Challenging the Status Quo: Innovate or Detonate

Narelle UNDERWOOD, Australia and Lisa POWELL, Australia

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SUMMARY

"The only constant in life is change"- Greek philosopher Heraclitus of Ephesus. Technology has and is continuing to change the way the world functions and how business operates. The rate of change is rapidly accelerating as technology is utilised in more innovative and disruptive ways. Disruptors such as Uber, Netflix and driverless cars are not just thinking outside the box, they are questioning the need to have ever had a box. Unlike ever before, consumers have mobile solutions and instant connectivity at their fingertips resulting in greater demands for immediate results and digital solutions. The survey profession is faced with a need to challenge the status quo and develop innovative solutions to problems that are not yet thought of.

The profession of surveying has a long history of evolving and adapting to inevitable change driven by political, economic and technological factors. This paper explores the importance of digital transformation and innovation in the surveying profession to meet the ever-evolving needs of the consumer. The authors explore global factors affecting business and challenges specific to the survey profession within NSW. Several options are presented to address these challenges, including shifting the core business of a surveyor from measurement to management and promoting the value the profession adds for consumers. The authors also examine the benefits of a diverse workforce and options to foster diversity within the profession.

1. INTRODUCTION

The art of surveying has existed since ancient civilisation, with evidence of land and infrastructure surveys being carried out in Egypt, Babylon, Greece and Rome using gifts (rod and rope) handed down to Kings from the Gods (Monaghan, 2011). The technology used by surveyors since 3500BC has undergone numerous innovations as society's need for accuracy has increased. From rod, rope and clay tablets, as a profession we've seen technology transform with the development of the plane table, chain, circumferentor, theodolite, wire, EDM, total station, photogrammetry, and more recently, GPS/GNSS, LiDAR and drones (UAV / RPAS).

While the basic principles that survey knowledge is based upon have not changed significantly since the adoption of trigonometry, the applications of survey information and data have, and continue, to grow exponentially. The 3rd industrial revolution (digital revolution) saw the survey profession transformed with the adoption of computer and internet technology. Complex calculations are now much easier to complete, and the development of CAD and GIS software packages mean that survey data is easier to prepare, analyse and distribute. The combination of changes in technology and society also mean that the profession has been able to diversify and

attract some females to its ranks, although there is still a significant gender bias in the profession today.

The 4th industrial revolution (connectivity and cyber physical systems) presents the survey profession with significant challenges that it needs to address. An aging profile, measuring technologies that anyone can use, artificial intelligence and open data mean that many current customer service and business models will be challenged. As with any challenge, there always exists an inherent opportunity to innovate and reinvent. Cloud computing, Blockchain, the Internet of Things (IoT) and the growth in demand and understanding of geospatial (location-based) data and services all present areas that the survey profession can influence and capitalise on. Ignoring them and continuing with the status quo is not an option if the profession wishes to thrive in the new paradigm.

2. EXAMINING THE CURRENT STATE GLOBALLY

Before examining the challenges currently faced by the Survey profession it is important to reflect on the impact technology and innovation are having at a global level. An article published by University of Sydney (UoS) Deputy Vice-Chancellor (Research) Professor Duncan Ivison, effectively summarises the importance of innovation: "Rethinking how we live and work in the midst of the dramatic technological changes occurring all around us is vitally important. We are living through the emergence of a new industrial revolution, one where artificial intelligence, quantum computing and other technologies that haven't even been invented yet will have far reaching consequences for not just our economy but our society and culture." (UoS, 2017). The unparalleled rate of change facing organisations globally requires a workforce that is innovative, adaptable and able to respond to new business models and markets. Diversity in the workforce is key to reaching this capability.

The exponential rate of change due to technological advancement and innovation is constantly changing the way business operates. As a society, we have adapted to the accelerated pace of change caused by technology and the disruption this causes for markets, labour and business. Reflecting on changes over the past 5 years, we have seen the rise of mobile technology, the birth of the mobile 'app', the wide spread adoption of cloud based computing and increased connectivity of users. In Australia the total number of households with access to the internet has risen by 20%, with 97% of households with children under 15 years having access to the internet and of these 99% using mobile devices for this access (Australian Bureau of Statistics, 2018). In 2014 the UoS undertook a study which reviewed the mobile and internet connectivity of people experiencing homelessness in Sydney and Melbourne and found that 95% of participants had a mobile phone (Humphry, 2014). This highlights the extent to which mobile technology is integrated into our society.

