EMERGENCY SERVICES WORKFORCE 2030 – CHANGING LANDSCAPE LITERATURE REVIEW

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ACKNOWLEDGMENTS

Steering Committee

The Workforce 2030 project was guided by a Steering Committee made up of emergency management sector representatives:

- Nancy Appleby, Department of Fire and Emergency Services, WA
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Research Advisory Panel – Changing Landscape Literature Review

The Research Advisory Panel comprised of academic researchers external to the project. Panel members individually reviewed sections of the Workforce 2030 literature reviews and provided detailed feedback specific to their research expertise that has been incorporated into the final outputs.

- Professor Chris Bearman, Central Queensland University (Changing nature of work)
- Andrew Gissing, Risk Frontiers (Physical and digital technology; Changing risk)
- Dr Peter Hayes, Central Queensland University (Digital technology)
- Dr Pam Kappelides, LaTrobe University (Changes in volunteering)
- Adjunct Professor John Handmer, RMIT University (Changing risk; Shifting expectations)
- Celeste Young, Victoria University (Changing risk)

EXECUTIVE SUMMARY

The *Changing Landscape Literature Review* collates a high-level evidence base around seven major themes in the changing landscape (i.e., the external environment) that fire, emergency service, and rural land management agencies operate in, and which will shape workforce planning and capability requirements over the next decade. It is an output of the *Workforce 2030* project and is one of two literature reviews that summarise the research base underpinning a high-level integrative report of emerging workforce challenges and opportunities, *Emergency Services Workforce 2030*.

Workforce 2030 aimed to highlight major trends and developments likely to impact the future workforces of emergency service organisations, and their potential implications. The starting point for the project was a question:

> *What can research from outside the sphere of emergency management add to our knowledge of wider trends and developments likely to shape the future emergency services workforce, and their implications?*

The seven themes included in the *Changing Landscape Literature Review* are: 1) demographic changes, 2) changing nature of work, 3) changes in volunteering, 4) physical technology, 5) digital technology, 6) shifting expectations, and changing risk. A second, accompanying literature review, the *Changing Work Literature Review*, focuses on another nine themes related to emergency service organisation's internal workforce management approaches and working environments.

Theme	Selected key trends and developments	Selected potential implications for emergency services
1. **Demographic changes**	A growing and ageing national population; Complex demographic shifts in rural, regional, and remote communities; Urbanisation and densification.	Challenges to capability planning as populations fluctuate and shift; Mounting pressure on volunteers in smaller rural, regional, and remote communities; Volunteer ageing and difficulty attracting young volunteers in rural areas due to youth outmigration; Opportunities to engage with new volunteer bases, e.g., rural retirees.
2. **Changing nature of work**	Growing concerns over employment security for key groups of workers; Increasing uncertainty as new technology reshapes work tasks and roles.	Physical and unpredictable nature of much emergency service work may restrict flexibility to adapt to changing employment relationships, employee demographics and technology impacts; Engaging across traditional boundaries to enable non-routine solutions to problems will be increasingly important; Shifting employee attitudes and expectations around work will require changes in workforce recruitment and retention strategies.

Theme	Selected key trends and developments	Selected potential implications for emergency services
3. Changes in volunteering	Formal volunteering rates have declined, and time restrictions will remain a major barrier to volunteering; More people prefer more flexible and diverse styles of volunteering; We now recognise a more diverse range of motivations for volunteering; Recognition and measurement of informal volunteering is increasing.	Mounting volunteer workloads are increasing barriers to emergency service volunteering; There is greater choice in how people can help in emergency management including less time intensive pathways than formal emergency service volunteering; Growing importance of adapting volunteer strategies and management approaches to wider volunteering trends; Recruiting both older and younger volunteers will continue to be important; Need for more collaborative, networked coordination of disaster and emergency management to embrace the growing range of ways people can participate.
4. Physical technology	Growing pressure on critical infrastructure from growing and densifying population; Increasing reliance on high-capacity communications networks brings benefits but also complex risks; Key areas of new physical technology with potential to impact emergency services workforces include 3D printing and additive manufacturing, robotics, autonomous vehicles and drones, nontechnology and material science, and wearable devices.	Risks of ageing infrastructure and underinvestment in maintenance; Growing cybersecurity risk; 3D printing and additive manufacturing bring new opportunities for disaster resilient infrastructure, planning and repairs; Potential for overloaded network infrastructure as robotics and drones expand; Transformative potential of autonomous vehicle technology; Opportunities wearable exoskeletons to improve health and safety in some conditions.

Theme	Selected key trends and developments	Selected potential implications for emergency services
5. **Digital technology**	Advanced computing developments creates new ways to approach problems; Artificial intelligence and machine learning can make increasingly complex decisions; Internet of Things and 5G mobile technology providing faster and more simultaneous connections; Social media use continues to expand, and combined with mobile and geolocation technology increases potential of crowdsourcing and volunteered geographic information for situational awareness; Growing importance of organisations focusing on obtaining and interpreting data to inform decisions and services.	Likelihood of fierce competition for workers skilled in digital technology and data analytics; Increasing capability in bushfire and flood prediction, with associated flow-on issues around community expectation, liability, and changes in incident management; Increasing opportunities to improve workforce management with better data tracking; Declining costs of new technology simplifies their adoption and use, e.g., virtual, augmented, and mixed reality environments; Potential to use 'serious games' increasingly for disaster preparedness; Leveraging of advanced technology for 24/7 oversight and intelligence of emergency events and disasters; Opportunities to leverage social media to gather incidence intelligence; 'Robodebt' scandal serves as a warning against poor and inappropriate adoption of automation.
6. **Shifting expectations**	Public trust in government is at an all time low; Future of public service delivery and public administration will look different but unclear yet as to how; Growing government and community expectations of deeper community participation and coproduction, but critique of undue "responsibilization" of citizens and civil society; Government expectations of volunteer-based services in rural communities may be unrealistic.	Low levels of trust in government may shape expectations of the emergency services and could complicate community engagement; ESOs will need to pay closer attention to careful management of public expectations; Community and government expectations of greater collaboration, personalisation of services, and commitment to public value outcomes will intensify, requiring changes in service design and delivery; A broader conception of what constitutes the emergency management workforce will be needed to inform more collaborative and inclusive planning; Emergency service organisations will need to carefully consider whether communities and volunteers have the influence, capacity, freedom and resourcing to fulfil government expectations, especially in rural communities.

Theme	Selected key trends and developments	Selected potential implications for emergency services
7. Changing risk	The global risk landscape will be shaped by the effects of the COVID-19 pandemic for many years; there is close agreement between different climate models about major climate change impacts to 2030; interconnected and interdependent support systems increase our vulnerability to cascading disasters.	Australia's changing disaster risk profile challenges the sustainability of the current organisational and workforce arrangements for emergency response and recovery management; ensuring the health, safety and wellbeing of emergency service staff and volunteers will become a more pressing challenge; climate change is also likely to impact the risk mitigation practices of ESOs; climate change will challenge the emergency services in more ways than just through its impacts on disaster risk.

INTRODUCTION

The *Changing Landscape Literature Review* collates a high-level evidence base around seven major themes in the changing landscape (i.e., the external environment) that fire, emergency service, and rural land management agencies operate in, and which will shape workforce planning and capability requirements over the next decade. It is one of two literature reviews that summarise the research base underpinning a high-level integrative report of emerging workforce challenges and opportunities, *Emergency Services Workforce 2030*.

The workforces of these agencies and organisations include career and volunteer members. They also include first responders as well as support staff and volunteers in professional services, technical, and administrative roles. For brevity, we refer to these agencies as 'emergency service organisations' (ESOs) and their workforce as the 'emergency services workforce'.

While the *Changing Landscape Literature Review* focuses on the emergency service workforce, it also recognises that the emergency services are part of a wider emergency management workforce that is diverse and changing. The full emergency management workforce extends far beyond emergency services to include the volunteer and paid workforces of not-for-profits active in recovery, local governments, wider community and faith-based organisations, government departments, private businesses and more. Therefore, this review considers the future emergency services workforces within the context of how they interact with and form a part of this wider workforce.

THE PROJECT

The *Change Landscape Literature Review* is an output of the *Workforce 2030* project. *Workforce 2030* aimed to highlight major trends and developments likely to impact the future workforces of ESOs, and their potential implications.

The starting point for the project was a question:

> *What can research from outside the sphere of emergency management add to our knowledge of wider trends and developments likely to shape the future emergency services workforce, and their implications?*

It was a question raised in response to a Workforce and Volunteerism Research Advisory Forum held by the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC) in May 2019. This forum highlighted the need for a 'big picture' view of current research that can inform future-focused workforce problem-solving in emergency service organisations.

The emergency management sector already benefits from a strong body of research on a range of issues influencing the future emergency services workforce and future capability needs. Much of the most recent research has been undertaken within the research program of the Bushfire and natural Hazards CRC (BNHCRC). A focus within this research has been the development

of tools and resources to assist planners and managers within the sector make decisions about the future.

In this context, the objectives of the *Workforce 2030* project were to:

1. Review a wide selection of future workforce-related research from *outside* the emergency management sphere and summarise major trends and developments it reveals.

2. Identify potential implications of these trends and developments for the future emergency services workforces, including those highlighted within emergency management research.

3. Highlight key BNHCRC research projects that provide important knowledge and tools for strategic decision making and workforce planning in the emergency services.

THIS LITERATURE REVIEW

A range of major trends will change the way Australians live and work in the coming years, forcing us to think critically about the forthcoming opportunities and challenges. The *Changing Landscape* literature review focuses on seven major themes in the changing landscape (see also Figure 1):

1. Demographic changes

2. Changing nature of work

3. Changes in volunteering

4. Physical technology

5. Digital technology

6. Shifting expectations

7. Changing risk

These themes were identified through the collation of information from several sources including: 1) major findings in other studies of major trends, 2) consultation with researchers familiar with the emergency management context, 3) consultation with emergency service workforce managers on the Project Steering Committee and beyond, and 4) consultation with existing workforce strategies.

A second, accompanying literature review, the *Changing Work Literature Review*, focuses on another nine themes related to ESO's internal workforce management approaches and working environments.

EMERGENCY SERVICES WORKFORCE 2030

CHANGING WORK

RECRUITMENT, ASSESSMENT &
SELECTION
SOCIALISATION & TRAINING
WORK DESIGN
DIVERSITY & INCLUSION
MANAGING MENTAL HEALTH &
WELLBEING
LEADERSHIP
CHANGE MANAGEMENT
MANAGING AN AGEING WORKFORCE
MANAGING VOLUNTEER WORKFORCES

**A CHANGING
LANDSCAPE**

DEMOGRAPHIC CHANGES
CHANGING NATURE OF WORK
CHANGES IN VOLUNTEERING
PHYSICAL TECHNOLOGY
DIGITAL TECHNOLOGY
SHIFTING EXPECTATIONS
CHANGING RISK

FIGURE 1: WORKFORCE 2030 THEMES

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1. DEMOGRAPHIC CHANGES

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Demographic change refers to variations in population characteristics (e.g., age, origin, location, education levels) and is a critical external environment factor that will shape workforce capability requirements over the next decade.

1.1. KEY TRENDS AND DEVELOPMENTS

Table 1, below, provides a snapshot of Australia's demographic statistics and population projections. It paints a broad-brush picture of a nation that is expected to continue to become more populous, older, with lower labour participation and longer life expectancy.

	2013	2033	2061
Total population	23.3 million	31 million	42 million
Population aged over 65	14 per cent	19 per cent	23 per cent
Working age population (aged 15 to 64)	67 per cent	63 per cent	61 per cent
Population aged less than 15	19 per cent	18 per cent	17 per cent
Dependency ratio (dependents for every 100 workers)	50 per cent	59 per cent	65 per cent
Fertility rate (births per woman)	1.9	1.8	1.8
Net overseas migration (migrants per year)	240,000	240,000	240,000
Life expectancy	79.9 years for men 84.3 years for women		85.2 years for men 88.3 years for women

TABLE 1: AUSTRALIAN DEMOGRAPHIC STATISTICS AND POPULATION PROJECTIONS. (SOURCE: MCKENZIE, 2015, FIGURE 1, PP.89. USED WITH PERMISSION)

1.1.1. Net overseas migration is a key driver of Australia's rapidly growing population. The long-term effects of border closures and COVID-19 on Australia's demographic trends remain to be uncovered.

By international comparison, Australia has a small but rapidly growing population. Australia's population surpassed 25 million in 2018, which is equivalent to the city of Shanghai. This makes it the 55th largest country in the world. Yet, we were growing at a faster rate than other developed nations (1.8% annually compared to the global average of just over 1.5%). In 2017, the overall population was projected by the ABS to grow from 24.6 million to between 29.2 and 30.8 million by 2030, and between 37.4 and 49.2 million by 2066 (ABS, 2018).

Net overseas migration is a key driver of our population growth. Indeed, three in ten Australians were born overseas and Australia is more culturally diverse than any other developed nation (Heenan, 2010). Most of the growth in Australia's population is expected to occur in metropolitan areas, with significant flow-on impacts also on regional areas through increased numbers of recreation visitors (Foster et al, 2013a). Meanwhile, the population of regional areas is also expected to grow overall, driven primarily by migration of people from metropolitan areas. However, there is significant variation from place to place within the regions.

Impact of COVID

Contrary to previous trend forecasts, in 2020, Australia has entered its slowest population growth in more than a century. COVID-19 is reshaping our nation's future in various ways. The 2020-21 federal budget revealed that due to international border closures related to COVID-19 and a slowed fertility rate, Australia's net migration intake is set to drop to negative levels for the first time since World War II (Truu, 2020), and is not expected to return to positive levels until 2022-23 or meet migration forecasts for a decade (Ryan, 2020). Deloitte predicts that Australia's population will grow by at least 600,000 fewer people than had previously been estimated for 2022, while the Treasury estimated a gap of 1 million (Remeikis, 2020).

The long-term effects of border closures and COVID-19 remain to be uncovered. However, a drop in migration and population signals some challenges ahead, including decreased birth rates and accelerated population ageing, fewer younger migrants traditionally used to boost the workforce as the older generation retires, less diversity, and increased pressure on budget constraints related to planned infrastructure and community spending.

1.1.2. Australia's population ageing trend presents challenges for labour supply and organisations will need to overcome barriers to mature age participation in the workforce.

Australia's population is also ageing as it is growing. Falling birth rates mean that the proportion of younger age groups in Australia's population are expected to continue to shrink in the next decade, while older groups rise rapidly. Over the last two decades, between 2000 and 2020, the proportion of the population aged 65 years and over increased from 12.4% to 16.3%. This group is projected to increase more rapidly over the next decade as further cohorts of baby boomers (those born between the years 1946 and 1964) turn 65 (ABS, 2020, see also Figure 2). At 30th June 2000, two out of three people were aged from 15 to 64 years – usually referred to as the working-age population. This proportion increased to a high of 67.5% in 2009, before declining to 65.1% by 30 June 2020 (ABS, 2020).

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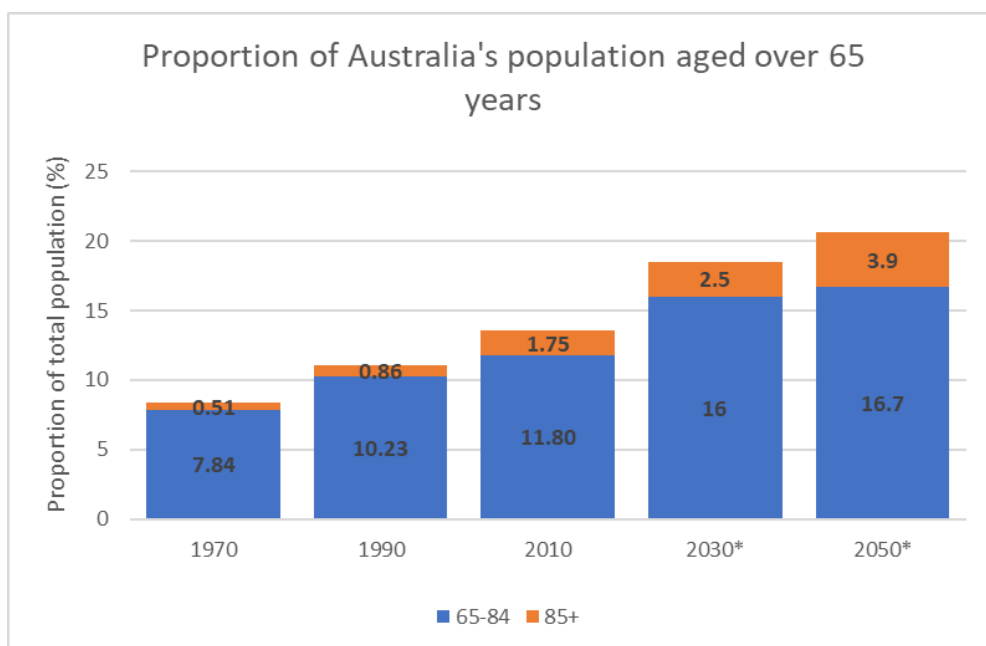## Proportion of Australia's population aged over 65 years

FIGURE 2: NUMBER AND PROPORTION OF OLDER PEOPLE, 2013-2053. (SOURCES: ABS, 2018; ABS, 2019).
* PROJECTED DATA FOR 2030 AND 2050 FROM ABS 2018, SERIES C.

Using demographic decomposition techniques and cohort-component projection models, Temple and McDonald (2017) investigated the impact of variations in mature age labour force participation on labour force outcomes over Australia's recent past (2000-2015) and immediate future (through to 2030). Their study revealed that while the rate of population ageing is projected to increase, labour supply growth is projected to decrease between 2015 and 2030, relative to that observed from 2000 to 2015, due to declines in the proportion of the population in 'working ages' (estimated at age 15-64). Conservative changes to prevailing mature age participation would add just over 300,000 additional workers. This labour supply figure could increase to 900,000 in a hypothetical scenario where Australia's mature age participation matches those of our nearest neighbour, New Zealand.

