name-data-literacy-worth-teaching/>>.

<sup>20</sup> Australian Government Department of Education and Training, *‘Nationally recognised training search portal’*, (2017) <<https://training.gov.au>>.

<sup>21</sup> At the time of writing of this Public Paper, the Department of Education and Training was working to develop and launch an algorithm to assist with content analysis of training package components. Depending on when this is made available, more sophisticated unit analysis may be possible and therefore may alter the number of potential units identified.

<sup>22</sup> Dean Takahashi, *IBM uses big data to prevent mining equipment failures* (Venture Beat, 2014) <<https://venturebeat.com/>>.



### Efficiently allocating hospital resources

A hospital in Texas has successfully used predictive analytics to reduce its 30-day readmission rate for heart failure patients by nearly half. The hospital uses a Big Data algorithm to generate a 30-day risk score for heart failure, to allow physicians to target their care and resources towards those most in need.<sup>23</sup>

### Increasing the efficiency of transport infrastructure

Many European railway operators are beginning to employ Big Data to more efficiently schedule services, and allow different trains to 'swap out' itineraries in real time, in order to respond to delays. This approach has made railway services more punctual and reliable, allowing existing infrastructure to accommodate up to 10% more traffic.<sup>24</sup>

### Improving efficiency in local governments

The Local Government Association of Queensland (LGAQ) is leading a project, entitled LG Sherlock, which will combine data from numerous councils across Queensland. This data will then be analysed to yield statewide insights that can be utilised by local governments to make more informed decisions and reduce operational risks, with the ultimate goal of providing better value for ratepayers.<sup>25</sup>

### Providing insights into customer needs and demands

Big Data is increasingly used by businesses in order to better understand and cater to their customers.<sup>26</sup> For example, online streaming service *Netflix* analysed their customer behaviour data, in order to predict that the show '*House of Cards*' would be popular, before they purchased the rights to produce it. They also used data analysis to market the show. For example, customers who had watched a large amount of action genre content would be shown a more action-heavy trailer for the show.<sup>27</sup>

---

<sup>23</sup> George Leopold, *Hospitals Use Predictive Analytics to Allocate Resources* (Datanami, 2014) <<https://www.datanami.com/>>.

<sup>24</sup> Carl-Stefan Neumann, *Big data versus big congestion: Using information to improve transport* (McKinsey & Company, 2015).

<sup>25</sup> Greg Hallam, *Diving into Big Data* (Local Government Association of Queensland, 2017) <<http://lgaq.asn.au/>>.

<sup>26</sup> Rohit Tandon; Arnab Chakraborty; and Ganga Ganapathi, *Marketing: Leveraging Big Data around customers* (Analytics Magazine, 2012) <<https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/big-data-...improve-transport>>.

<sup>27</sup> David Carr, *Giving Viewers What They Want* (New York Times, 2013) <<http://www.nytimes.com/>>.

## 3. Stakeholder Consultations

### 3.1 Consultation approach

#### 3.1.1 Stakeholder engagement approach

A key objective of our stakeholder consultations was to achieve breadth of representation from industries, geographic locations, and stakeholder categories. To do this, we leveraged our existing PRG and IRC member network, the broader PwC network, other SSO and Department contacts, training providers, subject matter experts and thought leaders. We also consulted with second degree contacts who were referred to us through the course of this Cross Sector Project, pushing content through these networks and social media channels (LinkedIn, Twitter, industry newsletters, Skills for Australia website subscribers).

Figures 3, 4 and 5 in Appendix B show the overall respondent profile (industry, geographic location and stakeholder category) of stakeholders consulted for the Big Data Cross Sector Project. In total, 113 stakeholders have been consulted representing 27 different industries across our three main channels: interviews, survey respondents and focus group attendees.

- Top industries represented (out of a total 27 industries consulted):
  - Information and Communications Technology
  - Education
  - Business Services
  - Health
  
- Top stakeholder categories represented:
  - Employers
  - Training provider or other educational institution
  - Technical experts
  - Government Department

All states and territories had a voice in consultations.

#### 3.1.2 Consultation channels

As mentioned in Section 1, there were multiple channels by which stakeholders could contribute to this project, and these are briefly noted below (key summary tables can be found in Appendix B). Each consultation followed seven lines of enquiry, also noted below.