Mobile technology has evolved from a medium for casual pursuits to a necessity for business applications. Internet giants, Google have recently adapted their search algorithms to favour mobile-friendly web-pages, reflecting user behaviour trends (Google, 2018). An astonishing example of the increased global connectivity is the 2016 launch of the 'Pokemon Go' mobile

phone application. After launching in Australia and New Zealand, it is reported to have taken just 19 days for the application to be downloaded on 50 million platforms (Tech Times, 2016). In comparison, Facebook reportedly took 3 years to reach the same milestone (Desjardins, 2018) and looking even further back in history, the telephone took decades.

The widespread adoption of mobile technology and changing customer expectations has allowed for innovative new businesses such as Uber, Amazon and Airbnb to disrupt and change entire industries. Berger et al. (2017) found that the introduction of the 'sharing economy' platform created by Uber to the taxi industry was minimal with Uber effectively expanding the market and meeting the shortfall from licensed taxi services. However, it was also determined that the flexibility and earning potential for employees was greater with Uber and in areas where the two service competed wages for licensed taxi services decreased by an estimated 10%.

The Guardian published an article written by Coleman (2013) which explored the need for businesses to continue to seek out new products, services and revenue streams in order to exploit new market opportunities. Coleman identified that the key to diversifying successfully was "having a well-established core business, doing thorough research of potential new markets and ensuring you have the right people to help manage a diversification strategy."

The video hire company, Blockbuster, provides an excellent example of the importance of diversifying to meet changing consumer needs. In 2000 Netflix approached Blockbuster and offered to sell them Netflix for $US50 million. Blockbuster declined thinking Netflix was targeting a niche market (Chong, 2015). By 2014 Blockbuster had closed all remaining stores in the US (Stern, 2013). In 2017 Netflix surpassed $US11 billion in annual global revenue (Feldmen, 2017).

In order to keep up with evolving customer expectations of effective, immediate results many businesses are undergoing digital transformations. This is not just the adoption of technology and digitisation of records, it is a total radical rethink of how the business utilises technology to meet ever increasing and shifting customer demands. Gerard (2017) writes "Digital transformation does not merely *allow* a business to re-evaluate its position on the market in real time, it *dictates* it." Customers are continually discovering new ways to consume, new needs and aspirations and it is up to business to shift their mindset toward agile, innovative customer centric business models, which identify and fulfil the evolving needs of the consumer (Gerard, 2017). In the digital era, companies are increasingly diversifying which means that any company can disrupt your line of business, regardless of their core business.

Location-based services have become increasingly popular and are commonly utilised as an effective marketing tool for businesses, geo-social networking, online searching, navigation and more. As users become more familiar with geographic information and begin to understand the power of position it is expected that we will continue to see more innovative and diverse uses of geographic information. The *LBMA 2017 Global Location Trends Report*, surveyed 500 marketing decision makers and found that 25% of marketing budgets are spent on location-based marketing and over 50% of brands are using location data to target customers. This represents billions of dollars and illustrates that location is an increasingly critical element of

business marketing. Increasingly organisations are looking to add location data and analytics to their capabilities in order to reveal further insights into consumer behaviour and to support better decision-making (Forbes Insights, 2016). As illustrated in Figure 1, spatial information provides the key to location-based services and ties context-aware services to position presenting a wealth of information and opportunity.

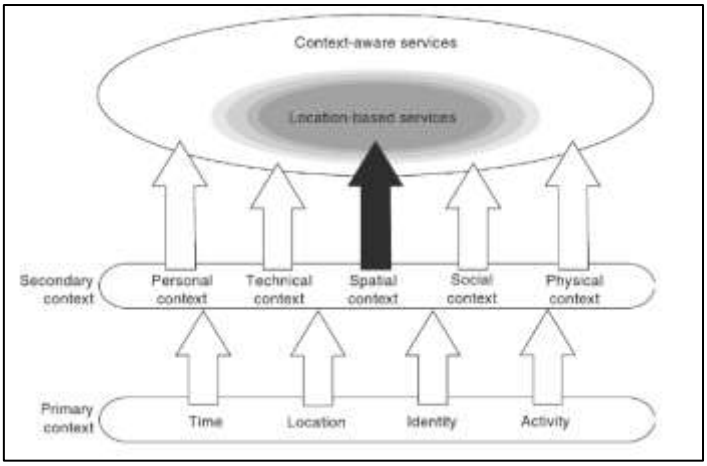

Figure 1: Spatial information provides the key to location based services (Kupper, 2005)