Temple and McDonald concluded that barriers to mature age participation in the workforce must be addressed for Australia to benefit from increased mature age labour force participation. Older Australians make valuable contributions to the workforce and community. In view of the ageing population, encouraging mature age labour force participation will be an important focus for government and many organisations in the upcoming decade. This is discussed further in the 'Managing an ageing workforce' section.

1.1.3. Rural and regional communities are experiencing complex demographic shifts, resulting in uneven and sometimes challenging circumstances across locations. Some significant influences on the demographic structure of rural and regional communities include population ageing, youth movement, and population mobility.

Populations across smaller cities, regional centres, rural communities, and remote areas are shifting. Regional population growth has been slower than in urban cities due to lower rates of overseas migration to these areas. Some significant influences on the demographic structure of rural and regional communities

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include population ageing, youth movement, and population mobility (Commonwealth of Australia, 2016; Wasserman & Gamlen, 2017). Changing immigration policies have sought to better distribute the abilities of skilled immigrants into rural Australia, and new governmental relationships with Indigenous populations are other examples of changes facing rural Australia (Connell & Jones, 2016).

The average age in rural areas is also increasing much faster than that in urban areas (Keating & Phillips, 2008). Young people relocating out of rural areas for education and employment opportunities and older people migrating into rural areas for retirement represent two concurrent trends that have driven accelerated demographic ageing in Australian rural areas (Hugo 2005). It is expected that in 2027, the proportion of people aged 65 and over in both inner regional and outer regional areas will increase by approximately five and six per cent (National Aged Care Data Clearing House, 2012). In major cities, however, the increase for this age group is expected to be half as much. Furthermore, young women are identified as an especially mobile group; Dufty-Jones and Argent (2018) report that young rural women out-migrants identified more barriers to a successful return to rural areas compared to their male counterparts. This gender difference is significant as rural communities may miss out on a considerable section of the human capital that can be generated through return-migration.

Complex demographic shifts are also contributing to uneven and challenging circumstances for rural and regional Australia. Larger centres, major cities and high amenity areas continue to attract people and business away from many smaller towns. Rural and regional locations experience counter-urbanisation processes and rural youth outmigration differently. On the one hand, coastal and peri-urban areas (e.g., Margaret River in WA and Kangaroo Valley in NSW) tend to struggle to meet the needs of expanding populations. Regions with high amenity values, including coastal and scenic areas close to major cities have seen strong growth over recent decades. On the other hand, inland and predominantly dryland farming regions are increasingly facing the consequences of population decline (Connell & Jones, 2016). This includes the wheat-sheep belt and remote areas that do not have substantial mining activity (Taylor, Walton, Loechel, Measham, & Fleming, 2017).

Many rural and remote economies are in decline as both people and economic activity move towards larger regional centres and cities. However, some rural and remote areas have shown economic growth because of mining construction and production, as we see in northern Australia. For example, as Connell and Jones (2016, p.5) stated:

> *Certain regions, such as parts of Queensland and Western Australia, where mining has boomed, and Victoria, with better soils, more space, and high capital-intensive forms of production, have improved their economies of scale, gained export markets and retained or even boosted their populations. In other regions where farms and exports are smaller, and where capital is scarce, local economies have stagnated. Patterns of growth and decline and resultant social problems have not been distributed evenly between, or within, regions. While some centres continue to grow, many smaller towns have become caught in a vicious cycle of decline, losing residents, industries, and confidence about prospects for a sustainable future and fearing neglect from the*

centre. Above all rural and regional Australia has become substantially more complex than in any other era."

1.1.4. The Australian population overall is urbanising and densifying, placing pressure on existing infrastructure networks.

The Australian population is densifying and urbanising, particularly in fast-growing cities including Sydney, Melbourne, Brisbane, and Perth. Despite being a large continent with a relatively small population, Australia's population distribution is highly concentrated. Our living spaces are becoming denser and more urban (Australian Infrastructure Audit, 2019). This pattern has seen the proportion of the population living in towns and rural areas declining since the early 20th century (BITRE, 2014). As noted in earlier sections, individuals moving to cities tend to be relatively young. The median age for capital cities (36.0 years) was younger than the rest of Australia (41.2) in 2019 (ABS, 2020). The transformation from suburbanised to urbanised structures will lead to new patterns of living, travel, and demand for services, thereby placing pressure on existing infrastructure networks.

Alongside our increasing population and growing urban development and wealth (Handmer et al., 2018), the rise in development pressures may be accompanied by increased development in at-risk areas. For example, the Australian Government Productivity Commission (2014) predicts exposure to coastal inundation across Queensland to double by 2030. Importantly, however, increases in urban density continue to occur without equivalent increases in evacuation capacity, such as corresponding increases in open space or improvements to road and transport infrastructure to increase relocation options (Foster et al., 2013b).

1.2. POTENTIAL IMPLICATIONS

- Fluctuating population distribution and higher levels of mobility and volatility will pose as a challenge for emergency service delivery. The migration of residents from metropolitan to regional areas represents a challenge, as these 'tree-changers' might bring with them very limited awareness and experience of the risks they face. Further, these new regional residents are likely to have experience in urban service delivery too and thus carry higher and potentially unrealistic expectations of emergency services. While this is not a new problem, the scale of it is likely to increase. Agencies will need to place emphasis on engaging new residents to increase awareness, preparedness and safe responses and manage their expectations (Foster et al., 2013b).
- Population growth benefits the Australian community by supporting reduced ageing and adding to the labour force, yet it puts pressure on infrastructure, services, and the environment. At the same time, ageing population will also place greater demands on government services. It is therefore important for relevant bodies to plan ahead for infrastructure, housing, and service delivery needs (including targeted community interventions) to manage these implications of population changes.

- Population changes also present opportunities. Some regional areas will benefit greatly from population growth, providing a stronger basis for community participation in preparedness and response activities than before. Increasing numbers of retirees in regional Victoria with the time and skills to volunteer represent a valuable resource for emergency management (Salt, 2012). However, following an initial spike in volunteer activity in the next few years, it is likely that the ageing 'baby boomer' generation will be able to devote less time and energy to physical response activities. These limitations could be compensated for by greater volunteer involvement in prevention and preparation activities.

- With several government policies aimed at promoting growth in regional areas, ESOs may need to closely monitor population growth in these areas and be prepared for impacts to service delivery requirements.

- The Victorian Fire Services Commissioner's 2021 research program noted that emergency management will be confronted with larger populations and an increased number of assets at risk. Given increasing demands on emergency services, it may be worth considering alternative approaches to increase community preparedness and resilience, such as requiring aged care facilities and even individual homes to have rehearsed plans and the capacity to implement them in an emergency. This is consistent with the idea of sharing responsibility between agencies and community as set out in the National Strategy for Disaster Resilience (Foster et al., 2013b).

- Rural communities are increasingly reliant on volunteers (Winterton & Warburton, 2014). Indeed, volunteers provide many essential services, including rural firefighting, ambulance services, and crime prevention- all of which are commonly provided by the public sector in urban areas (Fahey & Walker, 2002). "At the same time, the demographics of population ageing and policy change are also increasing demand for such services. This includes growth in the numbers of frail elderly people living in the community in their own homes rather than in institutional care" (Warburton et al. 2013).

- The net migration of young people from rural to urban areas means that volunteer-based services in rural communities may struggle to recruit younger volunteers, simply because there exists only a small pool to recruit from. Of the rural Western Australian volunteer workforce, 9% of volunteers are planning to move within two years, potentially threatening the sustainability of the volunteer workforce in these communities (Holmes et al., 2019). However, long-term rural residents have been found to be more likely than newer residents to have volunteered (Davies et al., 2018), which highlights the need to target recruitment with long-term residents in different demographic groups within these remote populations.

- Alongside the unique challenges found in rural areas due to their geographic isolation, rural Australians generally experience higher levels of community interconnectedness and increased community participation, volunteering, and informal support from their local community (Ziersch et al., 2009). Furthermore, volunteering is a productive ageing activity, with research linking the relationship between volunteering and healthy ageing (Warburton & Peel, 2008; Winterton & Warburton, 2014). ESOs may use this to attract more

volunteers, particularly in rural communities where there is an older population. However, it is also important to note that there are risks associated with over-reliance on volunteers in rural communities. Furthermore, elderly people may be less able to volunteer with emergency management organisations in relation to physically demanding activities (Gissing et al., 2020).

- Declining and ageing populations in regional and more isolated towns present challenges. Adults over 65 are estimated to comprise a quarter of the population by 2056, and to be over-represented in rural areas due to younger community members migrating to urban areas for work and education (Anderson et al., 2018). Those seeking quiet retirement or housing affordability may also move to rural areas (Anderson et al., 2018; Winterton & Warburton, 2011). At the same time, older people can also be a driving force within community activities and volunteering. Those who relocate to rural communities often contribute key skills and experience they bring with them (Winterton & Warburton, 2014).

- Declining and ageing of rural populations is a trend that is intersecting with the contraction of land management and forestry industries to create workforce challenges for land management agencies. According to the According to land managers, these intersecting shifts have led to decreasing development of fire management skills and attrition of experienced personnel from government agencies.

- As Australia's communities continue to become more diverse, engaging with culturally and linguistically diverse members will continue to become increasingly important for emergency service personnel. For example, the CBD and inner suburbs of Melbourne comprise large proportions of international students and new migrants who have limited knowledge of local ESOs and available services. ESOs may wish to collaborate with universities and other relevant institutions to increase awareness and engage these communities in emergency preparedness, response, and recovery (Foster et al., 2013b).

1.3. RELATED RESEARCH

The Australian natural disaster resilience index (University of New England)

- See https://www.bnhcrc.com.au/research/resilienceindex
- "A system for assessing the resilience of Australian communities to natural hazards".

ARC Centre of Excellence in Population Ageing Research

- See https://cepar.edu.au/

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2. CHANGING NATURE OF WORK

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"The nature of work in Australia is changing and the skills an employer requires in an employee today are fundamentally different to what they looked for a decade ago".

Senator the Hon Michaelia Cash,

Minister for Employment, Skills, Small and Family Business (National Skills Commission, 2020, p.5)

Work can be defined as "human activity that is goal directed, purposive, or instrumental and creates value to society" and is the process by which humans transform resources into outputs (National Research Council, 1999, p.22). The nature of work is changing and in many areas the pace of change is increasing (World Bank Group, 2019). The rapidly changing world of work presents both opportunity and uncertainty. These features have come dramatically into focus during the ongoing COVID-19 pandemic. For example, technology for collaboration is being adopted by many and new opportunities for remote working are being explored. At the same time, the intense threats to health and the economy make the extent of future change highly unpredictable.

The pandemic response entailed new ways of working under increasing uncertainty, highlighting core changes associated with the Fourth Industrial Revolution now unfolding. Technological transformation defines this stage of industrial change (Baran & Bible, 2019) with rapid advances in artificial intelligence and machine learning impacting the digitisation of work, social media communications and cloud-based collaboration tools enabling geographically dispersed teams (Bodrožić & Adler, 2018; Haynes, 2020). In addition, industrial transformation is disruptive to social, economic, cultural, and environmental conditions.

Increasing automation, changing economic conditions, and evolving employee expectations are all influencing how work is done. For some jobs, the complexity of work is increasing as technology creates more varied opportunities for communication and decision making. For other jobs, work is being simplified and 'old' tasks are replaced with new tasks. Some jobs are disappearing altogether, creating anxiety about the future for those who do not see alternative options and prompting more widespread concern about who will be affected by future change.

To provide a backdrop against the review themes that are to follow, we first review major trends observed and expected for the future of work. This section then outlines the major technological changes that are disrupting current ways of working and implications for the way tasks are implemented and organised.

2.1. KEY TRENDS AND DEVELOPMENTS

Some key trends in work and employment have emerged in recent decades including the composition of the workforce, the content of jobs, and the employment relationship. Thus, individuals are required to quickly adapt to

changes, whether expected or unexpected, and to think about their career in a more sustainable way (e.g., career transition, skills upgrading). Under these conditions, sustainable employability, defined as employees' capacities to function in work throughout their working life, has become more important to help individuals achieve meaningful and lifelong employment.

2.1.1. Workforce demographic change influenced by factors such as global migration trends and the ageing population is increasing the diversity of the future workforce. This makes fostering an inclusive workplace a priority for organisations.

Shifting demographic trends are increasing the heterogeneity of the working population. Changing participation rates and global migration trends are factors that influence the increasing diversity of the future workforce. Despite current travel restrictions temporarily dampening the trend towards increased ethnic/racial diversity, the underlying trend appears likely to continue, in part due to a growing awareness of the social and production benefits of a diverse workforce.

Alongside an ageing population in many countries, the average age of the workforce is also increasing. While an increased life expectancy boosts the total available workforce, there are challenges for reskilling and upskilling mature workers in line with the rates of technological advancement. Indeed, technological changes are already outpacing educational systems and organisational training programs. The implications of an ageing workforce are discussed in further detail in the 'Demographic Changes' section of this review and the *Changing Work Literature Review*: 'Managing an Ageing Workforce'.

The labour market is also becoming increasingly polarised, with ongoing growth in both high-education, high-wage jobs and low-education, low-wage jobs but little growth being observed for middle-skill jobs (Autor et al., 2019). This trend has resulted in a growing divergence between the incomes of those who have completed further education, and those who have not.

Furthermore, there is an increasing move away from the traditional division of work and family responsibilities, with the female workforce participation rate at an all-time high of 60.7% (DSE, 2019). Further, female employment growth is currently outpacing that of males and predicted to grow by 8.8% from 2018-2023, compared with 5.6% predicted growth for males (DSE, 2019).

2.1.2. The changing nature of employment relationships and conditions, such as the growth of the gig economy, are generating new ways of thinking about how services are delivered and are enabling the rise of demand-driven services.

The changing nature of employment conditions is a major concern for a growing number of workers. A recent study by the World Economic Forum (2018) of human resource leaders in large, multinational firms suggest that organisations will increase their reliance on contractors and develop new project-based work designs as well as remote staffing arrangements that engage workers with increasing flexibility. These trends are pushing for more simultaneous collaboration among many functional specialties and professions. As a response,

the basic template for organising and designing work has shifted from functional specialisation and full-time employment toward project teams and contingent assignments (Guile & Lahiff, 2017; Scully-Russ & Torraco, 2020). Scully-Russ and Torraco (2020) observed, "contingent project teams are now the norm throughout the economy, causing a shift in the conventional employment relationship from a stable, full-time job to more casual forms like freelance, temporary contracts, and self-employment" (p. 17). Platform-based organisations such as Uber are also supplanting traditional employment relationships and generating new ways of thinking about how services are delivered. Indeed, many papers discussing changes in the nature of work comment on the growth of alternatives to the traditional norm of long-term and full-time employment, with much attention given to the "gig economy" (Murphy & Tierney, 2020).

The growth of the gig economy is associated with a move away from permanent contracts and a shift towards more temporary contracts. Following widespread concern over wages and conditions offered to gig workers, the Victorian Government commissioned an Inquiry into the Victorian On-Demand Workforce (Industrial Relations Victoria, 2020). The resulting report revealed that around 7% of the Australian workforce are finding work through the gig economy. NSW has the highest level of 'gig workers' (7.9 per cent), followed by Victoria (7.4 per cent). However, whether this type of work will continue to grow remains to be seen.

Part-time employment share has also continued to rise and now accounts for nearly one-third of the total employment. An increase in part-time employees enables organisations to respond to demand-driven changes more flexibly. For the individual, part-time employment is highest for females and young people (15 – 24 years), with two key reported reasons being balancing work with study and parenting responsibilities (Cassidy & Parsons, 2017).

2.1.3. There is an increasing awareness and uptake of flexible work, particularly during the COVID pandemic.

Since the introduction of technology into the workplace, the assumption that employees must be collocated for effective work has been dispelled. Indeed, the future workforce is increasingly likely to be working in virtual teams. Murphy and Tierney (2020) noted:

> *This transition from primarily collocated work to global virtual teams has brought about some advantages, as well as disadvantages. Some of the most pertinent advantages are that it is possible to form a team of experts dispersed throughout space and time. This reduces the time and cost associated with travelling, it allows the team to function across a 24-hour workday, and it allows for companies to offer staffing flexibility to meet market demands (Kirkman et al., 2012). Still, there are some challenges associated with managing and working in global virtual teams: for instance, group interactions are much more complicated because the traditional cues used to understand one another are obscured, and virtual teams have been found to have lower levels of team cohesion, trust, social control, and commitment to team goals (Hoch & Kozlowski, 2014). Although these qualities are undoubtedly undesirable for virtual teams, this work arrangement is still in its infancy, and it is likely, in particular as*

> *society becomes more integrated through IT and IT itself becomes more adept, that virtual teams will become more effective.*

Amid the pandemic, there is a new awareness of how work can be undertaken remotely. Recent studies suggest that employees who telework are at least as productive as those in the office. Yet, during the pandemic, some workers have suffered psychologically and experienced burnout and other negative outcomes of combining remote work with home roles. Recent research finds that people can protect their health by seeking support from loved ones and learning how to adapt to changes in work and family (CSUF News Service, 2020).

2.1.4. Employment security and rising job precarity are a concern, particularly for certain groups of workers.

Employment security is a pressing concern for workers in a changing and volatile work environment. During the pandemic, unemployment rates rose to record levels (National Skills Commission, 2020), making threats to employment status more salient than ever. Data from the HILDA longitudinal study indicates that approximately 80% of employees have maintained a sense of job security over past decades, with small decline in job security over the years since the Global Financial Crisis. However, the overall figures mask poor and declining job security for some employees. Technicians, machinery operators, clerical workers, and drivers comprise a group whose sense of security is falling quickly. In contrast, professional workers have maintained relatively stable levels of job security and sales workers have improved in their perceptions over recent years.