##### *Interviews*

Interviews were held with key stakeholders over the phone or in person to better understand issues and opportunities. Pull and push methods were used to identify stakeholders for interviews: those who contacted us directly or via our networks (pull) and those who we targeted based on their industry representation, geographic location, or stakeholder category (push). Interviews were conducted from mid August to late October 2017. The interviewee profile is included in Appendix B.

##### *Nationwide Industry Survey*

A nationwide industry survey was developed to help reach a broader stakeholder group (beyond our own network), and to provide another channel for people to provide additional feedback. Again, push and pull methods were used to identify survey respondents. The survey was published via the PwC's Skills for Australia website and launched through our network and social media channels (LinkedIn, Twitter, industry newsletters, promoted at industry conferences). The industry survey was live from 23 August 2017 to 25 October 2017 (9 weeks) and received 64 responses as of 25 October 2017. The respondent profile is included in Appendix B.



### Focus groups

Focus groups were offered as an additional mechanism for stakeholders to contribute their views and allow the opportunity for a mix of stakeholders to come together and engage in a dynamic, interactive group discussion about the lines of enquiry. A Big Data focus group was held in Sydney on the 18th of September 2017.

### 3.1.3 Lines of enquiry

Six lines of enquiry were developed for the Big Data Cross Sector Project and used to guide our stakeholder consultations. These lines of enquiry were designed around what is known from existing research, skills or training that we want to test with stakeholders; and what gaps there are in existing research, skills or training that we need to know to prepare a Case for Change.

1. **Current and emerging industry trends:** What are the current and emerging trends in your industry – both in Australia and internationally? Consider any sector specific threats, system/software threats etc.
2. **Skills needs:** What are the Big Data skills or jobs needed in your industry? What Big Data skills are common versus specialised for workers in your industry?
3. **Effectiveness of existing training:** How well does existing education or training equip learners with the Big Data skills they need in industry? What opportunities are there to improve training (content and structure) and its responsiveness to changes in industry? What opportunities are there to streamline training and reduce overlap or duplication? What gaps are there in existing education or training that need to be addressed?
4. **Risks and benefits of change:** What are the risks and benefits of any proposed changes? What are the risks and benefits of no change?
5. **Training on different levels:** Are there certain Big Data skills needs for different levels in the workplace?
6. **Additional considerations:** What else needs to be considered that has not already been covered by these lines of enquiry? What elements of training delivery have been most successful that could be considered in delivering generic Big Data units?

### 3.2 Current and emerging industry trends

In order for us to gain a better understanding of the industry trends, stakeholders were asked to identify which industry trends in Big Data were most relevant to workers in their industry, and shaping the need for workers with Big Data skills.

The top industry trends surrounding Big Data include: rapid pace of digital and technological change, increased dependence on digital technology, increased digital connectivity, ‘internet of things’ data, and automation.

1. **Rapidly changing technologies as part of the ‘Industry 4.0’ movement is increasing the relevance of Big Data related skills** - more specifically, this trend is driven by the acceleration of storage space (especially via ‘the cloud’); the improvement of sensing technologies;<sup>28</sup> increasing power of computers and data analysis tools; the rise of artificial intelligence (including machine learning); automation; the ‘Internet of Things’; continuing digitisation of plants and manufacturing; and increasing frequency of online transactions.
2. **The amount of data being generated is growing exponentially** - increasingly, business functions and processes are being automated or augmented using digital technology. This increased dependence on digital technology is resulting in larger and larger amounts of data being stored digitally, making it accessible for data analysis. The world creates an additional 2.5 quintillion bytes of data every year and, in 2016, approximately 90 percent of all existing data was created between 2014 and 2016.<sup>29</sup>