3. CHALLENGS FACING THE SURVEY PROFESSION IN NSW

As highlighted in the previous section there are a number of factors affecting business globally which have the potential to significantly impact the survey profession. The accelerated rate of change of technology, diversification of industries, increase in mobile technology and rise of location based services has and will continue to change the expectations consumers have and the value the survey profession can provide to society. As precise positioning technology rapidly improves we are witnessing the democratisation of measurement and the rise of non-skilled users capturing spatial data. To stay relevant the profession must identify innovative ways to add value to measurement and spatial data. It needs to promote this value within society to raise the public profile of the profession. A lack of diversity and aging demographic with the profession threatens the ability to create innovative solutions and drive digital transformation within survey firms.

With consumers able to access and capture spatial data with the click of a button, the art of measurement has become democratised and the role of the surveyor devalued. As technology continues to evolve the profession must take the lead and drive innovation or risk being left behind as non-professional users forge forward. The paper *Surveying: A Profession Facing a Global Crisis?* by Hannah et al (2008) accurately summarises the situation: “Our future is at stake, as the market in which surveyors operate finds itself under dynamic change. The challenge is for the profession to respond or be left behind, as others take advantage of the opportunities which we ignore”.

The European GNSS Agency has published two key reports which provide insight into the global GNSS market, *GNSS Market Report Issue 5* (2017) and *GNSS User Technology Report: Issue 2* (2018). Surveying accounts for less than 5% of the GNSS receiver market while smartphones dominate with close to 80%. It is estimated that by 2020 there will be 8 billion GNSS devices in use, meaning on average more than one device per person on the planet. There is a clear trend in the rapid adoption of multiple frequency GNSS including in consumer devices with the first dual-frequency smartphone being released in May, 2018. The new and emerging GNSS trends in Figure 2 highlights the continued democratisation of measurement as GNSS technology becomes more widely adopted across industries outside of surveying. The introduction of Satellite Based Augmentation Systems (SBAS) in Australia will further drive this trend as consumers access sub-meter positional accuracy on their mobile devices.

LBS	More and more smartphones integrate multi-constellation GNSS, boosting GNSS performance. Over 90% of context-aware apps now rely on GNSS.
Road	GNSS answers the need of Autonomous Driving (AD) for reliable and accurate positioning. OEMs and technology companies are leading the development of Autonomous Vehicle encouraged by governments.
Aviation	The aviation market continues to increasingly rely on GNSS, including rotocraft and unmanned vehicles. SAR beacons manufacturers are developing solutions for Aircraft Distress Tracking leveraging GNSS.
Rail	GNSS-enabled solutions can offer enhanced safety for lower cost, e.g. in railway signalling. GNSS is becoming a generic system widely used in non-safety relevant applications.
Maritime	GNSS has become the primary means of obtaining PNT information at sea. SAR beacon manufacturers are preparing for multi-constellation GNSS.
Agriculture	GNSS applications represent a key enabler for the integrated farm management concept. Drone uptake in agriculture is increasing, accounting for over half of the commercial market.
Surveying	Falling device prices drive the democratisation of mapping. GNSS remains the backbone technology in increasingly sophisticated applications.
Timing & Sync	GNSS timing is at the core of many critical infrastructures, including telecoms, energy, finance. Evolution of telecom networks makes GNSS increasingly essential, driving future shipments.

Figure 2: New and emerging GNSS trends by market segment (European GNSS Agency, 2017)

An increase in the adoption of UAV/RPAS technology is replacing or rethinking traditional surveying disciplines such as detail surveys and even terrestrial laser scanning. New tools are being developed which further reduce the need to engage a survey professional. An example of this is 'AeroPoint' created by Propeller (2018), which is a ground control point with inbuilt GPS capability. The units log static GPS data which is post processed online with CORS data to provide accurate ground control for drone-based imagery at the 'push of a button'. Propeller promote the AeroPoint as delivering high-precision ground control without the need for a 'GPS expert', 'complex surveying equipment' or the risk of 'human error'. The role of the surveyor in this space is testing and understanding the accuracy of the data, managing and utilising the data in a meaningful way and finding new and innovative ways to use the data to meet the needs of customers and communities.