2.1.5. Growing uncertainty is a defining feature of new technology as it shapes future work tasks and roles.

Advances in sensor technology, communication networks, and data analytics are combining to enable complex tasks to be monitored and controlled in entirely new ways. In previous decades automation replaced mechanical and repetitive tasks with technology such as robotics. By contrast, the next wave of automation is impacting knowledge work, such as decision making and creative roles such as product design. Knowledge work requires individuals to use their cognitive skills, including problem solving and creative thinking skills to a greater extent than when work primarily revolved around routines and physical actions (Jacobs, 2017). Increasingly, artificial intelligence, machine learning, and voice recognition are being pooled to automate knowledge work (Bughin et al., 2018), thereby transforming how the nature of how this work is organised and performed.

The automation of traditional professional tasks is producing another wave of concern about employment and the management of work. There is widespread concern that technology might oversimplify some work previously undertaken by professionals. For example, some roles will require high vigilance over long periods for unusual and dangerous events yet require little other action because automated processes handle routine operations. Indeed, Burke and Ng (2006) note that some jobs require less skill than in the past because computerised systems have replaced human operators in carrying out cognitively demanding tasks. Some examples cited include the use of AutoCad in designing and building houses, GPS and navigation systems in flying an aircraft. Important are

consequences of computers and related electronic devices removing the need for human judgement, memory, spatial skills, product knowledge, and the like from many jobs (Murphy & Tierney, 2020).

More colloquially, the concern for the future of work is expressed in terms of a fear that robots will take over many human jobs. However, the progress of automation is more nuanced with high potential to augment rather than replace human capacities, and new tasks and roles becoming available (Deloitte Insights, 2018; Schwartz & Monahan, 2018). Nevertheless, the nature and pace of this change is creating uncertainty for people, governments, and industry. Indeed, this uncertainty is a defining feature of technological change.

As employers grapple with the challenges, employees increasingly expect employers to offer flexible work arrangements. Implications of such expectations lie in an organisation's ability to attract and retain talent particularly as jobs require higher skilled roles and focus on emerging technologies.

To understand the impact of technology on future work, it is important to identify specific tasks and processes undertaken in the conduct of human work. A focus on changes in job profiles, titles, and job descriptions can mask important changes that are occurring across roles, both within an industry and across disparate industries. On the other hand, it is important to recognise that the atomisation of roles and tasks – where each activity is broken down to small components to identify the potential for automation – risks ignoring the essential human requirements of work.

Two central questions confront anyone seeking to describe the way technology is changing human work.

First, how can people work effectively in a highly connected world with people more tightly interdependent with other people, as well as technology, through teams, networks, and interconnected systems?

Second, how can people work adaptively in an increasingly uncertain world of rapid, unpredictable, and sustained technological change?

Addressing these questions is the foundation for understanding the requirements for work in a constantly changing technical environment (Griffin et al., 2019). A highly connected and dispersed network will require digital, conceptual, and interpersonal skills of a different scale and quantity to traditional team environments. An increase in the integration of information calls for higher-level understanding of the interdependencies within the work environment. Employees will need to have a rich view of information networks and the role they play. Communication skills to interpret and convey information will be important and the need for an ability to work interpersonally with diverse groups will increase. The future of work requires 'true collaboration', and this true collaboration requires a lot of people input to be able to use collaborative technology to maximise its value to work. The World Bank Group (2019) emphasised the primacy of human capital in meeting a challenge that, by its very definition, resists simple and prescriptive solutions. They noted:

> *Many jobs today, and many more in the near future, will require specific skills—a combination of technological know-how, problem-solving, and critical thinking as well as soft skills such as perseverance, collaboration, and empathy. The days of*

staying in one job, or with one company, for decades are waning. In the gig economy, workers will likely have many gigs over the course of their careers, which means they will have to be lifelong learners. (p. vii)

New technology will provide better analyses of the environment, enhance predictions of the future, and support new forms of decision making. However, these changes are unlikely to reduce uncertainty when working in more technical environments. Indeed, uncertainty is likely to be a more prevalent feature as new systems come online, and new capabilities are developed. Employees will need to develop a more positive engagement with uncertainty and develop the ability to adapt quickly to new situations. These core features of technological change have implications for the emergency service workforce which we discuss in the following section.

2.2. POTENTIAL IMPLICATIONS

- Changing employment relationships, employee demographics, and technology will each have sustained impact on the emergency service workforce. Some of these changes will be particularly challenging for emergency service organisations who must already work in unpredictable physical environments, which themselves are generating more frequent and severe emergency events. Many emergency service workers, therefore, do not have the same advantages as knowledge workers, for example, where greater flexibility is easier to envisage. However, transformational changes underway in the management of remote operations can significantly augment the roles of the emergency service workforce. In addition, the command and control structure of emergency management provides a foundation capability that could transform to integrate changing technical capacity.

- The ability to engage across traditional boundaries is enabling non-routine solutions to problems via collaborative innovation both within and across sectors. Additionally, access to knowledge and skills is more available from diverse sources across previously disparate areas of work, and the potential to shift from vertically integrated structures to horizontally integrated networks promises new ways of working and solving problems.

- Remote capabilities are expanding as intensive data produced by complex networks of communication (e.g., dispersed geolocation sensors) is managed and analysed more quickly and intelligently through processes such as machine learning. The complexity of these networks will continue to place new demands on the emergency management workforce. While some information tasks will be less demanding, there will be more complex requirements on people to integrate and update information. Knowledge about how information is generated through remote systems will be needed if individuals are to have appropriate mental models of the environment and are prepared to trust in the new forms of data and decision-aids that will be forthcoming.

- As employee attitudes and expectations around work are shifting, emergency service organisations may need to rethink their strategies for attracting and retaining their employees. For example, there may be a need

to consider agile policies and processes in order to respond to continuous change in a timely manner if organisations want to maintain a competitive advantage for attracting the top talent.

- While technological change can often make work easier, it also has the potential to diminish the breadth of roles, decrease wages, and increase work intensity and demands (Ikin et al., 2019). It is important to focus on *improving* work conditions with technology to allow humans to focus on more meaningful, stimulating, and creative tasks (Elaborated further in the *Changing Work Literature Review*: Work Design).

- A key implication of tasks requiring less skill than in the past is that the skills of human operators will decay or not be developed adequately from the start, due to the limited opportunity to practice them. This has direct implications in some areas of emergency service where callouts are infrequent. Thus, as automation and technology are increasingly embedded into work, it is important for emergency service organisations to consider technology-related human factors issues, such as good communication and coordination to equip human operators with the situational awareness to respond to any automation failures that might arise (Bearman, 2013).

- The changing nature of work does not happen in isolation. Myriad factors, some of which have been discussed above (e.g., demographic changes and technological advancements), that happen outside of work and organisations should be taken into consideration when considering forces that will impact the workforce over the next decade. To this end, the six other focal themes highlighted in this phase of the report should be given consideration to ensure that they expand, rather than limit the developmental potential of the emergency service workforce over the next decade.

2.3. RELATED RESEARCH

MAPNet: Rethinking Work Skills for the Future (FOWI)

- See https://www.thriveatwork.org.au/resources/mapnet/v
- "The MAPNet framework provides a new way of thinking about skills based on the deep structure of work activities. The deep structure classifies activities based on two fundamental mechanisms through which organisations achieve goals: optimising uncertainty and optimising interdependence."

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3. CHANGES IN VOLUNTEERING

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The United Nations defines volunteering as "activities undertaken of free will, for the general public good and where monetary reward is not the principal motivating factor" (UNV, 2018, p.10). Around 90% of the emergency services workforce are volunteers (Commonwealth of Australia, 2019). This section highlights broader volunteering characteristics and trends with implications for volunteer workforce planning in the fire and emergency services. It includes trends in formal volunteering (organisation-based) and informal volunteering (outside of an organisational context) and focuses on the most recent available research.

3.1. KEY TRENDS AND DEVELOPMENTS

3.1.1. Formal volunteering rates have declined in recent years, and time restrictions continue to be a major barrier to volunteering.

Australia has always had a strong tradition and culture of volunteering (Oppenheimer, 2008). The latest data from the Australian Bureau of Statistics (ABS, 2020) shows that almost a third (29.5%) of Australians aged 15 and over participated in formal volunteering (unpaid voluntary work through an organisation) in 2019. This amounted to 596.2 million hours contributed to the community in the 12 months prior to the data collection. However, ABS data also shows a decline in the rates of formal volunteering in Australia. Among people aged 18 years and over, rates fell from 36.2% in 2010 to 28.8% in 2019 (ABS, 2020). There is some evidence that the average number of hours volunteered has also declined (O'Dwyer, 2014), although there is insufficient data available to give an accurate measurement of how much.

A widely known major factor contributing to declines in rates of formal volunteering is restrictions on people's time availability. Responses to Volunteering Australia's 2016 State of Volunteering report, for example, confirmed that work and family commitments are major barriers to volunteering (Volunteering Australia, 2016, p.12). Limitations on people's time to volunteer are set to continue. As the latest ABS figures show, Australians are feeling busier than ever, with 39.5% of people aged 15 and over reporting they 'always' or 'often' feel rushed for time (ABS, 2020).

3.1.2. More flexible and diverse styles of volunteering are preferred by more volunteers.

Despite falls in formal volunteering rates, international research shows that volunteering may best be described as transforming rather than declining (Hustinx & Lammertyn, 2003; Rochester et al., 2010). Some commentators do find evidence that people's willingness and capacity to participate in civic life through volunteering and other activities has fallen, associated with a decline in social capital (e.g., Leigh, 2011). However, other research shows that people are

still motivated to contribute to their communities but are increasingly doing it in different ways compared to the past. Broad shifts in the way people live and work in the 21st Century "have recast the conditions and values that shape people's choices about how, when, where and why to volunteer compared to the past" (McLennan, Whittaker, & Handmer, 2016, p.2033).

Within these shifts, there has been a decline in the dominance of the traditional style of volunteering, particularly since the 1980s. Traditional volunteering is characterised by "a lifelong and demanding commitment" to a single organisation, underpinned by collective and altruistic values and devotion to community service (Hustinx & Lammertyn, 2003, p.168). Newer styles of volunteering are associated with contrasting and more diverse characteristics such as (McLennan et al., 2016, p.2033-4):

- greater prevalence of shorter-term or episodic volunteering,

- greater individualism and self-reflection in the way people make decisions about where, how, and why they volunteer,

- greater desire for autonomy and using existing skills,

- greater importance given to personal benefits and fulfilment, and

- less loyalty to particular organisations in favour of greater loyalty to particular causes, projects or outcomes that are meaningful to the individual.

The distinction between 'traditional' and 'new' volunteering styles is not clear cut, however. For example, many short-term and episodic volunteers also engage in traditional volunteering with other organisations (Holmes, 2014), while others move back and forth between short and long-term volunteering at different times depending on life stage and availability. This is particularly pertinent in the context of disaster and emergency management, where events trigger people to volunteer in different ways, often for short, intense periods. In Australia, this is often encapsulated in the concept of 'spontaneous volunteering' (Whittaker, McLennan, & Handmer, 2015), discussed further below.

3.1.3. Helping others remains a core motivation for volunteering, but motivations are also now recognised as more diverse and shaped by specific contexts.

With the rise of more individualised and self-reflective approaches to volunteering (as well as to many other aspects of modern life, including paid work, see Hustinx & Lammertyn, 2003), some research suggests that motivations for volunteering have become less altruistic and more self-oriented. Self-oriented motivations include developing new skills, career development, finding social connection and belonging, and self-fulfilment from contributing to personally meaningful causes (Kragt & Holtrop, 2019). However, a strong body of research reinforces that helping others remains a core motivation among newer forms of volunteering and volunteers, including: episodic volunteers (Dunn, Chambers, & Hyde, 2015), corporate volunteers (Sekar & Dyaram, 2017), spontaneous volunteers (Helsloot & Ruitenberg, 2004), younger volunteers (Walsh & Black, 2015), and digital volunteers (Barrera & Yang, 2019). Furthermore, research shows that self-oriented motivations have always sat alongside altruistic ones in

traditional volunteering also, for example, prestige and career enhancement (Hustinx & Lammertyn, 2003).

At the same time, different motivation profiles have also been found to exist among volunteers (i.e., different mixes of motivations), varying with demographic, social and other characteristics (Kragt & Holtrop, 2019), including among emergency service volunteers (Kragt, Dunlop, Gagne, Holtrop, & Luksyte, 2018; McNamee & Peterson, 2015). There are also some differences in motivations across different types and stages of volunteering, and across different organisational contexts and sectors. Thus, instead of more self-oriented motivations replacing service to others as a key motivation for volunteering, both types may sit comfortably together, and even "strengthen and enrich each other" (Hustinx & Lammertyn, 2003, p.174) as part of multifaceted and variable motivational mixes.

3.1.4. Recognition and measurement of the scope and contributions of informal volunteering are increasing.

Overall, the majority of volunteering worldwide is informal. However, in countries where volunteering is measured, measurement usually focuses on formal volunteering and largely neglects informal volunteering (UNV, 2018, p.10). This can lead to some misperceptions about volunteering and civic engagement within segments of the population where cultural or social norms of informal volunteering and social obligation as a member of a community are strong. Moreover, these participants will not necessarily consider themselves to be 'volunteers'. For example, it is well established that volunteering by culturally and linguistically diverse (CALD) and Indigenous community members are under-represented in formal Australian volunteering data due to their higher rates of informal volunteering (CIRCA, 2016). This is despite the fact that "sharing, helping, supporting, giving and volunteering were found [in a recent Australian study] to be integral to CALD and Indigenous cultures and to form the basis of many cultural and religious traditions" (CIRCA, 2016, p.9). This includes helping others within their own cultural communities, as well as the general public.

In response to voluntary sector feedback, the ABS began to collect data on informal volunteering for the first time in the 2019 General Social Survey (ABS, 2018). In the 4 weeks prior to the survey, around one third (33.4%) of Australians aged 15 and over participated in informal volunteering (outside of an organisational setting, excluding helping non-household family members) and a little over half (51.5%) provided unpaid work/support to people living outside their household (including helping non-household family members, ABS, 2020).

3.1.5. Prevailing assumptions about both older and younger volunteer cohorts are being recognised as overly simplistic.

With populations in most modern Western countries ageing, policy makers have assumed that the 'Baby Boomer' cohort "will have the human capital and the willingness to greatly expand the pool of volunteers as they age, thus playing key roles in solving critical social problems" (Chambré & Netting, 2018, p.1296). Yet, just as with many other aspects of volunteering, the real situation is more complex. Australian research shows that, "volunteer *rates* decline with age but the *percentage of time* given increases" (Scaife, McGregor-Lowndes, Barraket,

& Burns, 2016, p.3, emphases added). However, this increase in time given by older volunteers may not continue in future. Recent research outside of Australia finds that newer styles of more episodic, self-reflective volunteering are also common among this generation (Hansen & Slagsvold, 2020). Further, older volunteers may struggle with the implications of professionalisation and managerialism in volunteer-involving organisations (Warburton & McDonald, 2009).[1] There are also interactions between different types of productive activity for people in older age groups; for example a rise in informal helping responsibilities can reduce their availability for formal volunteering (Pettigrew, Jongenelis, Jackson, & Newton, 2019).

Despite media stereotypes of younger generations as individualistic and self-oriented, young people care deeply about contributing to society. For example, surveys show that 'Millennials' and 'Gen Z' are more likely than previous generations to choose to work for an employer that improves society, even when it means accepting lower pay (Deloitte, 2018). Recently, the COVID-19 pandemic has further increased the desire of these younger cohorts to have a positive impact in their communities (Deloitte, 2020, p.3). However, voluntary work by younger generations is also influenced by the same shifts impacting on their paid work. Millennials are less likely to remain loyal to a particular organisation, for example, and they are "passionate about issues, not institutions" (Case Foundation, 2019). Millennials and Gen Z are also more likely to engage in civic life through every day and informal practices than through formal volunteering and structured institutions compared to older generations (Case Foundation, 2019; Mutch, 2013; Walsh & Black, 2018). At the same time, in a hyperconnected and uncertain world, Millennial and Gen Z cohorts also face increasing levels of stress and time pressure (Deloitte Global, 2020, p.3).

3.1.6. Social media has lowered barriers to participation in disaster management and formal organisations are no longer the gatekeepers they once were.

New communications technology and, particularly, social media have had a substantial impact on the way people participate in disaster management and the way volunteers of all kinds are coordinated. Overall, easy access to new communications technology has raised public expectations of the speed and accessibility of information, and the response of official agencies. These technologies have also lowered the communication and information barriers to participating in disaster management, enabling a much wider range of people to self-organise to respond to disasters without the need for mediation, control, or direction from formal organisations (McLennan, et al., 2016). As has been observed in the context of international humanitarianism, this has led to "…not simply a technological shift [but] also a process of rapid decentralization of power" (UN-OCHA, 2013, p.16 citing Tim McNamara). This is likely to have far-

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[1] See more about the implications of managerialism in the following sections: this review Shifting Expectations (wider public and voluntary sector implications); *Changing Work Literature Review – Managing Volunteer Workforces* (implications for volunteer experience and volunteer management approaches).

reaching implications for how disaster response and relief occurs and how it is coordinated.

New communications technology has also enabled the rise of digital or virtual volunteering in response to disaster events. Digital volunteers have been found more effective than government organisations at managing, collating, organising, and disseminating information from the 'data deluge' that accompanies disasters in the Internet age. Moreover, they can do it in near to real time and increase situational awareness of both survivors and responders (Cobb et al., 2014; Haworth & Bruce, 2015). While digital volunteering has not yet taken off in Australia (but see, for example, Downard, 2019; Wilkie, 2015), recent international research is providing insight into how digital volunteer networks can be integrated with the official on-site disaster management systems (Cobb, et al., 2014; Hughes & Tapia, 2015).