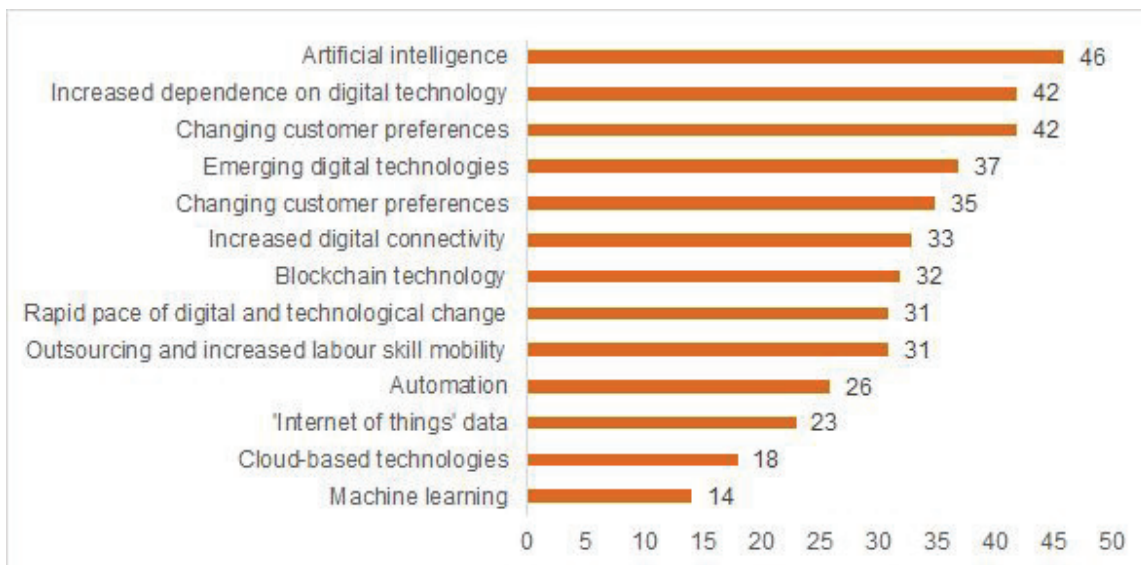
<sup>28</sup> Australian Industry Standards, *Rail IRC Industry Skills Forecast and Proposed Schedule of Work* (2017)

<<http://www.australianindustrystandards.org.au/>>.

<sup>29</sup> Rick Osowski, *How big is big data?* (IBM Bluemix Blog, 2015) <<https://www.ibm.com/blogs/>>; PwC’s Skills for Australia, *Business Services Industry Skills Forecast and Proposed Schedule of Work* (2017) <<https://www.skillsforaustralia.com/>>.

3. **Demand for employees with data analysis skills continue to rise**<sup>30</sup> - this sentiment was echoed by employers from a variety of sectors that we consulted with; employers are seeking learners to be equipped with Big Data related skills.
4. **The ability to understand and make decisions based on data is important at all levels** - entry-level employees are being asked to use data in their decision making, and management are asked to make strategic business decisions based on data driven insights.<sup>31</sup>
5. **Emerging skills and training gap** - consultation feedback suggests that workforce entrants across many industries do not have the required Big Data related skills for their role.<sup>32</sup> Furthermore, this is aggravated by the fact that current training is not adequate to equip workers with these skills.
6. **Organisations that leverage data are seeing improved outcomes** - data analytics is used to create value and improve performance across a variety of business functions. Examples of possible benefits include more efficient and cost effective processes, better utilisation of resources, and better business intelligence to drive decisions.

**Figure 1** Percentage of survey respondents who selected each trend in response to “Which of these industry trends is driving demand for workers with Big Data skills in your organisation/industry?”



Source: PwC’s Skills for Australia, Big Data Cross Sector Project Industry Survey (base: 64 responses as of 25.10.2017)

### 3.3 Skills needs in Big Data

In order to understand the specific Big Data skills needs required in industry, we asked stakeholders to comment on the skills that are currently in high demand. Stakeholders were then invited to comment on how difficult they found it to recruit employees with these specific skills.

Using data to inform decisions; managing datasets effectively; utilising insights from data analysis to create business value; presenting data visually; and understanding data trends and their implications were identified as the Big Data skills most highly demanded by industry.

- Using data to inform decisions was the most demanded Big Data skill, relevant to both entry-level day-to-day decisions, and management level workers.

<sup>30</sup> Brad Howarth, *Rising demand for big data analytics skills triggers wage debate* (CMO, 2013).

<sup>31</sup> CSIRO, *Tomorrow’s digitally enabled workforce* (Data 61, 2016) <<https://data61.csiro.au/>>.

<sup>32</sup> Katherine Noyes, *How the skills shortage is transforming big data* (PC World, 2016) <<https://www.pcworld.com/>>.

- Effective management of datasets was repeatedly identified as an important Big Data skill. Stakeholders highlighted that datasets are often unconnected, bringing about the need for effective management and governance of disparate datasets.
- The ability to utilise insights from data analysis to create business value was found to be a crucially important skill area for Big Data, as insights derived from Big Data do not provide any actual value to organisations until they are actioned.
- Organising and presenting data visually was another skillset identified as important, as it enables a worker to draw conclusions from data, and present data to make a case or to build a hypothesis.