Enemark (2009) identified that the role of the Surveyor was shifting from 'measurement' to 'management'. Enemark highlighted that the value Surveyors added to measurement was not just the capture of position but also the management of the measurement process and the related property and land use administrations. Only a few years ago professional competency was required to capture and interpret spatial information, but this is no longer the case. Consumers can easily capture and interact with spatial data and the value of using a professional is not obvious for many users.

Although the survey profession has continued to adapt to change due to technological advancements, the rate of change is slow and, in some cases, there is stubborn refusal to change. As technology progresses rapidly, the spatial information industry is embracing change and opportunities which the survey profession ignores. It is up to the profession to make themselves invaluable in this space as early adopters of technology and drivers of innovation. To continue to not just survive, but to thrive, survey firms need to be continually challenging the status quo, experimenting in new markets and being prepared to fail.

The NSW Government is investing in the creation of a proof of concept digital twin for the State, meaning 3D/4D data capture and visualisation state-wide. The NSW Digital Twin is a reality mesh model which will enable testing, building, operating and monitoring in a virtual environment. It will integrate live data feeds from across the State, building information models, 3D and 4D foundation spatial data, above and below ground infrastructure as well as analytics and reporting functionality. The challenge for the surveying profession is to be proactively engaged at a level that allows influence over the outcomes informing the resulting strategies and policies. There is an opportunity for the profession to lead this digital revolution, the adoption of digital workflows and lodgement of intelligent digital survey plans is the first step. Ignoring the opportunities this project presents could result in the survey profession being excluded from key decisions and implementation that could have significant impacts on survey businesses.

Another major challenge facing the profession is the ability to clearly articulate and therefore promote what its core expertise is and the value it adds. Hannah (2008) estimates that within the surveying profession there are close to 200 recognised skills and competencies ranging from engineering design, planning and cadastral surveying through to estate and spatial information management. This diverse skillset throughout the profession suggests a multitalented profession that are willing to think outside the box but may also indicate difficulty in defining its core expertise. Surveying generally has a low public profile, with the term ‘surveying’ being interpreted very narrowly (Williamson, 1997), resulting in a varied public perception. Without a clear definition of what a Surveyor is or does, anyone can call themselves a ‘Surveyor’, further devaluing the role of the surveyor in the broader community.

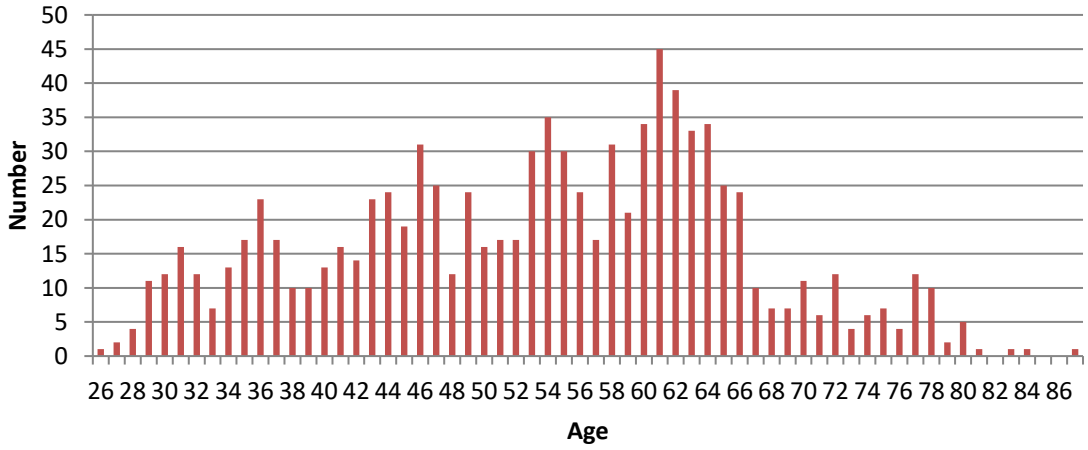

Figure 3: BOSSI age profile of Registered Land Surveyors in NSW 2017-2018 (BOSSI, 2018)