3.1.7. Informal, spontaneous, and emergent post-disaster volunteering is here to stay, and knowledge and capacity to integrate it with formal response systems is slowly increasing.

People mobilising to help others in the aftermath of a disaster event who do not have prior affiliation to dedicated emergency management sector organisations have been called many things: 'informal', 'unaffiliated', 'unofficial', 'spontaneous', 'community', 'convergent', and 'emergent' volunteers among them (Whittaker, McLennan, & Handmer, 2015). In Australia, the most used term is spontaneous volunteers, although this catch-all label can be misleading as it is often associated with a simplified and often inaccurate picture (McLennan, 2019b).

Spontaneous volunteering is something of a paradox for formal emergency managers, particularly when volunteers 'converge' on disaster-impacted communities from other places (Kendra & Wachtendorf, 2003). On one hand, it can hinder organised relief operations and divert resources that would otherwise be directed towards helping survivors. On the other, it can provide a much-needed surge in resources and skills, generate greater capacity to quickly adapt to local needs compared to formalised organisations, and provide important psychosocial support for both volunteers and survivors (Twigg & Mosel, 2017). When these volunteers are local, they also embody community resilience and bring with them immense local knowledge, skills, networks, and capacities. Importantly, spontaneous volunteers can become involved in response and relief efforts in many ways, and hence have different sets of benefits, risks, and coordination needs depending on the specific contexts.

Integrating informal, emergent, and spontaneous community responses to disaster with the formalised, top-down governmental response system is a key challenge in emergency management (Roth & Prior, 2019). However, knowledge and capacity to do this is slowly but steadily on the rise. Recent research is revealing, for example:

- How the legitimacy and authority of less formal voluntary groups and volunteers can be established and negotiated (Johansson, Danielsson, Kvarnlöf, Eriksson, & Karlsson, 2018; McLennan, Whittaker, Kruger, & Handmer, 2020),

- The importance of brokering organisations that bridge the gap between top-down and bottom-up responses to disaster (Roth & Prior, 2019), and

- The way social media and online platforms are used by emergent citizen groups and spontaneous volunteers to self-organise, innovate, and overcome logistical, coordination and risk management challenges. One of many examples is the linking of a cloud-based client management system, ServiceNow, to Amazon wish lists by the Cajun Army following the Baton Rouge floods (2016) and Hurricane Harvey (2017). This allowed them to streamline public donations through the direct purchasing of needed equipment, which were delivered directly to worksites avoiding the need for the Cajun Army to receive and manage donations (Stone et al., 2019).

3.1.8. COVID-19 is having diverse and mixed impacts on volunteering in different settings (that research has documented so far).

As with other areas of social life, the COVID-19 pandemic is having a major impact on volunteering. A study commissioned by Volunteering Australia found that around two-thirds of people who formally volunteered prior to the COVID-19 pandemic had ceased volunteering during the pandemic, a loss of 12.2 million hours of work a week (Biddle & Gray, 2020). This study also found that negative mental health and wellbeing impacts of COVID-19 were lower for those who were able to continue volunteering. However, some international studies also identify COVID-19 related opportunities for change, renewal, and improvement in, particularly health service, volunteering and workforce management broadly (Bourgeault et al., 2020).

Emerging research on volunteering during COVID is revealing diverse and innovative responses by voluntary organisations and volunteers:

- Innovative use of social media and digital platforms to mobilise and coordinate both formal and informal volunteering within the restrictions of social distancing (e.g., Li, Chandra, Nie, & Fan, 2020),

- The importance of pre-existing networks, and the important role of volunteers in community service and non-government organisations that were not previously involved in crisis management, but which pivoted into crisis management to assist with the pandemic response. However, while enabling a redeployment of volunteer resources, this pivot into crisis response can also 'crowd out' other social issues (Miao, Schwarz, & Schwarz, 2021), and

- Studies of who has volunteered show varying results, which may stem from different infection patterns, contexts and policy responses in different countries. They include medical students in Ireland (Byrne, Gavin, & McNicholas, 2020), midlife volunteers in China (Miao, et al., 2021), and older volunteers and volunteers with mental and physical health conditions in the UK (Mak & Fancourt, 2020, p.9).

Additionally, as Lachance (2021) explains, "the relevance of virtual volunteering is ever-present within this intersection of the COVID-19 pandemic, and the prominence of technology in our contemporary times" (p.105). As well as presenting challenges, this intersection also presents a range of opportunities for

organisations to engage with both their current volunteers and new volunteers. These include transitioning some roles to virtual spaces and increasing accessibility of volunteering, breaking down geographical boundaries that prevent some people from volunteering, and increasing opportunities to engage individuals with disabilities, youth and older adults in volunteering.

3.2. POTENTIAL IMPLICATIONS

- These volunteering trends are closely intertwined with other external environmental shifts outlined in this report. These include demographic change, especially rural depopulation and ageing (O'Halloran & Davies, 2020) and youth migration to urban areas, as well as the changing structure of work (McLennan & Birch, 2005) and the development of new communications technology. Moreover, in regions of Australia where climate change is projected to increase the frequency and severity of natural hazards, there is likely to be an ever greater need for volunteers to respond to emergencies across longer periods of time and under more severe conditions, placing a greater burden on those that do (McLennan, 2019a).

- The declining rates of formal volunteering in recent years are a key source of concern for workforce planners and volunteer leaders in the emergency services, both of whom report growing difficulty to recruit and retain committed volunteers in many areas, and who expect this difficulty to grow further in future (McLennan, 2020). These pressures are not new however, having been experienced since the late 1990s.

- Mounting volunteer workloads are a persistent challenge that increases barriers to people's ongoing participation in emergency service volunteering as well as other forms of emergency volunteering. As Parkin (2008) concluded, "volunteer workload management must become a priority of Emergency Service Leaders if service delivery capability and capacity are to be maintained or, in some cases, delivered" (p.66). This issue has continued to intensify since this time and is particularly felt by the most experienced volunteers in leadership roles (O'Halloran & Davies, 2020).

- Due to the impacts of new communications technology, people have greater choice in how they volunteer to help in disaster management, including pathways that are less time intensive and demanding compared to formal emergency service volunteering. The need to understand various motivations for joining the emergency services, and to communicate the benefits and opportunities of emergency service volunteering clearly and accurately to a wider range of potential new volunteers is now more important than ever (e.g., Muhammad Farid et al., 2019; Kragt, et al., 2018).

- The importance of adapting volunteer strategies and management approaches in response to wider volunteering trends, and recognition that the approaches of the past will not serve organisations well into the future will become even more important over the next decade (e.g., McCullough, 2017; McLennan & Kruger, 2019; QFES, 2018; Victorian Volunteer Consultative Forum, 2015). Within this, greater flexibility in all aspects of emergency service volunteering, and the effective use of new technology to coordinate and engage volunteers are key areas.

- In the context of an ageing population, recruiting both younger and older volunteers will continue to be important for volunteer sustainability. Interestingly, there are strong similarities in the strategies recommended in research to attract these cohorts. Both younger and older cohorts are discouraged from volunteering by a lack of autonomy and an "increasingly regulatory organizational environment" (Warburton, 2010). Further, the availability of more flexible volunteering opportunities, an inclusive culture, and access to training and skills development are key focal areas for attracting these age groups to workplaces (Deloitte, 2018; Hansen & Slagsvold, 2020) and to volunteering (Warburton, 2010).

- The lower barriers to participation in disaster management and the prevalence of informal, spontaneous, and emergent forms of post-disaster volunteering, increases the need for more collaborative, networked coordination of disaster management (Kapucu, Yuldashev, & Feldheim, 2011; Moshtari & Gonçalves, 2017). Roth and Prior (2019, p.19) suggest this requires an "opening up" of disaster management systems that represents "no less than a paradigmatic change that incites wariness among many managers". They conclude that "Ultimately, professional disaster managers should aim to act less as administrators or commanders of resources, and more as enablers of the broad capacities that rest within society" (p.27).

- The following issues will challenge volunteer workforce managers in the future, and little is known about them:

  o How change agents can best bring the existing workforce, both volunteer and paid, along on the journey to adapting emergency service organisations to the changing nature of modern volunteering (but we do know that strong change leadership, shared learning, appropriate resourcing, balancing risk management with the need for change, and changing culture carefully are key enablers, see McLennan & Kruger, 2019)

  o Whether and how trends in digital volunteering will unfold in the context of Australian disaster management in the future. As Lachance (2021) highlights, while the COVID 19 pandemic has threatened traditional forms of volunteering, it has also opened up opportunities for organisations to harness the potential of digital, or virtual, volunteering.

  o The implications for the emergency services and for emergency coordination arising from potential future disruptions and breakthroughs in communications technology, particularly new platforms for self-organisation and coordination among emergent groups and informal volunteers.

  o Whether formal volunteering rates in Australia will continue to decline in future, stabilise or increase.

  o How longer-term impacts of COVID-19 on volunteering and volunteer management – both negative and positive – may impact on the emergency services.

3.3. RELATED RESEARCH

Out of uniform: Building community resilience through non-traditional emergency volunteering project (RMIT, BNHCRC)

- See https://www.bnhcrc.com.au/research/communityresilience
- "This project investigated current and emerging issues around volunteering and volunteers responding to disaster events, and the different factors that can influence people's participation in non-traditional emergency volunteering."

Emergency volunteering 2030 study (RMIT, BNHCRC)

- See https://www.bnhcrc.com.au/research/resilience-hazards/3533
- This study was part of the *Enabling sustainable emergency volunteering project.* It aimed to support the emergency management sector to adapt to the transformation of volunteering and put itself in the best position possible to enable and enhance the value of volunteering to communities – before, during, and after emergencies - into the future.

Enhancing volunteerism project (La Trobe Uni, BCRC)

- See https://www.bushfirecrc.com/projects/d3/enhancing-volunteerism
- "The Volunteerism project has provided fire services across Australia and New Zealand with information to help strategic planning and policy development concerning volunteer numbers and suggested new ways of recruiting and supporting volunteer workforces."

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4. PHYSICAL TECHNOLOGY

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In this report, we use the term 'physical technology' to encompass the tangible/physical forms of technological advancements related to materials, machines, assets and infrastructure (excluding computer hardware, see the following section) to differentiate from technology related to digital information. Technological developments are far-reaching and often, their impact on practice is very difficult to anticipate. In this review, we focus on four key types of technological developments that we anticipate will pose opportunities and challenges to the emergency management sector, while acknowledging that these four are not an exhaustive set.

4.1. KEY TRENDS AND DEVELOPMENTS

4.1.1. By 2030, Australian cities will need to accommodate the added pressure on critical infrastructure, such as buildings and communication infrastructure, stemming from growing population and increased density.

Critical infrastructure refers to assets that provide services "that are essential for everyday life such as energy, food, water, transport, communications, health and banking and finance" (Infrastructure Australia, 2019). Local road, regional rail, and regional water infrastructure are often maintained by local government bodies, who have limited and decreasing budgets to service and maintain them (Infrastructure Australia, 2019). Amidst increasing population, Australian infrastructure has struggled to keep pace with the demand (Infrastructure Australia, 2019). Paradoxically, due to international border closures linked to COVID-19, Australia's lower rates of population growth have also affected the rate of infrastructure investment. Given that Australia has relied on population growth to facilitate economic growth, there will likely be changes to previously planned infrastructure and communities spending (Remeikis, 2020). Nevertheless, by 2030, Australian cities will need to accommodate the added pressure of the general trend of growing population and density, with increasing city density placing more pressure on infrastructure.

Emergency services infrastructure includes fire and ambulance stations, and other state and local emergency response facilities, such as state emergency services. Infrastructure Australia reports "our emergency services infrastructure is not adapting to changes in the nature and rate of emergencies. Without action, emergency services infrastructure which is not fit-for-purpose for the changing nature of emergencies will reduce access to life-saving services, particularly in rural communities and remote areas" (p.64). Indeed, emergency service response times can be four times longer for regional and remote areas than in urban areas (Productivity Commission, 2019).

4.1.2. As telecommunication networks continue to evolve and expand in the upcoming decade, Australia will increasingly rely on a high-capacity communications network. Alongside liveability and productivity advantages are communications infrastructure challenges, such as cybersecurity risks, ensuring network coverage and quality in rural and remote Australia, and deploying sophisticated technologies reliant on good communications.

Telecommunications infrastructure has grown significantly since Australia's first telephone call was made in 1879. With the help of significant technological advancements, telecommunications infrastructure "covers the networks that carry voice and data between users across Australia, and our connections with the rest of the world, impacting on our liveability and productivity." (Australian Infrastructure Audit, 2019, p.556). Communications is now central to our lives at home and work, and Australia will increasingly rely on a high-capacity communications network as we expand on knowledge-based and service industries for prosperity (Madsen & Percy, 2020). When considered and implemented early in the planning process, communications technology can significantly improve the efficiency and liveability of cities. Of relevance to the emergency management sector are examples such as reducing transport pressures, more efficient and energy-smart infrastructures, and improved connectivity between services providers and customers. Currently however, there remains significant blackspots that impact emergency services' ability to communicate, which might require alternative solutions such as utilising a mesh of drone networks or high-altitude balloons. As telecommunication networks continues to evolve in the upcoming decade, some notable challenges identified in the Infrastructure Audit 2019 include:

- Relative to comparable nations, Australia's performance for fixed broadband speeds is poor. Failure to rapidly improve speeds limits the high levels of digital access required for efficient and reliable service delivery.

- Increased usage of interconnected digital services is accompanied by growing cybersecurity risks, such as data privacy and system resilience. Lowered user engagement with new services and reduced network efficiency are potential outcomes of failure to manage these risks.

- Poor mobile network coverage and quality remain significant issues in rural and remote Australia, causing a 'digital divide' between rural and urban areas (Leung, 2014; Marshall et al., 2020) and sparking more recent research into digital inclusion initiatives in Australian rural contexts (e.g., Dezuanni & Allan, 2017; Park, 2017; Warburton et al., 2014). Indeed, the Australian Communications Consumer Action Network raised concerns over rural and remote users having lower access to emergency communications, including on major roads.

- There is a prioritisation of mobile network upgrades in rural and remote areas where population densities are highest. However, this prioritisation creates gaps in crucial areas such as productive land (e.g., farms and stations) and along transport corridors. Failure to deliver services to these critical areas affects community safety, liveability, and productivity such as reduced efficiency in emergency management service delivery

(Marshall et al., 2020). Considerations to telecommunications network resilience is also important considering Australia's recent bushfire crisis, which exposed the vulnerability of phone and internet networks during severe disasters (Davis, 2020; Hunter & Samios, 2020)

- While Australia is well positioned to embrace 5G technology ahead of other nations, 5G networks require substantial new infrastructure, bringing with them costs, planning, and security challenges.

4.1.3. 3D printing/ additive manufacturing will transform the way we manufacture and serves as a key to developing sustainable and disaster resistant infrastructure and planning.

Additive manufacturing, colloquially known as 3D printing, technologies are transforming the way we manufacture, with many industry experts predicting that additive manufacturing will mature into a technology that integrates into existing manufacturing workflows (Petch, 2020). Additive manufacturing is a group of technologies that allows a machine to build an object by adding one layer of material at a time, through computer-aided design and a computer-guided laser, extruder, or printer head (National Intelligence Council, 2012). Additive manufacturing is being used to create models and for rapid prototyping largely in the automotive and aerospace industries (National Intelligence Council, 2012), with most academic studies being conducted in engineering (Ryan et al., 2017). It has been called a disruptive technology, with two distinctive characteristics facilitating this disruptive potential (Jiang et al., 2017): 1. It enables direct production of physical objects form digital design data and allows manufacturing of customised products without the high surpluses conventionally connected with one-of-a-kind manufacturing (Gibson et al., 2014), and 2. It allows private and industrial users to design and produce their own goods (Rayna & Striukova, 2016).

Many industries can benefit from the flexibility, speed, and customisation of additive manufacturing. The benefits of using 3D printing for disaster relief efforts have become increasingly apparent more recently (Boissonneault, 2018). In particular, 3D printing technologies are useful in increasing efficiencies in the humanitarian air supply chain, and the use of this technology is emerging as a key to developing sustainable and disaster resistant infrastructure and planning (Corsini et al., 2020; Rodriguez & Beltagui, 2018; Saripalle et al., 2016). Examples include:

- Field Ready's water pipe fittings and washers created using 3D printing to rebuild infrastructure more efficiently after the severe earthquake in Nepal in April 2015,

- 3D printed drones (e.g., X VEIN) built for rapid search and rescue missions during disaster relief, and

- Rebuilding homes in a cost, time, and labour effective manner by construction 3D printing companies.

4.1.4. The field of robotics encompassing autonomous vehicles and drones are increasingly prevalent and sophisticated. As hardware continues to advance alongside real-time mapping algorithms, the field of robotics can provide further opportunities for disaster monitoring and aid supply.

Automated, or autonomous vehicles are vehicles with the capability to sense their environment and move without human input. Examples of these include self-driving cars, driverless trains, and autonomous mine trucks. These vehicles use sensors to interpret their surroundings and navigate around them and are transforming industries, such as agriculture and farming. Advances in autonomous machinery aim to remove human labour from repetitive tasks that require long hours in the driver's seat. Drones also fall under this category of robotic technology. They are unmanned vehicles that are navigated remotely using GPS tracking systems and can be useful in disaster scenes; for example, preliminary research shows that unmanned aerial vehicles can outpace ground-based rescue teams in locating isolated survivors. Additionally, they are flown remotely and as such, pose no physical and immediate danger to the flight crew.

4.1.5. Nanotechnology and material science have the potential to improve community resilience particularly in the areas of building materials, sensors, and medicine.

Nanotechnology is a "collective term for a range of technologies, techniques and processes that involve the manipulation of matter at the nanoscale – the size ranges from approximately 1 nanometre (nm = one millionth of a millimetre) to 100 nm … The term nanotechnology describes the technologies used to create, manipulate and characterise matter and processes at the nanoscale" (Australian Office of Nanotechnology, 2008 cited in Australian Academy of Science, 2009, p.5).