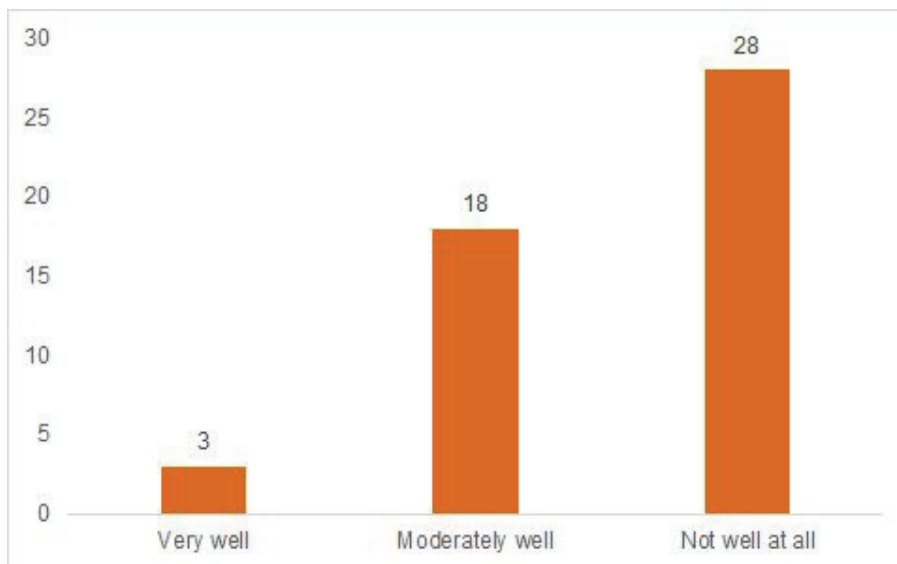
**New employees are not meeting the demands of Big Data skills required by industry.**

- 77% of respondents to the Big Data industry survey indicated that they had some degree of difficulty finding workers with the relevant Big Data skills that were needed in their industry.
- It was repeatedly made clear to us by stakeholders that, at the vocational level, it is important that students have basic STEM (science, technology, engineering, mathematics) skills, as these underpin data analysis skills.
- Several stakeholders noted that it was rare to find someone with strong technical Big Data skills, who also possessed the business acumen to apply these skills in an organisational setting.

### 3.4 Reviewing existing training

We asked our survey respondents to consider how well existing training equips learners with Big Data related skills. As demonstrated in Figure 2 below, the majority of stakeholders agreed that existing training only equips learners “moderately well” or “not well at all” in terms of Big Data skills. Feedback from consultations similarly indicated that there are gaps in existing training.

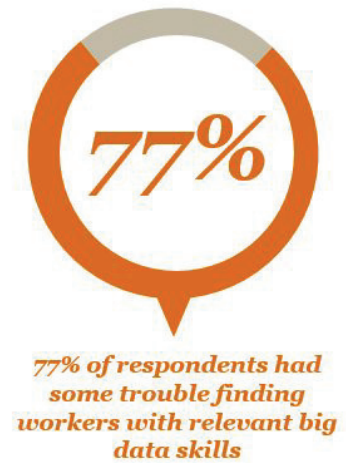
**Figure 2** Survey statement: *How well does existing training equip learnings with the relevant Big Data skills needed in industry?*



Source: PwC’s Skills for Australia, Big Data Cross Sector Project Industry Survey (base: 64 responses as of 25.10.2017)

### Existing training for Big Data is failing to meet industry needs.

- The majority of survey respondents believe that existing Big Data training is not meeting industry standards.
- A number of stakeholders believe that, despite impressive developments in Big Data, many people are unaware of the benefits and potential of Big Data.
- Some stakeholders also highlighted that, in some instances, universities are producing poor Big Data practitioners who need additional internal training to be work-ready.
- There are many workers who can benefit from basic data skills, even if they do not work directly with data. However, there is low awareness, especially among workers who are not technology literate, that there is a need for data skills in the workforce.
- There is a need for workers who possess technical skills and also remain flexible in their thinking, allowing them to apply their skills to solve a more diverse range of problems.