With the significant government investment in infrastructure and continuing growth in the property development market the profession is facing a major shortage of trained, experienced surveyors. Furthermore, there is an astonishing lack of diversity within the profession. In NSW the average age of a registered land surveyor is 53 and as can be seen by Figure 3 there is a significant spike in those aged 61. Gender diversity in the profession is minimal with only 3% of registered land surveyors in NSW being female (BOSSI, 2018) while other parts of the world, particularly in European and African countries the gender balance is more equitable. With females comprising 47% of all employed persons in Australia, there is significant room for improvement (WGEA, 2018).

The Department of Jobs and Small Business released findings as part of their skills shortage research (2018) which classified the survey profession as having a shortage of skilled workers in NSW. This classification was a result of the following determinations:

- 50% of advertised vacancies in surveying not filled,
- Average of <1 suitable applicant per vacancy with many employers taking less-than-ideal applicants,
- Employers generally unable to fill positions for specific fields including cadastral, construction and engineering.

According to the Department, these findings have been consistent in NSW since 2011. In 2015 the Consulting Surveyors National commissioned a report, titled *Determining the Future Demand, Supply and Skills Gap for Surveying and Geospatial Professionals: 2014-2024* which found that NSW is predicted to reach the peak of its expected skills shortage in 2020/2021 with a predicted shortfall of 1000 surveyors in NSW. The report also determined that given the age profile of the current total skilled labour workforce the workforce will shrink by an estimated 24% over the decade (from 2014-2024) due to demographic factors alone.

Lorenzo et al. (2016) undertook a study exploring the link between diversity and innovation with a focus on the impact on revenue. The study surveyed diversity managers, HR executives, and managing directors at 171 German, Swiss, and Austrian companies. The study focuses on six types of diversity and found a significant relationship between innovation and diversity of employees in the form of industry background, country of origin, career path and gender. The study interestingly found that age had a negative impact on innovation which suggests that companies are having issues with inter-generational collaboration.

A number of other studies have made similar conclusions, including the study *Global Diversity and Inclusion: Fostering Innovation Through a Diverse Workforce* by Forbes Insights (2011) which concluded that diversity is a key driver of innovation and that a diverse and inclusive workforce is essential for attracting and retaining top talent. Based on the research the survey profession must commit to diversifying its workforce.

4. OPTIONS

4.1. Measurement to Management

Changes in measurement technology mean that for ongoing success, the survey profession must identify and promote the value it adds to measurement. It must continue to develop from a core business of providing measurement expertise and expand to provide specialisation in project, data and land management. Increasingly, projects are reaching a level of complexity such that multi-professional groups are required to manage and implement large projects (Hannah et all, 2008). With a foundation skill set based in science and land management surveyors are ideally placed to add value to and in many cases lead such a team.

As the collection of data and art of measurement becomes easier, management of data and associated metadata becomes more complex and challenging. Surveyors have a key role to play in the management, analysis and interpretation of data. The profession needs to embrace new methodologies and lead other industries in best practice techniques to utilise technology. Surveyors can understand and interpret accuracy of derived products, to combine data from a variety of sources and create meaningful products of known accuracy that are fit for purpose. By collaborating with users of spatial data from a variety of industries the profession can play a key role in managing spatial data for a huge variety of uses.

The democratisation of measurement means that any person can use a device (GPS, drone, scanner etc) to capture and create a spatial dataset and combine it with information from other sources such as government departments through their data portals (eg data.nsw) or web services. This could include information such as aerial imagery, environmental or planning constraints and property boundaries. The risk is that unless the person involved is a professional with an understanding of metadata, accuracy and projections the derived product could influence an incorrect decision by the user of such data. This also extends to multidisciplinary projects where different types of data and/or aspects of a project are managed by different professionals. Surveyors are uniquely placed to help coordinate and provide advice to clients on when a particular data source is going to be fit for their specific purpose.

To gain a competitive advantage in the marketplace survey professionals must develop innovative solutions which drive efficiency and quality. The EGA 2017 *GNSS Market report* predicted that revenue from value-add services to GNSS were set to skyrocket by 20% between 2015 and 2020. Value-add services are any service which leverage GNSS technology to add value to users and include location based services. With a thorough understanding of GNSS technology and the opportunities and limitations it presents, surveyors are uniquely positioned to discover new markets utilising GNSS.