Nanotechnology is an emerging technology in which implications are varied, spreading across health, the environment, and industrial manufacturing (Australian Academy of Science, 2009). While nanotechnology and material science research specific to emergency management has been relatively scant, scholars suggest that it has the potential to improve community resilience particularly with respect to building materials, sensors, and medicine. As Nichols (2015) noted:

> *Applications of nanotechnology to building materials include the development of concrete that is stronger and would require less steel-reinforcement, thus making safer buildings, dams, and bridges. In regard to sensors, nanotechnology could be used to develop detection systems that could sense trace amounts of chemical and biological agents before they reached lethal concentrations and could lead to earlier evacuations of residents. Medical applications of nanotechnology include improvements in rapid diagnostics and vaccines that would improve public health decision-making and reduce the spread of disease. Stronger infrastructure, early warning, and better medical response have the potential to significantly reduce injuries, illness, and deaths. The integration of nanotechnology into the disaster management cycle, particularly in the pre-disaster phase, could revolutionize how disasters are managed and how community resilience can be strengthened.*

4.1.6. Advances in technology in the form of wearable devices are envisioned to increase user safety and may increasingly serve as a form of personal protective equipment (PPE).

Fatigue, physical, and mental strain are becoming increasing concerns for many workers, such as healthcare, mining, manufacturing, and the emergency service workforce (see the *Changing Work Literature Review*: Managing Mental Health and Wellbeing). Wearable devices that can track users' movements and health indicators, such as smartwatches, are becoming increasingly sophisticated through the 'Internet of Things' (discussed in the next section titled 'Digital Technology). Furthermore, devices such as exoskeletons or exosuits are increasingly being considered to help ease users' physical strain when workers are fatigued and can engage with workers' bodies to enhance their strength. Exoskeletons are wearable devices that can be powered or unpowered and augments a human's strength and/or capabilities through embedded smart technology and sensors (NIU, 2020). Many are designed to relieve muscular stress for workers, decrease injury prevention (Butler & Gillette, 2019) and have the potential to increase safety in the workplace.

4.2. POTENTIAL IMPLICATIONS

- Ageing infrastructure and underinvestment in maintenance are likely to impact the reliability of services. Gissing et al. (2018) highlighted that local road, regional rail, and regional water infrastructure are of most concern. Importantly, infrastructure planning and maintenance are critical considerations in the context of improving resilience against natural hazards (Infrastructure Australia, 2015).

- Growing cybersecurity risks associated with increased usage of interconnected digital services will require capability within the emergency services, such that they are prepared to identify and respond to consequences arising from network hacking and disruptions with critical infrastructure.

- The deployment of 3D printing technologies to areas impacted by disasters should provide opportunities to fast-track repairs of essential infrastructure and remove logistical issues that may rely on overseas suppliers.

- Trends in agriculture such as mechanisation, enhanced productivity, and a declining workforce is likely to lead to large, asset-laden farms with few people available for protection during an emergency (Foster et al., 2013). This demographic-related by-product brought about by such advances in machinery (e.g., autonomous farming) may present challenges for emergency service organisations with regards to access to human resources during an emergency.

- Challenges associated with autonomous drones/ vehicles: communication between first responders and a command centre may be obstructed by damaged or overloaded network infrastructure. Ensuring autonomous vehicles operate safely and reliably particularly in populated areas will be crucial (National Intelligence Council, 2012).

- Autonomous vehicle technology may transform many aspects of disaster management (Gissing et al. 2018). For example, drones are currently being used to collect data and inform search and rescue operations and, in the future, networks of firefighting drones may be able to work together to detect and extinguish fires. Unmanned or automated vehicles may help optimise mass evacuations by vehicles, transport relief supplies (e.g., JD's autonomous delivery robot delivers medical supplies to a hospital in Wuhan during the coronavirus pandemic and minimises human-to-human contact; Yang and Liu, 20220), and transporting injured individuals thereby reducing demands for human resources. Drones can be used post-fire in disaster management to survey or map scenes to assess damages or to search and locate missing people. As drones become smaller and more affordable, they are likely to become a standard piece of equipment to assist emergency responders (Gissing et al. 2018).

- Exoskeletons enable workers to exert more force than normal (i.e., "make them stronger"), or reduces the strength exertions required to perform a task (i.e. "lighten the load"). Advances in wearable exoskeletons may show promise and success in enhancing emergency service workplace ergonomic issues, including injury prevention and reducing the time injured employees are out of work (Forbes, 2019). However, more research is needed in this area to identify whether this technology is an effective workplace ergonomic intervention for the emergency services in particular (Budnick and Walsh, 2020; Howard et al., 2020).

4.3. RELATED RESEARCH

Built environment research cluster (BNH CRC)

- See https://www.bnhcrc.com.au/research/cluster/built-environment
- "Our research objectives are the establishment of an understanding of the vulnerability of buildings and key infrastructure that is consistent and comparable across a range of natural hazards."
- Projects in this cluster:
  - Cost-effective mitigation strategy for building related earthquake risk (University of Adelaide)
  - Cost-effective mitigation strategy for flood prone buildings (GeoScience Australia)
  - Enhancing resilience of critical road infrastructure (RMIT University)
  - Improving the resilience of existing housing to severe wind events (James Cook University)
  - Natural hazard exposure information modelling framework (GeoScience Australia)

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5. DIGITAL TECHNOLOGY

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The current phase in human history, often referred to as the "fourth industrial revolution" or "information era", is characterised by digital transformation. Rapidly evolving technology has advanced our world at an exponential pace and is expected to continue in the 2020s. Digital technology refers to "all electrical devices which make use of information represented in digital form – such as binary code – to perform useful functions" (Hajkowicz & Dawson, 2019). Computers, robots, smartphones, software, and sensory systems are examples of digital technologies and demands for interoperable equipment and technologies will only increase in the future. A report produced by US National Academy of Science stated that "IT provides capabilities that can help people grasp the dynamic realities of a disaster more clearly and help them formulate better decisions more quickly". Advancement in technology offers new opportunities for the sector to deal with myriad complex challenges but may also create new types of challenges that can overwhelm decision makers and are important to consider. The section below highlights key emerging technologies set to transform Australia. It may be noteworthy that, given the rapid and future-focused nature of technological advancements, most information available for review was sourced from industry publications, rather than academic outputs. While, as with physical technology, digital technological changes are pervasive, with unknown impacts, below, six advancements in digital technology were identified that appear likely to progress and likely to impact the emergency service workforce of 2030 and beyond.

5.1. KEY TRENDS AND DEVELOPMENTS

5.1.1. Advanced development in computing creates new possibilities and new ways to approach problems that previous computing power have difficulties performing.

The tablets and smartphones of today are as powerful as desktop computers were a decade ago. Quantum computing, based on the laws of quantum mechanics, is redefining the way computing operates in the future, and giving unprecedented levels of computing power (Australian Infrastructure Audit, 2019). Quantum computing, with its capacity to accommodate huge volumes of rich data and complete predictive modelling substantially faster, is likely to change the way and extent to which data are incorporated into decision making in emergency management. For example, quantum computing models may enable the improved accuracy of models used to track climate change and its effects, or the early prediction and detection of fires and storms. This rapid growth of computing power, along with declining costs, act as a key enabler for complex analyses, data management, global communication, and early forms of artificial intelligence. While the prospects of quantum computing are exciting, quantum computing experts do not anticipate them to completely replace what classical computers can do in the immediate future, but rather be used to

accelerate advanced problem-solving capacities. As such, the implications of quantum computing are likely to become pertinent towards the end of this decade.

5.1.2. Artificial intelligence and machine learning can mimic human intelligence skills to make complex decisions and perform tasks autonomously.

Artificial intelligence refers to any human-like intelligence exhibited by a computer, robot, or other machines (IBM, 2020) and is a subfield of digital technology that is witnessing rapid growth. For example, PwC (2019) suggests that AI could be worth AU$22.17 trillion for the global economy by 2030. Artificial intelligence enables computers and machines to mimic the perception, learning, problem-solving, and decision-making capabilities of the human mind. Machines can also learn from past mistakes and automate complex decisions based on big data. Common examples of artificial intelligence applications that are currently used include speech recognition technology, natural language processing (e.g., digital assistants Siri or Alexa), image recognition, real-time recommendations on websites, virus and spam prevention, automated stock trading, ride-share services, household robots, and autopilot technology (IBM, 2020).

5.1.3. The Internet of Things and advancements in 5G mobile technology will provide faster and more simultaneous connections for people, everyday objects, and infrastructure.

The 'internet of things' refers to integration of computing, networking, and sensors into objects that were previously unconnected, making everyday objects "smarter". For example, we now have more interconnected and smart devices: smart phones, watches, TVs, lighting that can be controlled remotely or set to turn off and on at certain times. Smart watches and other devices can form wearable devices that can track movement and health indicators too. The internet of things transforms processes and systems in businesses by embedding internet-connected sensors and regulators in equipment that can monitor and regulate (e.g., diagnose, repair, and maintain) operations and output (Scully-Russ & Torraco, 2020). In relation to infrastructure, the ability to connect assets and networks through the internet can help with predictive and on-demand maintenance or replacements of infrastructure assets and networks). Furthermore, advancements in 5G mobile technology will provide access to faster network speeds, lower latency, and more simultaneous connections than current 3G and 4G networks available in Australia today (Australian Infrastructure Audit, 2019).

5.1.4. Social media use continues to expand rapidly as a means of staying connected as well as receiving and sharing information. Combined with mobile and geolocation technology it has also enabled crowdsourcing of data via the public and the use of volunteered geographic information in disaster management (VGI).

Social media is a group of internet-based applications that allow the creation and exchange of user generated content, platforms such as Facebook,

Youtube, Instagram, and SnapChat are examples. For many, and made possible through mobile technology, social media is a key way of staying connected with family, friends, and their wider community. The growing use of social media also means that these platforms are an important 'go to' source of information and communication channel for many Australians, including during emergencies (Hayes et al., 2019). As a response, organisations continue to develop increasingly sophisticated social media or digital marketing capability as a means to communicate and interact with the broader community or their clients.

Combined with mobile and geolocation technology, social media also opens doors to the use of volunteered and crowdsourced geographic information. As Haworth and Bruce explain in a review of VGI for disaster management: "new opportunities for the creation and dissemination of important disaster-related geographic data from a dense network of intelligent observers are now provided through online user-generated geospatial data termed volunteered geographic information (VGI)" (p.237). Crowdsourced maps using VGI can be more up-to-date and comprehensive than official maps (Haworth and Bruce, 2015). The massive response of digital volunteers to the 2010 Haiti earthquake is a key example of this that opened the door on digital humanitarianism that is truly global in reach (Zook et al., 2010).

5.1.5. In an increasingly data-driven world, organisations that focus on obtaining and interpreting data to boost functioning are likely to have a competitive advantage.

Digital connectivity is generating more data than ever before, and the operations of many businesses in a wide variety of industries are increasingly becoming data science operations and driven by data. Operations are increasingly focusing on obtaining, screening, analysing, and interpreting data with intelligent algorithms to boost functioning and make wise choices. Indeed, employment statistics reveal the importance of data to organisations and industries. In Australia, the number of jobs in data science and informatics are exponentially increasing. There is little doubt that organisations of 2030 and in the future will be much more heavily reliant on data collection and analyses.

Related to the internet of things and increasingly data-driven world is cloud technology. Cloud technology minimises the need for local processing power and resources by allowing the movement of data processing or storage service to the Internet (Scully-Russ & Torraco, 2020). Such improvements in technology have greatly improved workers' access to a broad range of real-time information and increased the analytical capacity of knowledge workers. In their integrative review, Scully-Russ and Torraco (2020) suggest that the cloud will be responsible for sorting, storing, retrieving, and delivering large volumes of detailed information in the future.

5.1.6. Advancements in virtual and augmented reality are making headway in digital education by creating more immersive and engaging experiences for users.

The lines between real and digital worlds are becoming more blurred with technological advancements in virtual and augmented reality. Using computer modelling, virtual reality technology creates an immersive artificial version of real

or an imagined life. Augmented reality extends the real world to the digital world by overlaying computer-generated enhancements to a real space or network. These technologies can create more immersive and engaging experiences for people, such as providing virtual copies of products and ecosystems where consumers are able to tweak details without having to touch the actual system. For example, smartphone apps now allow customers to digitally 'place' new furniture or appliances into a room in their home, and there is an increase adoption of digital education that make use of more advanced technologies, such as gamification, virtual and augmented reality to enhance learning experiences (Australian Infrastructure Audit, 2019).

5.1.7. As communications advances alongside mapping and remote sensing technology, real-time data handling will increase alongside a demand for data specialists to turn raw data into interpretable and relevant information.

The widespread adoption of mapping and navigation applications by users around the world has transformed the remote sensing industry over the years. The evolution in mapping and remote sensing can be primarily attributed to technological advancements in remote sensing industry as well as critical technologies such as increased computing power, mobile technology adoption, efficient distributed computing and dissemination, and advance pattern recognition technologies from imaging, machine learning, and more. Remote sensing consists of a variety of platforms ranging from space-borne (e.g., satellites), airborne (e.g., aerials, drones), and ground-based (e.g., terrestrial sensors). There is also a growth in dynamic intelligence and population mapping, for example using mobile phone tracking to analyse population movements, which in turn provide a better view of the community's exposure to different hazards (Deville et al., 2014; Lai et al., 2019).

Over the last few decades, remote sensing techniques have improved the identification of active fire locations, facilitated the prediction of fuel loads, and monitored post-fire impacts on the environment. Advances in technology has facilitated the development of new experimental satellite sensing systems to overcome limitations in current systems, such as detecting small, low intensity fires and forecast their impacts (Jones et al., 2017), but also other predictive services such as tsunamic early-warning systems. As volumes and speeds of data handling continue to increase, the gap between remote observation (taking images from satellite) and receiving information at the hands of end users is decreasing. This ability to move into near real-time data handling will continue to expand over the near future, increasing our ability to turn raw signal data into images that can be translated into information that is relevant to a particular natural disaster more efficiently. Continued advances in accuracy and detail in data obtained will also be useful for land planning and monitoring purposes, such as for fuel reduction and asset protection.

5.2. POTENTIAL IMPLICATIONS

- Researchers and practitioners have long discussed the risks of professions being automated by computers and robots in the coming years. While some jobs may disappear, most jobs are being impacted and reshaped by

technology. New jobs are also being created because of technological advancements. In a nutshell, digital technology is reinventing the workplace and the workforce of the future. As discussed in the 'Changing Nature of Work' section, the working landscape, including the emergency service workforce, will likely emphasise adaptability, flexibility, people and technical skills, and the ability to learn as key skills of the future.

- Currently, data specialists are difficult to find, and not enough specialists are being trained to meet vacancies requiring advanced skills (Miller & Hughes, 2017). In a review of AI in talent acquisition, Albert (2019) noted that organisations typically adopting AI-tools tend to be larger, technology-focussed, and innovative firms. As emergency services further relies on digital technology, the field is faced with fierce competition with other firms to recruit and retain staff skilled in AI, machine learning, and other data analysis skills required for the future.

- Advances in digital technology including remote sensing, data processing and communication platforms will continue to support the provision of ever more capable bushfire predictive services. Emergency service organisations will need to contend with a range of flow-on issues raised by the increase in modelling capability, as well as inherent limitations. These include, for example (see Neale and May, 2018; 2020):

  o Ensuring the validity of models, e.g., for extreme conditions, in diverse conditions etc.

  o new skills and training needs for FBANS (Fire Behaviour Analysts) in both the 'science and art' of forecasting,

  o changes in incident management and operational processes arising from access to faster and more powerful predictive capabilities (e.g., for undertaking and justifying planned burns, use of fire behaviour models by incident controllers),

  o effective communication of uncertainty to communities and other stakeholders, and

  o the potential for community expectations of public warnings to increase, or forecasting information to be misinterpreted,

  o potential for a legal liability to arise regarding 'duty of care' and use of predictive data for risk mitigation, e.g., in planning schemes (Stickley et al., 2016)

- New opportunities for flood prediction are also being identified from new technology. These include, for example, IoT architecture to improve sensing of hydrological data (Khalaf et al., 2020), and the use of crowdsourced water level observations in hydrological models to improve flood predictions (Mazzoleni et al., 2017).

- Against an increasingly data-driven world, and as a practical tip for ESOs to be able to make use of data to track KPIs and strengthen their workforce in the future, some data that could be worth tracking include:

o Applicant pool details at recruitment and selection, such as age, gender, ethnic diversity of applicants and those who are successful

o New members' onboarding and training experiences

o Employee work experiences relevant to pressing issues, such as age diversity climate

o Employee turnover data, including reasons why they leave

This issue is also associated with the capability of emergency service personnel to effectively interpret more complex and larger volumes of information in real time.

- While there are many opportunities to make better use of data and translate this into information and knowledge, an ongoing challenge for emergency service organisations may be the associated issues of knowledge management and organisational learning (see Owen et al., 2020). ESOs will also need to account for the capability of practitioners to effectively interpret more complex and larger volumes of information. In some cases, this capability may come from new forms of partnership. For example, skilled volunteer-based Virtual Operations Support Teams (VOST) have proven effective in managing the data deluge that accompanies large-scale disaster events (see Roth and Prior, 2019).

- Newer and affordable technology is making it simpler for organisations to use virtual, augmented or mixed reality environments to support various aspects of training, development, and skills maintenance. These platforms can offer the opportunity to simulate environments that otherwise would be considered too high risk and offer potential cost savings for ESOs. These technologies, alongside developments in the NBN and online learning platforms, also allow ESOs to provide improved learning opportunities to more remotely located personnel or personnel that may have other work or family-related responsibilities that would otherwise preclude their involvement in training.