## 3.5 Risks and benefits of change

Throughout consultation, the majority of stakeholders were in support of the development of common Big Data units that could be contextualised across various industries. We also asked our stakeholders to comment on the potential impacts of change (including risks and benefits).

### 3.5.1 Potential risks of change

#### Obsolescence of new training products

Some stakeholders noted that there was a risk that the proposed new training products could quickly become outdated due to the rapid pace of technological change and the relatively slower process of training product development and review cycles. We have identified two methods to mitigate this risk. First, drafting units in a more generic nature that allows training providers to refer to the most current examples and applications of Big Data related skills. Second, conducting more frequent reviews of Big Data related training products to ensure that training materials keep up with advancements in Big Data related disciplines. Stakeholders were still in agreement that, despite this risk, the benefits of updating vocational training to include Big Data related skills far outweighs the negative prospect that they may become obsolete for a short period of time before they are updated again.

#### Learners studying Big Data skills might benefit from a background of STEM skills

In order to understand and develop their Big Data skills, there are several underlying STEM skills which learners might benefit from, such as: basic mathematical/numerical skills, basic statistics and probability skills, structured problem solving, and digital literacy. As many of these are basic STEM skills, they may fall outside the purview of the Big Data Cross Sector Project. As a result, there is a concern that some learners may not possess these skills when beginning to learn Big Data skills, which may inhibit the effectiveness of common Big Data units.

#### Other IRCs may choose to incorporate Big Data skills into their training packages, resulting in overlap and duplication.

As more and more organisations begin to recognise the value of Big Data skills, there is a possibility that other IRCs may decide to include Big Data-related units in their training packages, which may result in overlap and duplication of units across different training packages.

#### Consider funding arrangements and differences between state/territory jurisdictions

Differences in funding between state/territory jurisdictions was noted by stakeholders as a potential barrier to optimum uptake of a potential skill set. Nonetheless, a large part of the utility of a skill set is that they consist of units that could be imported into other training packages, helping to improve the potential flexibility of the VET system.



### *3.5.2 Potential benefits of change*

#### *Opportunities to embed data-driven decision making at all levels of an organisation.*

The introduction of common Big Data related units presents the opportunity to equip the wider workforce with basic data literacy skills. This means that workers at all levels will be able to interpret data at a basic level, and understand its impact. As a result, more employees will be able to apply data-driven decision making to their roles, across all hierarchical levels of an organisation.

#### *Improved organisational outcomes.*

A diverse range of organisations have applied Big Data in order to drive better organisational outcomes, such as better customer or business insights, improved efficiency of processes, and forecasting of business trends or issues (see section 2.2 for more examples). Wider access to workers who possess Big Data skills would enable more organisations to apply Big Data and benefit from its potential.

#### *Increased international competitiveness.*

If Big Data units are implemented into the Australian VET system, Australian organisations will enjoy better-developed Big Data capabilities. Due to the substantial benefits that applications of Big Data can bring to an organisation, this is likely to result in an increase in competitiveness for domestic businesses.

#### *Increased mobility for learners.*

Big data skills are in demand across a wide range of organisations, and are transferable across industries. This means that workers who are equipped with Big Data skills will have career prospects in many industries, and be able to move between different organisations. This career flexibility is also likely to attract more learners to Big Data, which would help to satisfy the current skills shortage in this area.

### *3.5.3 Potential risks if no changes are made*

#### *Australia's economy will be left behind as the rest of the world continues to improve their digital literacy.*

One of the main concerns voiced by stakeholders was the potential loss of competitiveness of Australia among other global economies. Many other countries are taking measures to address their shortage of Big Data related skills. If no change is made to Australia's VET system, we will fall behind these countries, and will no longer be a source of innovation in this area.

#### *Outsourcing of data analysis work to overseas workers.*

If Big Data skills are not available domestically, Australian organisations will have no choice but to outsource Big Data related work to overseas companies and workers. This will result in a loss to the Australian economy, as all of the potential jobs created from data analysis work go elsewhere. Furthermore, it might mean that data owned by Australian businesses, NGOs, and government departments could be sent overseas for analysis. This means we will be at risk of foreign companies possessing more data about Australia than domestic companies.

#### *Skills being taught in silos.*

Currently, many large ICT companies are conducting their own internal Big Data training, specific to their own software and procedures. If industry and company agnostic training is not introduced, there is a risk that large groups of workers will possess siloed Big Data skills that are difficult to transfer across industries or companies. It may also limit training and development in Big Data skills to companies that have the resources to develop and deliver their own internal Big Data training.