4.2. Promotion of the Profession

Very few members of the public have an understanding of the role that surveyors play in society. Surveying is a unique, interesting and rewarding career that contributes significant value to society. At the most fundamental level, surveying underpins land tenure which provides the foundation of our economy. The education of the public and continued promotion of the survey

profession is the responsibility of all surveyors.

It is important to capitalise on all media coverage the profession receives. The Anzac Soil Collection project provides a brilliant example of the survey profession embracing the opportunity to contribute to a unique project and promote the profession to a diverse audience. The project commenced in 2017 and collected soil samples from 1701 locations which were identified as the home towns of World War I enlistees. The survey profession was enlisted to assist with collecting these samples as they could provide spatial attributes with each sample, quality assurance, and had the mobility to gather samples across the state. This project achieved successful community engagement, received significant media coverage across all platforms and presented an opportunity for surveyors to promote what the profession does.

There are many infrastructure projects that receive extensive media coverage and provide opportunities for the survey profession to promote their contributions. Many projects simply could not commence or be delivered without the work undertaken by surveyors. It is important to capitalise on promotional opportunities as they present. For too long surveyors have undervalued their contributions to projects, often deeming them as not being interesting and just part of their everyday duties. A change to this mindset is required to promote and highlight the innovative ways surveyors are contributing to the development and delivery of projects.

Social media provides an excellent platform for promoting the profession as a valuable and rewarding career to a diverse audience. Widely used platforms such as Twitter, LinkedIn, Facebook and Instagram can be utilised to highlight the interesting, unique and diverse projects undertaken by Surveyors. The Instagram account 'Surveylife' posts images of surveying from around the globe and has a following of over 36,000 users. The account regularly receives over 2000 'likes' on photographs and up to 10,000 views on videos. This is a simple, free and effective way to promote the profession. #Hashtags are a metadata tag used on social media to label topics and allow users to easily find related posts. Hashtags can be used on social media posts to reach a much broader audience and draw users to posts.

Promotion of the profession to school aged students provides surveying exposure to a wide audience and helps develop a pipeline of future surveyors. The NSW Surveying Taskforce was created to help combat the shortfall of surveyors in the future. The Taskforce has created a website to capture those considering a career in surveying, has a social media presence and provides resources for presentations to school age students. While the Taskforce is doing fantastic work, the profession needs to supplement and support this. Surveyors can become a 'Surveying Ambassador' which provides opportunities to be involved in career events, school presentations, assisting with maths in surveying days or hosting work experience students.

In the UK, Geospatial marketing company, Elaine Ball Ltd, has launched a campaign titled 'Get Kids into Surveying' which produces marketing material aimed at promoting the profession to school aged children (Elaine Ball, 2019). The success of this campaign relies on engagement of the profession to utilise the available resources and reach the target audience.

4.3. Digital Transformation

"It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change." – origin unknown.

Digital transformation is the integration of digital technology into all areas of the business and results in fundamental changes to business models which allow technology, people and processes to continually adapt in order to deliver value to customers (The Enterprisers Project, 2019). Digital transformation requires an organisation wide cultural shift which is open to change, challenges the status quo, is comfortable with failure and invests in innovation. Digital transformation involves not just the digitisation of records but the uptake of technology to improve performance in the organisation for employees, suppliers, customers and stakeholders.

A successful digital transformation relies on effective leadership, not technology. The uptake of technology, upgrading of systems and digitising of records within an organisation is important but it does not equal a successful and effective digital transformation (Ionology, 2015). Figure 9 outlines the difference between an organisation which has undergone a successful digital transformation (Digital Business) and an organisation utilising digital information and processes (Doing Digital).

A successful digital transformation relies on leaders with a clear strategic vision which focuses on the customer experience. The greatest challenge for a leader managing the digital transformation of an organisation is change management. Effective leadership will deal with the culture shock which rapid change brings and will support people to cross the digital divide. As a culture develops which embraces innovation, challenges the status quo and is prepared to try and fail, it is up to the leader to ensure that the business model is adaptive and flexible to allow innovative solutions to grow rather than being lost in the void of business policy and red tape. The quickest way to destroy a culture of innovation is by bureaucratic negative which defaults to 'no' (Miller, 2016).