- Emergency preparedness is a promising application for 'serious games' as a way to increase attention to and understanding of preparedness communications (Chittaro & Sioni, 2015). A serious game is "a game designed with a purpose of educating or training the user in specific domain, namely in disaster management" (Simões-Marques et al., 2020). Serious games development is also closely related with the development of mixed reality applications (i.e., augmented and/or virtual reality) and multimodal systems. These applications allow users to immerse in a virtual world while augmented reality overlays digital information onto a realistic images of the physical world (Simões-Marques, 2017). With its potential to reach diverse audiences (adults, children, experts, and communities) while realistically simulating disasters, serious games may assist the sector in awareness raising, identifying hazards, undertaking preventative actions, empathy triggering, and perspective taking when used effectively (Solinska-Nowak et al., 2018).

- ESOs could leverage advanced technology to provide 24/7 oversight and intelligence of emergency events and disasters. The Infrastructure Australia report noted: digital communication networks are enabling early warning services for major disasters or events. Technology has also helped to improve

the mobilisation and coordination of emergency services, particularly volunteers, and enabled centralised management of emergency response. An example of such adoption is NSW's Critical Communications Enhancement Program, which aims to consolidate a large number of radio networks owned and operated by various agencies to facilitate more streamlined communications and coordinated responses between emergency services agencies (NSW Government Telco Authority 2019, n.d.).

- Wearable technology in the forms of smartwatches, jackets, head mounts made available through IoT, and that are equipped with sensors can help monitor a first responder's vitals. They can also monitor and alert any excessive physical strain and stress while on the job (Sims, 2019).

- Related to the note above, the IoT, 5G, and wearable technology clearly offer many potential opportunities for ESOs. However, some of the potential developments using IoT may rely on other parties investing in new technology (e.g., businesses and householders). In the case of 5G, this is likely to be most relevant for the more built-up areas of each state given the infrastructure requirements. There is also potential to bundle these technologies, for example, emergency responder vehicles are tracked to an incident, they receive live IoT sourced information from the alarm and security systems of the home or business they are attending (e.g., the smoke or heat is in the back office), and responders wear trackers and bio-monitors that can be provide real time information on their health status and location.

- Advances and increased use of social media platforms provides the public with additional information and empowers them to make decisions and to collaborate (Gissing et al., 2018). Some ESOs are also increasingly using these tools to target specific and harder to reach parts of the community (see Hayes et al., 2019). This is associated with workforce capability implications too, given the competition for a limited pool of digital marketing talent with for-profit and other organisations. ESOs must also take into account the evolving landscape of social media use. Currently, ESOs vary in their capabilities to use social media effectively and tend to emphasise the need for providing sound albeit more generic information. In contrast, community members tend to seek information that is more contextualised to their own needs (Hayes et al., 2019).

- Social media also has far-reaching implications for recruiting and brand management strategies, for mobilising and coordinating volunteering outside of formal organisational settings, and as a platform for digital or virtual volunteering.

- Social media's capacity to gather and share vast amounts of personalised and geolocated data is also potentially useful for incident intelligence (Gissing et al., 2018). For example, Snap Chat's 'snap map' function allows geo-located mapping of impacts from user's postings (Epstein, 2017), Facebook's 'safety check' function enables people to register their safety during a disaster or event, and Google's Person Finder application. In addition to notifying others about real-time situations and safety, these technologies may also assist in notifying official emergency management personnel of hazardous areas and freeing up communication networks

(Karsten and West, 2016). However, researchers have cautioned against heavily relying on social media given their vulnerabilities to disruption, therefore the public should be prepared to utilise alternate methods of communication.

- It is important however, that all new technologies for possible use within the emergency service context should be carefully examined to determine their relevance, robustness, and longevity. As the Review of the National Triple Zero (000) Operator report noted: "Using individual technologies for purposes other than for which they were created can sometimes provide unanticipated benefits, but they are not always suitable or robust enough for use within the Triple Zero context (for example, social media platforms do not offer message prioritisation or guarantee messages are received, nor do they allow the identity or location of users to be easily validated)." (p.18)

- Related to the above point, the 'Robodebt' scandal in Australia serves as a warning against poor and inappropriate use of automation by government organisations, which has potential in extreme cases to harm relationships with communities and undermine public trust (Braithwaite 2020).

- In considering the future use of digital technology for situational awareness, communication etc, ESOs also need to be mindful of implications arising from the 'digital divide' that exists between those with access to information via digital technology and those without (Haworth and Bruce, 2015).

- As infrastructure networks increase in complexity and interdependence, and the internet-of-things grows, unexpected risks and cascading impacts of failure will likely accompany (Boin & 't Hart, 2010). Greater reliance on technologies and their interdependencies also increases vulnerability to threats such as solar storms and cyber-attacks. As such, a broader systems approach is needed rather than to examine individual operators in isolation to reduce impacts if infrastructure that new technologies rely upon is disrupted (Gissing et al., 2018).

- As mapping and remote sensing technology continues to advance, ESOs can benefit from the shorter and more real-time reception of data. However, to be able to interpret the data and to use it effectively, ESOs need a workforce that is not only able to understand imaging and sensing, but also computer science and engineering competencies to optimise how to process data from satellite images to useful and digestible information for application such as fire detection, fuel management, and effects of fires and other emergencies. Such expertise may also be complemented by artificial intelligence for analysis. As such, computer scientists and data science skills will likely become more critical in the future.

5.3. RELATED RESEARCH

Bushfire predictive services research cluster (BNH CRC),

- See https://www.bnhcrc.com.au/research/cluster/bushfire-predictive-services

Communication and warnings & Sustainable volunteering research clusters (BNH CRC)

- See https://www.bnhcrc.com.au/research/cluster/communications-warnings
- See https://www.bnhcrc.com.au/research/cluster/sustainable-volunteering
- A range of student projects under these research clusters examine implications and opportunities associated with new communications technology.

Closing the research-practice gap (University of Tasmania, BNHCRC)

- See https://www.bnhcrc.com.au/resources/poster/7716

iFire and Burning landscapes: reimagining unpredictable scenarios projects (University of NSW),
- See http://www.icinema.unsw.edu.au/projects/ifire/project-overview/
- "The Project aims to transform the traditional artistic paradigm of visualisation as the human-centred depiction of predictable events by harnessing revolutionary advances in art and technology."

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6. SHIFTING EXPECTATIONS

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Shifting expectations is something of a 'mega theme' cutting across discourses about government, public administration, the voluntary sector, and emergency management in Australia today. 'Great expectations' is one of seven global megatrends tracked by CSIRO Futures (Hajkowicz, Cook, & Littleboy, 2012), with implications for future planning and investment in government and industry in Australia (CSIRO Futures, 2016). They describe it as a fundamental "consumer, societal, demographic and cultural megatrend" associated with rising wealth; demands for personalised, instantaneous, and targeted services; and experiences valued over goods.[2]

It is not only public expectations of government that are changing, however. They are one part of a generational shift in relationships between civil society (i.e., the voluntary, non-profit or community sector), the state (i.e., governments) and the private sector, with the boundaries between these spheres becoming more fluid and increasingly blurred. Significantly, these relationships are contested, complex and in flux in Australia, with an unclear trajectory ahead.

This situation has significant implications for how the emergency services are expected to function within Australian society and what they can achieve, and therefore their future workforce capability needs (AFAC, 2016, p.3). This section therefore outlines major themes in research regarding changing public expectations of wider government and the public sector, shifts in public service delivery, and changing government expectations of civil society, the voluntary sector, and volunteers.

6.1. KEY TRENDS AND DEVELOPMENTS

6.1.1. Satisfaction with services delivered by state/territory public sectors has broadly remained the same or increased; however, public trust in government is at an all-time low.

There is relatively little empirical, academic research about what the Australian public actually expects of governments and the public sector, or about how expectations have actually changed. However, an annual multi-jurisdictional customer satisfaction measurement survey is conducted for state public sectors that does provide a measure of whether expectations of public services are being met (including NSW, Vic, Qld and SA). Overall, the latest results available from this survey show either no change or increases in customer satisfaction compared to previous surveys (e.g. NSW Government, 2019; South Australian Government, 2020). The qualitative data for NSW also suggested that "trust can

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[2] Changing expectations of work and volunteering are also interconnected with this 'megatrend', see more on these in sections 2 (changing nature of work) and 3 (Changes in volunteering).

be built when consumer's existing expectations of staff and services are exceeded. The specific expectations which drive trust include having competent staff, secure handling of sensitive information, transparent processes, consistency of service and information and adherence to government rules and regulations" (NSW Government, 2019, p.14).

At the same time, however, there is rather damning evidence of the low levels of trust and confidence that the Australian public has in government overall. The 2019 Australian Election Study found that "trust in government has reached its lowest level on record, with just 25% believing people in government can be trusted" (Cameron & McAllister, 2019). Similarly, a national survey in 2018 found that "levels of trust in government and politicians in Australia are at their lowest levels since time series data has been available" (Stoker, Evans, & Halupka, 2018, p.9). Similar trends are evident globally (Edelman Trust Barometer, 2020).

There is also a growing division between an 'informed public' (e.g., well educated, wealthier, engaged politically) who continue to trust government, and the 'mass population', who continue to distrust government. In 2020, the gap between these two groups in Australia (e.g., 'trust inequality') was reported in one study to be the widest in the world (Edelman Trust Barometer, 2020).

6.1.2. Public service delivery and public administration are likely to look very different in the future; while exactly how is not yet clear, trends are towards greater collaboration and personalisation.

The way public services are delivered in Australia at both federal and state levels are in transition, with changes in public expectations being a key driver. A report into the future of the Australian Public Service (APS) commissioned by the Australian Government describes changing public expectations of "the role of the APS, how it functions, how it engages with the Australian public, and the transparency and visibility of its operations" that have "potential to shift the role government plays in meeting public needs" (Boston Consulting Group, 2018).

Due to the nature of federal and state/territory governance arrangements in Australia, it can be difficult to trace out clear lines of reform and change in public administration and public service delivery (Macaulay, 2020). However, like many other Western democratic countries, Australia has been heavily influenced by the ideas of New Public Management (NPM) since the late 1970s (Podger, 2017). NPM, also known in Australia as 'managerialism', centres on applying private sector management approaches to the public sector based on efficiency and effectiveness goals. These approaches include increased competition and 'performance motivated administration', 'contracting out' services to the private and voluntary sectors, 'contracting in' advice via private sector consultants (McGann, Blomkamp, & Lewis, 2018) and positioning citizens as customers (O'Flynn, 2007).

More recently, recognition of mixed results and limitations of managerialism and corporatisation in the public sector have delivered public administration into a new, hybrid phase in which the future directions are not yet completely clear. However, modifications to NPM approaches are underway, which have been labelled as New Public Governance (Podger, 2017). These include an emerging focus on creating public value, which is described as 'what is valued and good

for the public', and as "citizens' collective expectations in respect to government and public services" (Twizeyimana & Andersson, 2019, p.167). Key attributes associated with NPG approaches in Australia are "wider use of networks across and beyond government; partnerships involving collaboration and not just competition and strict purchaser/provider; horizontal rather than vertical management (the Australian term is whole-of-government); downward and outward accountability as well as upward accountability; and increased interest in addressing complex problems such as social exclusion, environmental concerns, and Indigenous well-being" (Podger, 2017, p.112).

Many aspects of public service delivery are being recast and reimagined because of this shift. Key examples are approaches to innovation and personalisation of services. NPM approaches emphasise innovation to promote competition, increase efficiency and to confront complex, multifaceted problems with evidence-based policy and design thinking (McGann, et al., 2018). Under the influence of NPG, however, innovation is increasingly linked with a focus on public value, positioning public managers as "orchestrators of networked interaction and mutual learning: acting as conveners, stewards, and catalysts of collaborative innovation" (Crosby, 't Hart, & Torfing, 2017, p.656). Meanwhile, personalisation is expected to shift "from citizen relationship management to citizen-managed relationships", which goes "well beyond citizen centric services, or whole-of-government approaches to service delivery and gravitates toward whole-of-life service delivery" (Kowalkiewicz & Dootson, 2019, p.11).

6.1.3. Deeper community participation and the coproduction of public services are clear trends, but they are also accompanied by the growing, and much critiqued, 'responsibilisation' of citizens and civil society.

A key trend within the changing public administration terrain, is an increasing focus on deeper public participation in decision-making and citizen-centric public service delivery (Althaus & McGregor, 2019; B. Holmes, 2011; Lindquist, 2013). This includes the coproduction of service delivery through collaborative arrangements. Public services are coproduced "when citizens or other civil society actors are directly and actively involved in the production or execution phase of public policy through the design and delivery of public services at the level of specific programmes" (McLennan, Whittaker, Kruger, & Handmer, 2020). As Alford (2009) notes, "it is not only clients who can engage in co-production with a public sector organisation. So too can volunteers, private firms, other agencies at difference levels of government, community organisations, and friends, relatives or neighbours of clients" (p.15).

There has been a huge growth in research and government interest in coproduction internationally in recent years (Loeffler, 2021). "In essence, the government at all levels, increasingly recognizes that it cannot deliver all services and policies on its own and sometimes needs the help of the whole community to be effective" (Velotti & Murphy, 2020). Various forms of coproduction and collaboration have been implemented in Australia, with individual coproduction (e.g., preparing your own property for the fire season) being more common than

collective (e.g., participating in community-based emergency planning) (Alford & Yates, 2015).

Importantly, public participation and citizen-centric efforts by governments are also commonly critiqued in governance and civic engagement research for failing to adequately redistribute power and an inattention to structural limitations to individual and community capacities (e.g., Arnstein 1969). Of particular relevance to emergency management given its emphasis on shared responsibility, is a strong critique from governance research of the increasing 'responsibilisation' of citizens and civil society in Western democratic countries, including in risk management. As McLennan and Handmer (2013) summarise: "the responsibilities of government and non-government sectors are being fundamentally reconfigured in risk management under the shifting social, political, economic, environmental and technological conditions found in modern democratic societies. […] A dominant trend associated with this has been the shifting of responsibility away from government and towards those at-risk—either rhetorically or in practice. This shift is criticized for overemphasising the responsibilities of those at-risk and under-emphasising the responsibilities of those parties able to influence social structures that shape risk."

6.1.4. It is unclear whether current government expectations of the voluntary sector and volunteers to deliver services can be realised into the future, especially in ageing and declining rural communities.

The shifting relationship between government and civil society, and the associated changes in public administration approaches have had significant impact on the voluntary sector in Australia. There is wide consensus in civil society and volunteerism research that government expectations of volunteer-involving organisations and volunteers in Western democratic countries around the world has risen substantially over the last two to three decades. As Rochester, Paine, Howlett, and Zimmeck (2010, p.1) state, "while voluntary action has been a consistent feature of most societies the current weight of expectation about the contribution it can make to individual development, social cohesion and addressing social need has never been greater, and it has a more prominent place on the agenda of public policy than ever before".

Australian volunteerism researchers have for some time carefully watched and documented "the shift in expectations of volunteers and volunteer-based organisations" (Oppenheimer & Warburton, 2014, p.2) In particular, governments have withdrawn from direct government delivery of services over the last 20 years, resulting in a "shift of public service responsibilities onto third sector organisations, and a push towards more efficient service delivery" (Brueckner, Holmes, & Pick, 2017, p.30). This has intensified government involvement in, and oversight of, the voluntary sector through "a raft of policies such as governance, risk management and workplace controls" (Oppenheimer & Warburton, 2014, p.2), leading to rising compliance and administrative demands under tightly contracted relationships (Warburton, Smith-Merry, & Michaels, 2013).

In this context, there is greater demand on volunteers to deliver a larger portion of community services, and many volunteer-involving organisations report having fewer volunteers than they need and difficulty recruiting (Volunteering Australia, 2016). The retraction in government delivered services has been most

significant in rural areas where "it is not considered cost effective for the public sector to deliver services, the market is not interested and the local third sector is expected to take up the slack" (Winterton and Warburton, 2014, p.181). In rural communities where rates of volunteering are already high, and where ageing and depopulation are occurring, this sets up some potentially significant challenges for volunteer, and indeed community sustainability (K. Holmes, Davies, Lockstone-Binney, O'Halloran, & Ong, 2019; Oppenheimer & Warburton, 2014, p.2).

6.1.5. The extent, composition, skills, and capacities of the public sector workforce will look different in the future compared to today.

The shifts outlined above are linked with calls to re-imagine the extent, composition, and skills and capacities of the public sector workforce over the next decade. Regarding the extent and composition of this workforce, this will likely shift due to both a broader conception of this workforce as well as changes in how 'talent' is engaged. The trends towards greater collaboration and networking, as well as coproduction of public services, not to mention community resilience and shared responsibility in the emergency management sphere, all lead towards greater awareness of, and engagement with, the 'hidden workforce' involved in delivering public services. McKeown and Lindorff (2011) describe this hidden workforce in the context of local government in Australia: "in addition to the 'known' and 'managed' internal workforce, many councils have an external workforce which includes temporary staff, independent contractors, those working for external contractors, volunteers, work placement students and trainees". The same can be said for many state government organisations.

Meanwhile, future public service delivery may involve a comparatively lower proportion of full-time, paid public sector staff. For example, a report on the future of government work in the United States by Deloitte emphasises how "In the past, governments largely accomplished their missions through the work of permanent employees, complemented by contractors. Today, governments are accessing a much broader spectrum of talent options" (Deloitte, 2019, p.11). It describes how a broader range of talent options in the future might include contractors, digital labour, ecosystem partners, government venturing, gig workers, micro workers, and crowd workers (see Deloitte, 2019, p.12 Figure 6).[3]

Regarding workforce skills and capacities, a range of different but similar frameworks have been developed to organise and specify the anticipated future public sector workforce capacity needs and how to develop them:

- ***Today's problems, yesterday's toolkit*** (Noveck & Glover, 2019) – Lists five core skills of the 'public entrepreneur': 1) defining problems collaboratively, 2) participatory design skills, 3) data-driven and evidence-based skills, 4) open innovation skills, 5) implementation and collaboration.