### **3.6 Training on different levels**

In order to determine the best way to deliver training of common Big Data units of competency, we asked stakeholders what they thought would be the best approach. Broad support emerged for two levels of training containing the following skills:

- 1. Basic introduction to Big Data and data-driven decision making**
  - a. Improve awareness of Big Data at a conceptual level
  - b. Improve data literacy
  - c. Introduce learners to different types of data and analytics techniques
  - d. How to read and interpret outputs/visualisations produced by Big Data sets.
  
- 2. Advanced suite of Big Data units at nominal Diploma level**
  - a. Visualise and present data
  - b. Use data for advanced operational decision making
  - c. Analyse data and report results
  - d. Manage data quality and governance
  - e. Manage and maintain datasets

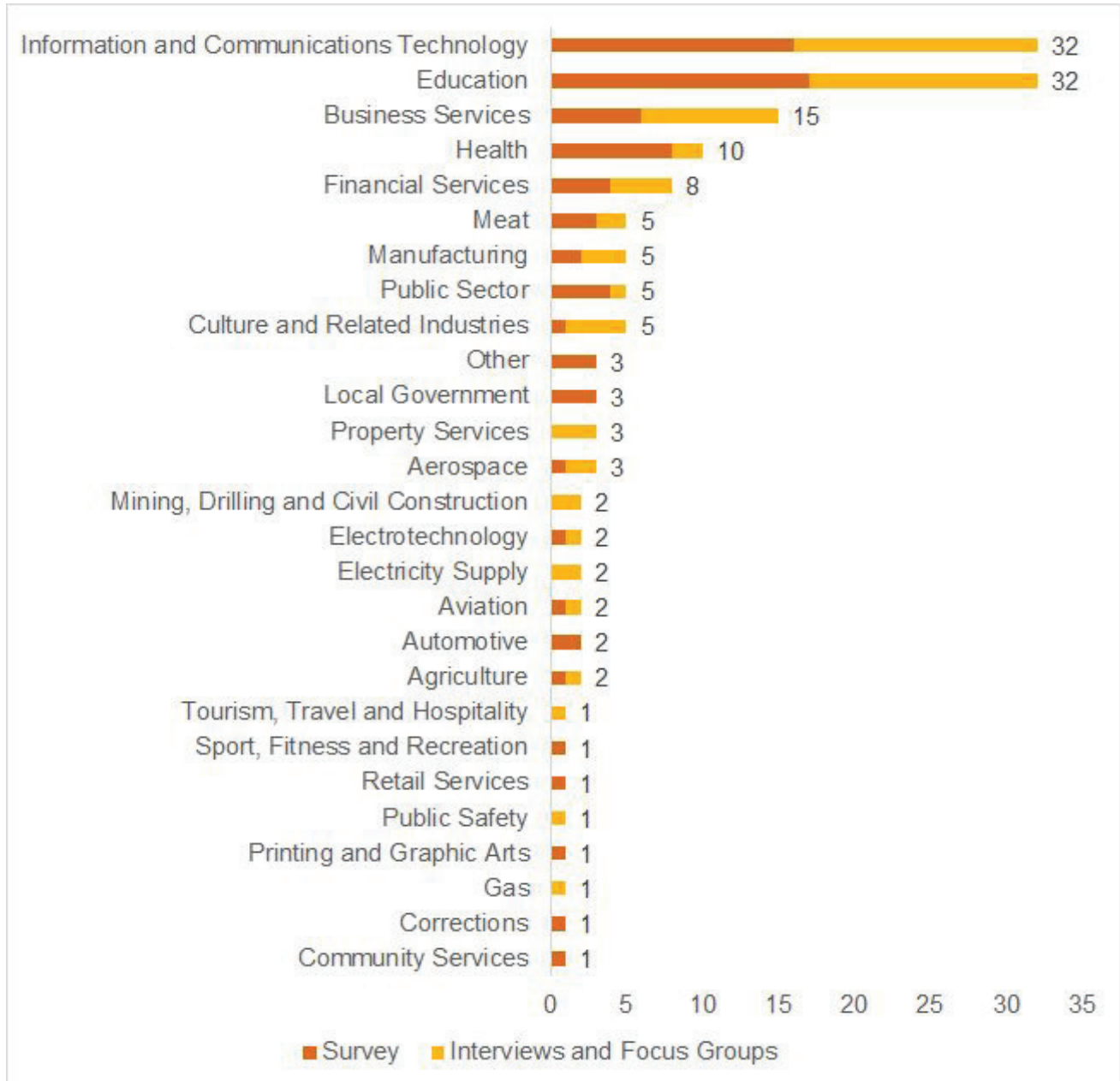
## 4. Appendices

### Appendix A - Terminology

Acronym	Meaning	Definition
AISC	Australian Industry and Skills Committee	A body consisting of industry and peak body representatives, which advises Commonwealth and State Industry and Skills Ministers on the implementation of national vocational education and training policies, and approves nationally recognised training packages for implementation in the VET system.
AQF	Australian Qualifications Framework	A national framework for regulated qualifications in the Australian education and training system, which sets forth principles to ensure consistency in the format of qualifications.