Every organisation requires a unique and specific digital transformation framework which addresses the challenges and opportunities the organisation faces. There are several key elements which underpin a successful digital transformation framework for any organisation:

1. Customer experience
2. Operational agility
3. Culture and leadership
4. Workforce enablement
5. Digital technology integration

Historically surveyors have adopted digital technology to replace specific workflows but have not adopted a digital mindset (digital end to end). Access to digital data, continual developments in technology and system connectivity provide an opportunity for surveyors to take a step back and reimagine their workflows to take advantage of digital systems. The profession needs to shift its culture from traditional, risk adverse mindsets to being more adaptable, open to change and innovative. By not being prepared to take a chance, the profession is missing opportunities

to reach changing and new markets. Adopting an agile mindset, "prepare to fail fast and fail early" provides an environment that supports iterative innovation, allowing the profession to utilise resources in more inventive and creative ways.

4.4. Fostering diversity

"Diversity fosters creativity. We need to generate the best ideas from our people in all levels of the company and incorporate them into our business practices." Frédéric Rozé, chief executive officer, L'Oréal USA (Forbes Insights, 2011). Forbes Insights (2011) concluded that the responsibility for the success of a company's diversity and inclusion efforts rested with senior management. The idea is that diversity in your workplace should reflect that of the wider community. Diversity can be categorised into two groups, inherent and acquired diversity. Inherent diversity refers to traits you are born with such as gender, ethnicity and sexual orientation while acquired diversity are traits which are gained through experience (Forbes Insights, 2011).

Diversity is central to innovation. It creates new and better ways of doing things, helps us to harness the benefits of technology and creates opportunities to more effectively meet the needs of our consumers. Inclusion is the key to unlocking this potential (Department of Human Services, 2016). Inclusive leadership in the profession is the key to driving diversity and innovation. The Diversity Council Australia (2015) outlines the five mindsets required for an inclusive leader:

1. Understands and believes in the benefits of diversity for organisational performance
2. Creates teams and networks in which all people feel they belong, are heard, valued and respected
3. Is open and curious about new and different perspectives from a range of people
4. Is flexible about, and responsive to, a diversity of people and perspectives. Willing to take an agile approach to problem solving.
5. Challenges accepted practices and is willing to incorporate different perspectives into business models.

Strong leadership is essential to set diversity objectives within an organisation and monitor their effectiveness. With a lack of diversity among qualified survey professionals in NSW it is important that organisations are setting realistic and non-trivial diversity targets and implementing strategies which aim to foster inclusion in the workplace. This means that diversity needs to be through all levels of the organisation, particularly in decision making roles. The Australian Government Department of Human Services has released their *2016 – 2019 Workplace Diversity and Inclusion Strategy* which provides an excellent example of a commitment to a workplace culture that; builds respect, fosters inclusiveness, promotes diversity and embraces the unique skills and qualities of all employees. Figure 10 provides the guiding principles used by the Department of Human Services, which underpin a successful diversity and inclusion strategy.

Fostering a culture which is inclusive, respectful and values differences will not only retain top talent in the profession, it will also attract talent. Leaders in the profession need to actively call

out behaviour which discourages diversity and openly celebrate initiatives that foster diversity. Providing mentors to employees who are under-represented within the profession can provide the necessary support to promote development and to retain these individuals. Connecting underrepresented employees with relevant professional organisations provides additional support as they are able to build meaningful relationships with a diverse range of colleagues throughout the profession.

Diversity needs to be seen and celebrated within the profession. Initiatives such as the *Women in Surveying* feature seen in the Institution of Surveyors NSW (ISNSW) Azimuth magazine are fantastic ways to showcase one aspect of diversity within the profession. The NSW Surveying Taskforce has published an article, *Women in Surveying (NSW*) (Brooks, 2017) on their 'Surveying: A Life Without Limits' website which highlights some of the successful female surveyors in NSW and organisations that are proudly advocating for women in the workplace. Similar initiatives, which reach a larger, broader audience outside of the profession, will help to promote this message and attract diverse talent to the industry.