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[3] However, some of these alternative ways of engaging in work can increase job precarity and uncertainty, see section 2 – Changing nature of work.

- ***Imagining the 21st century public service workforce*** (Dickinson and Sullivan, 2014) – Presents a set of skills of the 21st century public service arranged around three skill groups, 1) Technical - "ability to use methods, procedures, processes, tools, techniques, and specialized knowledge to perform specific tasks". 2) Human – "ability to work cooperatively with others, to communicate effectively, to motivate and train others, to resolve conflicts, and to be a team player."3) Conceptual – "ability to see the organisation as a whole and solve problems from a systematic point of view" (see also Dickinson, Needham, Mangan, & Sullivan, 2019).

- ***Scenarios for 2030*** (Boston Consulting Group, 2018) – Includes six common success factors for the Australian Public Service across four potential future scenarios. Workforce management recommendations across the six factors include: 1) increasing cross-sectoral working, 2) investing in digital skills and talent, especially data analytics and emerging technologies, 3) developing professional competencies, 4) establishing talent hubs to attract and retain talent, and 5) fostering an adaptive and agile workforce and innovation culture.

6.1.6. Post-event inquiries will continue to play an important role in articulating and shaping public and government expectations of emergency management; however, they have limitations as a basis for policy making and learning.

Following major natural hazard events in Australia, is a time of high scrutiny for the emergency management sector with a host of different kinds of formal and informal assessments and evaluations of performance. Moreover, this scrutiny is not likely to dissipate over the next decade. Rather, "public scrutiny of ESOs is likely to become more sophisticated with an increased focus on systems, accountability and audits" (Dunlop, 2004). Post-event evaluations include "government inquiries and reviews, after-action reviews and operational debriefs, community meetings/debriefs, community surveys and other social research, and independent evaluations" as well as media scrutiny (Dufty, 2013). Of these, judicial and quasi-judicial government inquiries are particularly important given their long history in Australia, their potential to influence public policy, and their public nature (Prasser, 2006).

As Lawson, Eburn, Dovers, & Gough (2018) state, "these inquiries vary in form and focus; however, the common objective is to identify the cause and consequences of disasters and recommend future practices for better outcomes. In some cases, they attribute responsibility or blame for failings" (p.34). Over 300 inquiries and reviews have been conducted into emergency management and natural hazards in Australia since 1886 (Bushfire & Natural Hazards CRC, 2021).

Public inquiries into disaster events have a role in articulating and shaping public and government expectations of emergency management, and public expectations of government in disaster management more widely (Lawson, et al., 2018). However, they also have significant limitations that mean caution is needed in applying lessons from them to areas such as workforce management, particularly at the strategic level. Eburn and Dovers (2015) outline numerous limitations of public inquiries:

- They "may convey a message of distrust of the emergency services and their volunteers",

- Recommendations may conflict with other interests and policy sectors,

- They can amplify hearsay, myth and fear,

- They don't consider budget implications, and

- They focus more on individuals than on systems and institutions.

Moreover, "A belief that the findings of the last inquiry will prevent 'a future tragedy of the [same] scale' is to make the military error of preparing to fight the last war, not the next one. Faithfully implementing all the recommendations from the last inquiry may well prevent that event occurring again, but the next fire or flood will never be quite the same and will usually be very different" (p.46).

6.2. POTENTIAL IMPLICATIONS

- While trust in emergency services remains high, the low level of trust in government generally, and the widening 'trust inequality' gap, may shape expectations of the emergency services, and complicate community engagement. Emergency services rate comparatively high for public trust and service satisfaction where data is available. In South Australia, for example, ambulance services, fire brigades, and the State Emergency Service were all rated in the top 5 out of 23 service areas for levels of consumer satisfaction and expectations in 2020 (first, second and fourth respectively) (South Australian Government, 2020). However, as Miranti and Evans (2019) argue, "lack of trust may make the general business of government harder to deliver", undermining people's tolerance for government-imposed limitations or the tackling of longer-term policy problems, for example. Research from outside Australia also suggests that trust in the emergency services is influenced by overall trust in the public service (Mizrahi, Vigoda-Gadot, & Cohen, 2019).

- It is likely that ESOs will need to pay greater attention to carefully managing expectations in future. Public expectations of government are often described in government and consultant reports as not only changing, but also rising. This is certainly true also within the emergency management sector. The National Strategy for Disaster Resilience, for example, positions 'unrealistic' community expectations as an underlying reason for a central policy focus on shared responsibility (COAG, 2011, p.2). Yet, as Bearman and Every (2018) recently noted, while "there is increasing interest by emergency services agencies in identifying what the community expects in terms of service delivery", "there is currently little published peer reviewed literature on this topic". Despite this lack of solid data, it seems that at least some public expectations of emergency services are unrealistically high compared to the capacity agencies have to deliver on them (Bearman & Every, 2018). According to Dovers and Handmer (2012), rising expectations combined with the second "macro trend" of community participation, "suggests that improved processes are needed to manage expectations and to negotiate between the different priorities of the growing range of stakeholders" (p.82). These authors

suggest that "community risk management approaches may help with this."

- Expectations of greater collaboration, personalisation, and commitment to public value outcomes in emergency management sector will intensify. However, changes will be needed in the ways services and designed and managed to achieve stronger public value outcomes. In general, public value concepts and practices have not yet penetrated very deeply into emergency management. As they do, changes in the way ESOs design and manage service delivery will change. Along this line, Parkin (2020) found that "more often than not" projects initiated in response to major emergencies "are not effective in providing either social or economic public value to affected communities". She also found that "significant investment in building project management knowledge, capability and resources in the EMS [emergency management sector] has not ensured the delivery of successful outcomes to impacted communities" (p.284). She concludes: "It makes no difference what type of project is initiated, how well the project management methodology is applied or how well delivered project outputs are if the project is the wrong project or if there are no outcomes of benefit delivered to the impacted communities."

- Community participation and coproduction of services are key mechanisms for delivering public value outcomes. Their growth will require a broader conception of the emergency management workforce in planning. ESOs may also need to re-imagine the extent, composition, and skills and capacities of their workforce over the next decade, in line with shifts in expectations of public service delivery. Collective forms of coproduction align closely with the 'participatory turn' in disaster management and with the Australian policy expectations of community resilience and shared responsibility (McLennan, et al., 2020). However, as some observers note, the emergency management section has not yet worked through what the participatory turn means in practice, with the rhetoric of participation currently stronger than the practice (Stark & Taylor, 2014). In a review of coproduction and cocreation in emergency services and emergency management internationally, Velotti and Murphy (2020) observe that "this radical new approach to the field of emergency management potentially changes the definition and scope of emergency services" (p.2). In a world of 'shared responsibility', "the conventional definition of emergency services as performed by trained professionals in the sector of law enforcement, fire and rescue services and emergency medical services" (Velotti & Murphy, 2020) is no longer sufficient, or accurate. It excludes a wide range of governmental, private, not-for-profit and community actors that contribute to disaster management and community resilience. The ongoing participatory turn will continue to challenge command and control approaches and traditional lines of accountability in emergency management for many years to come (McLennan, et al., 2020).

- Critique of the 'responsibilisation' of citizens and civil society serves as a warning to governments and ESOs to consider the extent to which communities, volunteers and not-for-profits have the influence, capacity, freedom, and resourcing to fulfil government and ESO expectations of them, especially in small rural communities (Kruger & McLennan, 2019). In

line with this, Podger (2012) reflects on "one of the most important issues for Australians to address as they embark on improving citizens' involvement: what should citizens be responsible for?" This question remains unanswered and contested in Australian emergency management (McLennan & Handmer, 2013). Atkinson and Curnin (2020), for example, lament "the mismatch of expected disaster obligations and responsibilities that currently exist between governments and citizens in Australia." Especially in small rural communities where volunteer bases are already overcommitted and government service delivery has contracted, current, volunteer-reliant workforce arrangements may not be sustainable into the future given the additional projected impacts of demographic and climate change.

- The limitations of post-event public inquiries mean that ESOs need to be careful in how they process and apply lessons from these inquiries to areas such as workforce management, particularly at the strategic level. Because of the limitations of post-event inquiries, Eburn and Dovers (2015) caution that "the community needs to move beyond developing policy by royal commission" to adopt "a more mature approach" that includes a more mature narrative of disasters, a broader view beyond the specific event, attention to difference, consideration of decision-making within institutional contexts, and a mandate to look at what worked well, as well as what did not.

- The way future political leadership changes and their policy implications for government-civil society relationships unfold over the next decade is a key source of uncertainty surrounding future community and government expectations of public sector organisations and the emergency management sector. One example is the extent to which governments, current and future, will act to reinforce volunteer-based services in rural areas. "If governments wish to maintain or enhance the utilisation of local volunteers for essential and non-essential service delivery in rural areas, better support is needed for the existing rural volunteer workforce and attention should be given to addressing the underlying causes of outmigration" (Davies, Lockstone-Binney, & Holmes, 2018, p,174).

6.3. RELATED RESEARCH

Policies, institutions, and governance project (ANU, BNHCRC)

- See https://www.bnhcrc.com.au/research/governance
- "The research identified barriers to community resilience and potential policy solutions that could be factored into the preparation, response and post-event phases of emergency management. Three research themes were covered: 1) What is 'community' and how can governments share responsibility with both communities and individuals? 2) How can insurers play a more active role in communicating risk and encouraging hazard mitigation? 3) Is there a better process or institution for effective lesson sharing after natural hazard events?"

Major post-event inquiries and reviews: review of recommendations project (AITHER, ANU, BNHCRC)

- "Commissioned by AFAC, the purpose of this project was to generate a high level and comprehensive description of the major recurrent categories of recommendations across multiple post-event reviews conducted since 2009", see https://www.bnhcrc.com.au/research/policy-and-economics-hazards/3928

Inquiries and reviews database (AITHER, ANU, BNHCRC)

- See https://tools.bnhcrc.com.au/ddr/home
- An output of the *Major post-event inquiries and reviews: review of recommendations project*, this is a comprehensive and user-friendly database of recommendations from post-event reviews and inquiries that can inform agencies own lessons identification practise now and into the future.

Community expectations projects (ANU, RMIT, Uni of Canberra, BCRC)

- See https://www.bushfirecrc.com/category/projectgroup/1-community-expectations
- "This research is in three parts that aim 1) to understand and find a way for all relevant agencies to include fire and emergency management considerations in their decision-making processes, 2) to understand how urban and regional planning can better understand and reduce vulnerability to fire and 3) to examine ways to improve the sharing of responsibility and reconciling community expectations."

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7. CHANGING RISK

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The increasing complexity of disaster risks presents new challenges that could overwhelm the capabilities of our emergency services. Australia's weather and climate agencies have told us that changes to the climate are projected to increase the frequency and intensity of natural disasters, potentially resulting in complex, concurrent and compounding events.

Royal Commission into National Natural Disaster Arrangements
(Binskin, Bennett & Macintosh, 2020, p.154)

Changes in Australia's disaster risk profile over the next decade will have significant implications for the emergency service workforce and for workforce planning. Changes in any of the constituent determinants of risk – hazards, exposure, vulnerability, and capacity – will affect overall disaster risk levels (see Box 1 for UNDRR definitions).

The following section considers major trends in each of the components of disaster risk, emphasising the cross-cutting and far-reaching impacts of climate change across all components of risk. It draws in part from a literature review on implications of climate change for the emergency services (Rickards & Keating, 2021) undertaken for the *Preparing emergency services for a climate challenged world* project (See Related Research, below).

Box 1: Disaster risk and its determinants

Disaster risk | "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity."

Hazard | "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation". Hazards may be natural ("predominantly associated with natural processes and phenomena"), anthropogenic ("induced entirely or predominantly by human activities and choices" or socionatural ("associated with a combination of natural and anthropogenic factors", e.g., climate change) in origin.

Exposure | "The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas."

Vulnerability | "The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards."

Capacity | "The combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience." "Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management."

(Source: UNDRR, 2020)

7.1. KEY TRENDS AND DEVELOPMENTS

7.1.1. The global risk landscape is evolving and will be shaped by the effects of the COVID-19 pandemic for many years to come.

Changes in Australia's disaster risk profile and its implications for ESOs need to be considered within the context of a changing risk landscape globally. As the World Economic Forum's most recent annual *Global Risks Report* underscores, the impacts of COVID-19 on the global risk landscape are significant and interactions between the effects of COVID-19 and other risks will reverberate around the world for many years:

> *The immediate human and economic cost of COVID-19 is severe. It threatens to scale back years of progress on reducing poverty and inequality and to further weaken social cohesion and global cooperation. Job losses, a widening digital divide, disrupted social interactions, and abrupt shifts in markets could lead to dire consequences and lost opportunities for large parts of the global population. The ramifications—in the form of social unrest, political fragmentation and geopolitical tensions—will shape the effectiveness of our responses to the other key threats of the next decade: cyberattacks, weapons of mass destruction and, most notably, climate change report (World Economic Forum, 2021, p.7).*

According to a survey of global risk perceptions included in the *Global Risks Report*, "the highest likelihood risks of the next ten years are extreme weather, climate action failure and human-led environmental damage; as well as digital power concentration, digital inequality and cybersecurity failure", while of the highest impact risks "infectious diseases are in the top spot, followed by climate action failure and other environmental risks; as well as weapons of mass destruction, livelihood crises, debt crises and IT infrastructure breakdown" (p.7).

The threat posed by these risks are expected to shift over the next decade, with infectious diseases/livelihood crises, then economic/geopolitical and then environmental/geopolitical risks most prominent (World Economic Forum, 2021, p.11, Figure 1):

- **Short-term (next 2 years)** | infectious diseases, livelihood crises, extreme weather events, cybersecurity failure, digital inequality economic stagnation, terrorist attacks, youth disillusionment, social cohesion erosion and human environmental damage.

- **Medium-term (3-5 years)** | asset bubble burst, IT infrastructure breakdown, price instability, commodity shocks and debt crises, interstate relations and conflict, cybersecurity and tech governance failures, and resource geopolitisation.

- **Long-term** | weapons of mass destruction, state collapse, biodiversity loss, adverse tech advances, natural resource crises, social security collapse, multilateralism collapse, industry collapse, climate action failure, and backlash against science.

Notably, the only time infectious diseases were previously included in the top five most impactful risks since the Global Risk Reports began in 2012 was in 2015 following the 2014 Ebola crisis. Following this crisis, the Director-General of the World Health Organization highlighted the increasing rate at which new

infectious diseases are emerging in an increasingly urbanised, globalised, and interconnected world:

New diseases are now emerging at an unprecedented rate. No one expects this trend to end. Moreover, in a world of radically increased interdependence, international travel, and trade, there is no such thing as a local outbreak anymore (Chan, 2015).

The challenges associated with delivering effective response to a widespread outbreak in such an interconnected world are significant. Overall, "the epidemics in the 21st century are spreading faster and further than ever. Outbreaks that were previously localized can now become global very rapidly" (WHO, 2018). Furthermore, climate change will continue to alter the incidence of infectious disease over the next decade in uncertain ways (Harley et al., 2011). Positively, however, the global impact of infectious diseases had been declining overall since 2000 prior to the COVID-19 pandemic due to the effects of prevention programs (WHO 2021).

7.1.2. Climate change is altering the frequency and severity of many natural hazards, and there is close agreement about major impacts up to 2030 between different climate models.

Climate change is projected to have continual and significant impacts on Australian climate and weather, and on our oceans (CSIRO & BOM, 2020; Earth Systems and Climate Change Hub, 2020). Different climate models produce different projections of climate change impacts under a variety of scenarios over time. However, there is close agreement between models up to 2030, with projections diverging by 2050 and beyond (CSIRO & BOM, 2030, p.23; Earth Systems & Climate Change Hub, 2020, p.15).

> *Observations, reconstructions and climate modelling paint a consistent picture of ongoing, long term climate change interacting with underlying natural variability. Associated changes in weather and climate extremes— such as extreme heat, heavy rainfall and coastal inundation, fire weather and drought—have a large impact on the health and wellbeing of our communities and ecosystems. They affect the lives and livelihoods of all Australians.*
>
> *Australia needs to plan for and adapt to the changing nature of climate risk now and in the decades ahead. Reducing global greenhouse gas emissions will lead to less warming and fewer impacts in the future.*
>
> State of the Climate Report (CSIRO & BOM, 2020, p.2)

The 2020 State of the Climate report from the CSIRO and Bureau of Meteorology presents projected future climate effects for Australia from simulations using the latest climate models (CSIRO & BOM, 2020 see also Figure 3):

- **Temperature** | Continued warming, with more extremely hot days and fewer extremely cool days.

- **Precipitation** | A decrease in cool season rainfall across many regions of the south and east, likely leading to more time spent in drought. | More intense short-duration heavy rainfall events throughout the country.

- **Fire weather** | A longer fire season for the south and east and an increase in the number of dangerous fire weather days.

- **Storms and cyclone** | Fewer tropical cyclones, but a greater proportion projected to be of high intensity, with ongoing large variations from year to year. | Fewer east coast lows particularly during the cooler months of the year. For events that do occur, sea level rise will increase the severity of some coastal impacts.

- **Oceans** | More frequent, extensive, intense, and longer-lasting marine heatwaves leading to increased risk of more frequent and severe bleaching events for coral reefs, including the Great Barrier and Ningaloo reefs. | Continued warming and acidification of its surrounding oceans. | Ongoing sea level rise. | More frequent extreme sea levels.

FIGURE 3: OVERVIEW OF FUTURE CLIMATE PROJECTIONS FOR AUSTRALIA IN THE STATE OF THE CLIMATE 2030 REPORT (CSIRO AND BOM, 2020. USED WITH PERMISSION).

It is important to recognise that not all regions of Australia are projected to experience increased risk of natural hazards due to climate change. For example, while some areas may experience increased frequency of cyclones, others may experience decreased frequency (Earth Systems & Climate Change Hub, 2020).