IRC	Industry Reference Committee	Committee comprised of subject matter experts, employers, industry association representatives in their respective industry, which have been appointed by the AISC and have decision making authority over their training package.
IoT	Internet of Things	The interconnection of computing devices embedded in everyday objects, enabling them to send and receive data via the internet.
NGO	Non-governmental organisation	A not-for-profit organisation which operates independently to any government, usually to address a political or social issue.
PRG	Project Reference Group	A group holding decision making power for a cross sector project, comprised of IRC members and subject matter experts.
RTO	Registered Training Organisation	An organisation registered to deliver accredited vocational training.
SSO	Skills Service Organisation	Independent service organisations that support Industry Reference Committees (IRCs) in their work developing and reviewing training packages.
STEM	Science, technology, engineering, and mathematics	An academic discipline encompassing science, technology, engineering, and mathematics.
	Training package	A set of nationally endorsed standards and qualifications used to assess the skills and knowledge of students.
UoC	Unit of Competency	The specification of knowledge and skill, and the application of that knowledge and skill, to the standard of performance expected in the workplace. A unit of competency is the smallest unit that can be assessed and recognised.

## Appendix B - Stakeholder consultations

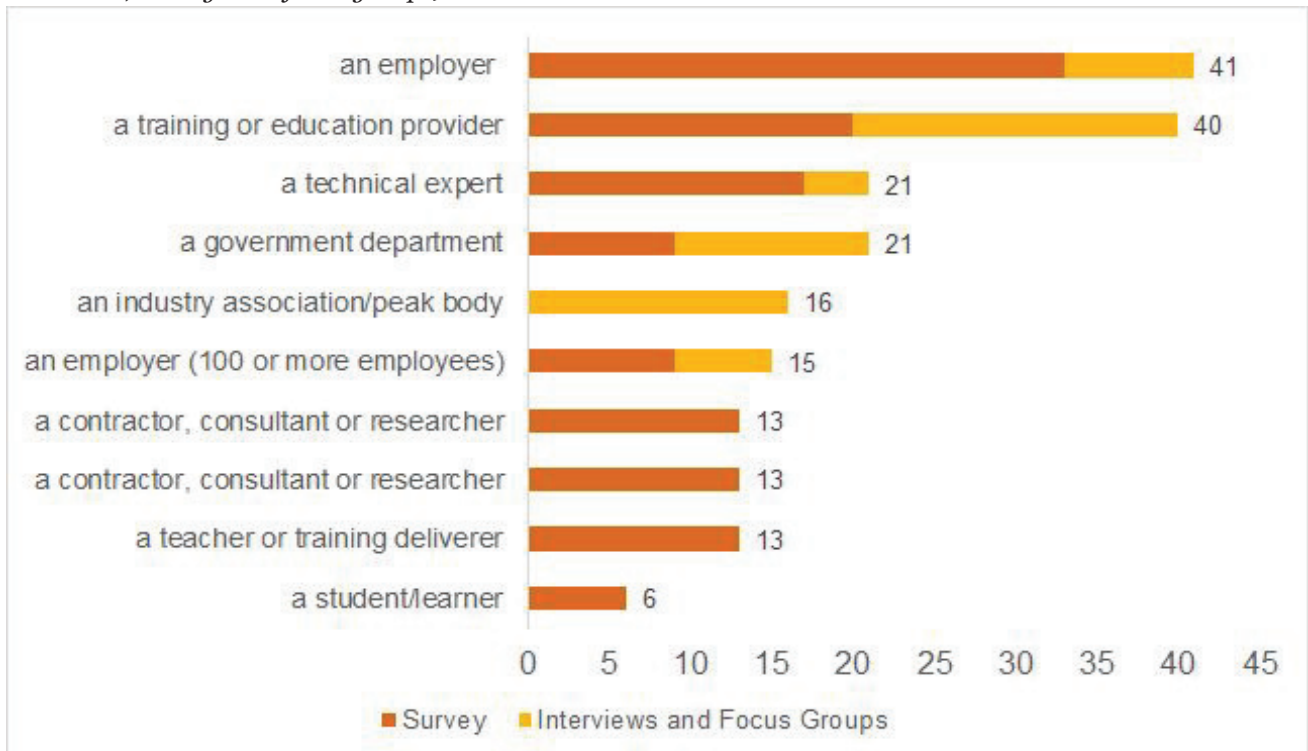
**Figure 3** Respondent profile from stakeholder consultations by industry (across all channels: interviews, surveys and focus groups).