When undertaking recruitment leaders need to think outside the box and question their own unconscious bias when assessing candidates. Many employers seek employees who will fit into their workplace culture. It is important to be open to people that may add to the culture rather than simply integrating. Using language in job advertisements which is inclusive and pro-diversity will help to attract a more diverse range of candidates. Having a diverse recruitment panel, which includes an 'independent' panel member who is not part of the organisation helps to counter unconscious bias and provide different perspectives to the recruitment selection process.

5. CONCLUDING REMARKS

"To improve is to change; To perfect is to change often" – Winston Churchill. As discussed, technology has and is continuing to change the way the world functions and how business operates. The rate of change is rapidly accelerating and unparalleled, as technology is utilised in more innovative and disruptive ways. Unlike ever before, consumers have mobile solutions and instant connectivity at their fingertips resulting in greater demands for immediate results and digital solutions. The surveying profession is not exempt from these changes and is faced with a need to challenge the status quo and develop innovative solutions to streamline workflows, increase efficiencies and create new products, or risk becoming irrelevant to an ever-changing society.

Through both global and survey specific examples the authors have examined several challenges currently facing the profession. The democratisation of measurement, rapid growth in demand for geospatial data and changing customer expectations are factors that need to be addressed. In a society where non-skilled users are plentiful and the value of using a professional is not understood the survey profession must develop a clear message to sell and promote its contribution.

Innovative businesses are disrupting traditional industries and developing new markets. Surveyors now represent only a minor proportion of the GNSS and RPAS markets, areas that were once dominated by survey professionals. Survey companies need to adopt a digital business mindset, continually challenging accepted practice, experimenting in new markets and be prepared to risk failure.

A number of options have been examined, which the surveying profession needs to invest in to realise the opportunities present in both existing and emerging sectors of the market. The lack of diversity in the survey profession across areas such as age, ethnicity, gender and experience threaten to inhibit its ability to meet the demands and challenges of consumer expectations in the future. The workforce of the future needs to represent the diversity of the society it serves in order to not only attract people to the profession but to also understand and capitalise on the changing opportunities that are present in the market.

Surveying is no longer just about measuring distances or cadastral boundaries. Surveyors, government and the wider community are beginning to acknowledge and recognise data as an asset and the foundation spatial data as infrastructure. The surveying profession, current and future, must recognise and capitalise on the strategic advantage which comes from having strengths and expertise in measurement, land management and spatial information science. Surveyors are ideally placed to provide innovative services which exceed the expectations of consumers and reach new markets.

In conclusion, the rise of the 4th industrial revolution provides surveyors with an opportunity to reinvent the profession and take advantage of continual advances in digital connectivity and cyber physical systems. If the profession does not embrace these changes it risks detonation, unable to attract the next generation to the profession and becoming irrelevant.

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BIOGRAPHICAL NOTES

Narelle Underwood is the Surveyor General of NSW, responsible for the leadership and regulation of the land and mining surveying profession and plays a key advocacy role in the geospatial industry. Narelle was announced as one of 60 Superstars of STEM, a program run by Science and Technology Australia to smash society's gender assumptions about scientists and increase the public visibility of women in STEM. In 2018 Narelle was listed in the inaugural NSW Top 50 Public Sector Women and was awarded the 2017 UNSW Maria Skyllas-Kazacos Young Professional Award for Outstanding Achievement.

Lisa Powell is a Senior Surveyor within the Survey Operations unit at DFSI Spatial Services. She holds a Bachelor of Spatial Science Technology degree majoring in GIS and a Diploma of Spatial Information Services (Surveying). Lisa leads the Survey Operations – Regional team in maintaining, preserving and improving the State's Survey Control network for regional NSW. Lisa is experienced in coordinating large scale survey control projects and played a key role in delivering the control and quality assurance for the NSW Surface Model Enhancement Project. Lisa is driven by the desire to make a positive and tangible difference within the survey profession and larger community, with a passion for diversity.

CONTACTS

Narelle Underwood
Department of Finance, Services & Innovation – Spatial Services
2-24 Rawson Place, Sydney NSW 2000 AUSTRALIA
Narelle.Underwood@finance.nsw.gov.au

Lisa Powell
Department of Finance, Services & Innovation – Spatial Services
346 Panorama Avenue, Bathurst NSW 2795 AUSTRALIA
Lisa.Powell@finance.nsw.gov.au