Source: PwC's Skills for Australia, Big Data Cross Sector Project Industry Survey, Interviews and Focus Groups (base 113 responses as of 25.10.2017). Respondents were invited to nominate up to two industries.

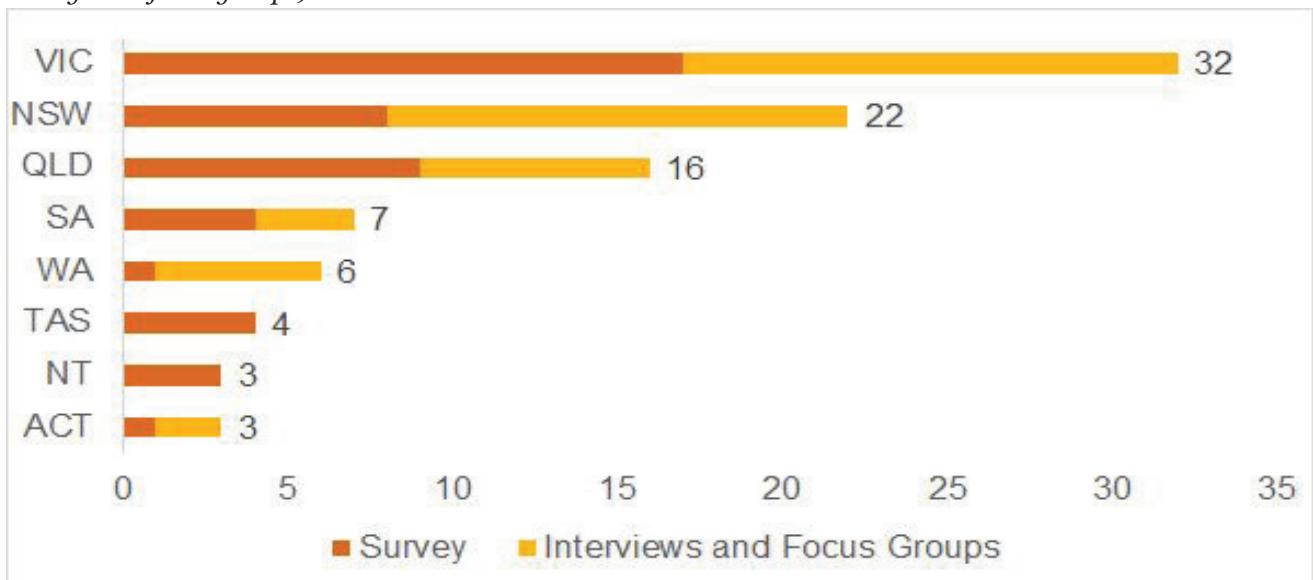


**Figure 4** Respondent profile from stakeholder consultations by stakeholder type (across all channels: interviews, surveys and focus groups).



Source: PwC's Skills for Australia, Big Data Cross Sector Project Industry Survey, Interviews and Focus Groups (base 113 responses as of 25.10.2017). Respondents were invited to nominate up to two stakeholder types.

**Figure 5** Respondent profile from stakeholder consultations by state/territory (across all channels: interviews, surveys and focus groups).



Source: PwC's Skills for Australia, Big Data Cross Sector Project Industry Survey, Interviews and Focus Groups (base 113 responses as of 25.10.2017). Some Respondents chose not to indicate their state/territory.