For ESOs, the most immediate and pressing effect of climate change is its impact on natural hazards. Climate change is already affecting natural hazards, with widespread recognition that "many natural hazards are becoming more frequent and more intense, driven by Australia's changing climate" (Commonwealth of Australia, 2018, p.5). However, the exact nature of climate change impacts on natural hazards are uncertain due to the limitations in climate models, the complex mix of processes, conditions and interactions that drive hazard events, and the influence of significant natural variability in many of those processes (e.g., Jones et al. 2013).

Taking bushfire as an example, longer fire seasons and more dangerous fire weather does not necessarily mean a higher occurrence of bushfire events (Clarke, Lucas, & Smith, 2013; Harris, Nicholls, Tapper, & Mills, 2020; van Oldenborgh et al., 2020). This is because "there is a range of factors such as ignition source, weather, climate, fire history, fuel type, terrain, suppression effectiveness and fire management that influence the occurrence and size of bush fires" (Harris, et al., 2020). As such, climate change effects on bushfire will manifest differently "depending on local fire dynamics" (Clarke, et al., 2013). Furthermore, there is uncertainty about the indirect impacts of climate change on future fire weather conditions through its effects on underlying processes and variability contributing to this weather (Clarke, et al., 2013), its effects on other bushfire risk drivers, and "positive feedbacks between land and climate" (Rickards & Keating, 2021, p.6).

Another significant element in climate change impacts on natural hazards is that they are non-linear (e.g., Schneider et al., 2001, p.93), with climatic warming occurring through step changes as well as rising trends (Jones, 2012). This means that likely future hazard occurrences cannot be extrapolated from past patterns, and that adaptation needs to respond to the potential for rapid as well as gradual change:

> *Abrupt shifts in regional climate will lead to abrupt changes in climate risks. For example, recent impacts in SEA* [south-eastern Australia] *after 1996 are non-trivial and include catastrophic wildfires, record periods of heat stress and sustained water shortages. Incremental adaptation planned to manage gradual change will lead to under-adaptation if such events occur, risking maladaptation in response to unanticipated, rapid change (Jones, 2012, p.11).*

7.1.3. Exposure to natural hazards is projected to further increase in some areas of Australia due to population growth, human settlement patterns and climate change, with extreme heat exposure becoming an increasingly significant threat.

The cost of disasters arising from natural hazard events has risen sharply in Australia and is expected to continue to do so into the future (Young et al., 2017). According to one study commissioned by the Australian Business Roundtable for Disaster Resilience and Safer Communities, "over the past 10 years disasters have cost the Australian economy around $18 billion per year. Assuming current development patterns and population growth continue, this is forecast to reach $39 billion per year by 2050" (Commonwealth of Australia, 2018, p.6).[4]

As Gissing, et al. (2018) stress, "it is clear that to date, the rising cost of natural 'disasters' (in the loose sense of the term described above) is mainly dictated by where and how we chose to live (Crompton & McAneney, 2008, McAneney & Crompton, 2014, IPCC, 2014)" (see also IFRC, 2019). In other words, an increase in the exposure of people, building stock and infrastructure to natural hazards,

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[4] Caution is needed, however, in the use and interpretation of disaster cost estimates, given their limitations, and the significant variability that exists between alternative methods (see Ladds, Keating, Handmer, & Magee, 2017).

driven by population growth and development patterns is a key factor contributing to rising disaster costs.

The projected exposure to natural hazards is expected to grow in some areas due to pressures to further develop hazard prone areas and climate change. Three geographic areas identified by Gissing, et al. (2018) are the Hawkesbury Nepean Valley, Queensland coast, and areas of Melbourne:

> In the Hawkesbury Nepean Valley the number of people requiring evacuation during a flood of 1867 proportions is estimated to rise from 90,000 at present to between 158,000 to 171,000 by 2041 (Infrastructure NSW, 2017); exposure to coastal inundation across Queensland is forecast to nearly double by 2030 (Australian Government Productivity Commission, 2014); and in Melbourne increases in urban density is occurring without equivalent increases in evacuation capacity (Foster et al., 2013b). Given these examples, risk-reflective land-use planning will remain key to ensuring existing risks are not significantly exacerbated (p.10).

As Rickards and Keating (2021, p.23) note, "traditional spatial planning is generally ill-equipped to manage the risks of climate change hazard exposure due to the power vested in applicants and its conventional focus on individual development applications and short-term impacts rather than cumulative impacts and long-term needs" (see also Gonzalez-Mathiesen, Ruane, & March, 2021; Handmer, 2008; Wenger, 2017).

Exposure of greater numbers of people and assets to extreme heat due to climate change is a trend that has far-reaching ramifications. Studies show that "with the exception of disease epidemics, extreme heat events had been the most significant natural hazard in Australia in terms of loss of life, killing at least 4287 persons since European settlement" (Coates, Haynes, O'Brien, McAneney, & de Oliveira, 2014, p.33). Moreover, "Without adaptive measures, the conjunction of expectations for extreme heat events to be of greater frequency, duration and intensity and an ageing and increasing population suggests an increase in future heat-related fatalities" (Coates, et al., 2014, p.34). Exposure of more people to extreme heat due to climate change has far-reaching effects on human health beyond immediate effects of heat stress and exhaustion (Lundgren et al., 2013). These include, for example, direct health effects such as exacerbation of existing health problems, and of mental, cognitive and behavioural disorders (Spector et al., 2019). They also include indirect effects like reduced food safety, water quality and quantity, increased prevalence of violence, and increased air pollution to name just a few (see Rickards & Keating, 2021, p.24-27 for a summary of human health and other effects).

7.1.4. Root causes of vulnerability are not well understood in Australia, while ever more interconnected and interdependent support systems increase our vulnerability to cascading disasters.

In the broadest sense, vulnerability is the potential for loss or harm. Attention to vulnerability brings into focus the reality that "hazards only lead to disaster if they intersect with an exposed and vulnerable society and when the consequences exceed its capacity to cope" (Australian Government Department of Home Affairs, 2018). Reducing vulnerability has become a central tenet of both disaster

risk reduction and climate change adaptation (Thomalla, Downing, Spanger-Siegfried, Han, & Rockström, 2006).

Sources of vulnerability are multiple: they can be physical, social, economic, and environmental in nature, for example. Of the various sources of vulnerability, social vulnerability is the least understood and the most difficult to measure (Cutter, Boruff, & Shirley, 2003). Vulnerability is also understood in different ways across research disciples and fields (Cutter, 1996; Hufschmidt, 2011; Wisner, 2009). Structural approaches emphasise social, political and economic root causes of people's vulnerability, drawing attention to the impact of marginalisation and inequality of access to resources within particular places (Hufschmidt, 2011; Wisner, Gaillard, & Kelman, 2012). Behavioural approaches, by contrast, emphasise the human capacity to adapt, and understand vulnerability more in terms of failures or inadequacies in adaptive measures and resilience (Hufschmidt, 2011).

Notably, structural approaches to understanding and reducing vulnerability are less influential in Australian disaster management. Consequently, "We do not […] have a good baseline understanding of the root causes of disaster and processes influencing how places and people are vulnerable and how this leads to disaster" (Australian Government Department of Home Affairs, 2018). Moreover, "We acknowledge vulnerable people and can identify the attributes that apply to them. […] However, we are less rehearsed in talking about how prevailing institutional arrangements and decision-making processes lead to […] poverty, inequality, disadvantage, marginalisation, chronic illness, alcohol and drug use, and family violence" (Australian Government Department of Home Affairs, 2018, p.41).

A key factor increasing vulnerability to natural hazards in Australia in the growing interconnectedness and interdependency of support systems and networks, including growing reliance on technology. This increases vulnerability to cascading disasters in particular. As Young and Jones (2014) explain, the interconnected nature of economic, social and environmental systems "can result in chain reactions that resonate across systems and through subsystems, possibly continuing for long periods after an event" (p.9). Gissing, et al. (2020) describe the 2016 South Australia blackout as a recent example of such an event, "which resulted from a series of tornadoes that damaged 23 transmission towers, cutting power to the city of Adelaide for days. The blackout caused issues with access to food, public transport, finances, telecommunications, water, medications and fuel."

7.1.5. The potential for compound, catastrophic and cascading disasters in the future is of mounting concern for ESOs and an increasing focus of research.

Compound disasters occur when numerous drivers and/or hazards combine to increase risk. An example of a compound event provided by Gissing, Timms, et al. (2020) occurred the USA in 2017: "when in the space of three weeks three major hurricanes -- Hurricanes Harvey, Maria and Irma -- made landfall, followed by wildfires in Northern California a month later. Hurricane Harvey made landfall on August 25 in Texas as a Category 4 storm flooding some 200,000 homes" (p.6). Australia has a history of compound disasters which lead to coordination

challenges and resource depletion (Gissing, Timms, et al., 2020). Their impacts are amplified when they occur at times of societal stress, resulting in incredibly complex emergency management challenges.

A disaster is catastrophic when it is "beyond our current arrangements, thinking, experience and imagination (i.e., that has overwhelmed our technical, non-technical and social systems and resources, and has degraded or disabled governance structures and strategic and operational decision-making functions)" (AIDR, 2019). As Gissing et al. (2020) highlight, "catastrophic disasters are cascading in nature, escalating in their impacts as interconnected systems fail successively, yielding yet further impacts and making recovery more complex and prolonged. Essential infrastructure -- water, gas, sewage, power, healthcare, banking, transport, food supply, emergency response and communication -- becomes severely disrupted. Restoration may take months and disease and fires may wreak further havoc."

Again, there is considerable uncertainty regarding conditions and drivers of compound, catastrophic, and cascading disasters (Gissing, Eburn, & McAneney, 2018). Research on these types of events, however, draws attention to the interplay between hazards and vulnerabilities, and the role that exposure and vulnerability play in amplifying and accelerating the secondary and cascading impacts of triggering hazard events (Cutter, 2018). As such, researchers like Pescaroli and Alexander (2018) call for a more central focus on vulnerability assessment: "Shifting from a focus on hazards to one on vulnerability assessment enables one to recognize the sensitive nodes that may cause secondary events to escalate" (p.2250). Meanwhile, Young et al. (2017) emphasise the need for strategic management of systemic risk, due to risks that are triggered within increasingly interconnected systems interacting to create "new risks that have not been encountered before" (p.15):

> Natural hazards and the risks they trigger are systemic and can impact on environmental, social and economic systems simultaneously over multiple timeframes. These systems and the risks associated with natural hazards are interconnected and interact with each other (p.15).

7.2. POTENTIAL IMPLICATIONS

- ESOs are already grappling with the implications of climate change risk and impacts: "Addressing climate change risks and impacts remains an urgent, significant challenge for the emergency management sector […] despite concerted effort from various agencies. Member agencies are already feeling the impacts of climate change and experiencing first-hand how communities are being affected" (AFAC, 2018).

- Projected climate change effects are likely to significantly alter Australia's risk profile, with more severe consequences from natural hazard events in many regions. This is expected to increase pressure on emergency services workforces and resources.

- Significantly, the changing disaster risk profile in Australia challenges the sustainability of the current organisational and workforce arrangements for emergency response and recovery management (CSIRO, 2020). Due to this,

the CSIRO's Climate and Disaster Resilience report, commissioned by the Prime Minister following the Black Summary fires of 2019-20 recommends that: "Commonwealth, state and territory governments should review the human resourcing of emergency management to understand how it is being delivered on the ground, including consideration of the role of community and volunteers, and paid workers. For example, increased hazard reduction burning is likely to call heavily on volunteer firefighters, who are also increasingly called upon during the main fire seasons." (p.9) Further, as Gissing, George, et al. (2020) conclude in relation to planning for cascading and catastrophic events: "The role of emergency service first responders in responding to a catastrophe must adjust from one which typically undertakes direct taskings to one which would facilitate, lead, support and enable community-led actions" (p.40).

- Ensuring the health, safety and wellbeing of emergency service staff and volunteers will become a more pressing challenge under climate change. For example, bushfire volunteers responding to longer and more severe bushfire season may face greater fatigue, stress and mental health risks. Moreover, emergency service workers are one of the professional groups most at risk from extreme heat exposure and managing heat exposure is likely to become a growing challenge and focus for ESOs (e.g., Gao, Kuklane, Östergren, & Kjellstrom, 2018).

- Climate change is also likely to impact the risk mitigation practices of ESOs, for example, longer fire seasons may decrease or alter the windows for prescribed burning (Di Virgilio et al., 2020), "while more extreme fire conditions are rendering prescribed burning less effective in reducing fire risk, and more fire and other events stretches EMS resource and reduces time for maintenance and recuperation" (Rickards & Keating, 2021, p.16). Here again, however there is considerable uncertainty regarding how climate change will affect elements of risk mitigation, such as conditions for prescribed burning (Clarke et al., 2019).

- Sector-wide collaboration and strategic-level, joint agency planning, and interoperability will be increasingly vital to respond to climate change impacts, as noted in the AFAC discussion paper on climate change: "The scope and complexity of climate change demands a collaborative, sector-wide commitment in Australia and New Zealand so fire and emergency services remain effective, flexible and adaptable. Collaboration leads to better outcomes for AFAC members, our stakeholders and the communities we support" (AFAC, 2018; see also Bosomworth, Owen, & Curnin, 2017; Young et al., 2017). This will require the sector to build skills and capacities in strategic thinking and planning: "Long-term strategic planning of natural hazards is an emerging area of decision making in the emergency management sector, and the required skills, structures and processes are evolving. Programs working in this area will need to consider what skills and capacity can be built in these areas. Also, what may need to change and what will be needed to support this" (Young et al., 2017, p.21).

- Climate change will challenge the emergency services in more ways than just through its impacts on disaster risk. Interactions with other trends will create second and third-order effects impacting all components of the

emergency management sector's operating environment (Young et al., 2017). Examples include rising and shifting community, public, and private sector expectations of emergency services in confronting climate change impacts (AFAC, 2018; Rickards & Keating, 2021). Other examples include potential for liability exposure, and implications of changes to the insurance sector (AFAC, 2018).

- A significant implication of climate change for ESOs is the increased uncertainty and unpredictability of future conditions and events. This combines with a range of other factors to increase the difficulty of estimating future natural hazard risk: "Due to a large number of influencing environmental and anthropogenic factors, natural hazard risk is difficult to estimate accurately, and is exaggerated by large uncertainty in future socio-economic consequences. Furthermore, resources are scarce, and the benefits of risk reduction strategies are often intangible" (Maier, 2020). This in turn increases the importance of methods for strategic planning and decision-making under conditions of uncertainty, such as scenario-based planning (Riddell, van Delden, Maier, & Zecchin, 2020; Young et al., 2017).

- Integrating climate change adaptation and mitigation into emergency management planning, including workforce planning, needs to be prioritised (AFAC, 2018). As Young and Jones (2014) explain, "For people undertaking adaptation it requires understanding of their internal and external systems, and the relationship and interdependencies between them. It also requires an understanding of mitigation and adaptation activities, and the differences and synergies between these two areas. Uncertainty is part of the adaptation process that needs to be accommodated and managed in a way that enables effective responses and action" (p.12).

- The role that exposure and vulnerability play in amplifying and accelerating the secondary and cascading impacts of triggering hazards has increased calls for a more central focus on vulnerability assessment (Pescaroli & Alexander, 2018, p.2250).

- Improvements in many areas and levels of disaster risk reduction have meant that potential losses and damages from disaster events have been lessened. A national focus on disaster risk reduction may further boost improvements in key areas of risk reduction (Commonwealth of Australia, 2018).

7.3. RELATED RESEARCH

Significant research has been undertaken that supports emergency service organisations to make decisions about risk, and to adapt to and plan for the impacts of climate change under conditions of uncertainty. Major projects and some of the key research-informed resources developed are included below.

Planning and capability requirements for catastrophic and cascading disasters project (Risk Frontiers, Macquarie Uni, BNHCRC)

- See https://www.bnhcrc.com.au/research/catastrophic
- *Emergency management capability maturity assessment tool*: This tool "can be utilised by jurisdictions and organisations to better understand potential capability gaps in the context of severe-to-catastrophic disaster scenarios. Through utilisation funding provided by the Bushfire and Natural Hazards Cooperative Research Centre, this tool will be promoted for use across all jurisdictions" (Gissing et al. 2020).

Improved decision support for natural hazard risk reduction project (Uni of Adelaide, BNHCRC)
- See https://www.bnhcrc.com.au/research/riskreduction
- *UNHaRMED*: "This system allows for the dynamic understanding and assessment of all three components of risk; exposure, vulnerability and hazard, in line with recent recommendations from the World Bank's Global Facility for Disaster Reduction and Recovery (Fraser et al, 2016). UNHaRMED thus allows policy makers to better understand the drivers of risk and the impact of their policies on risk profiles now and into the future. This enables policy makers to account for climate change, urbanisation, population increases and future environmental conditions in risk assessments" (Maier 2020).

Mapping and understanding bushfire and natural hazard vulnerability and risks at the institutional scale project (Victoria Uni, BNHCRC)
- See https://www.bnhcrc.com.au/research/vulnerabilityandrisks
- *Problem solution framework*: "This document is designed as a framework to assist understanding of how to manage and implement actions in context of continuous change, where risks and actions are complex and outcomes often are uncertain. Although it uses climate change as the focus, this framework can be applied to assist understanding in any area of practice requiring management of ongoing change and dynamic risk, in current and future contexts" (Young, 2014, p.6) See https://www.bnhcrc.com.au/publications/biblio/bnh-1570
- *Risk ownership framework for emergency management policy and practice*: "The purpose of this framework is to provide a companion process for current risk planning processes, in particular the National Emergency Risk Assessment Guidelines (NERAG), where key tasks can be integrated into current risk assessment and planning activities.
Its aim is to support better strategic management of risks associated with natural hazards. It does this through providing a series of tasks that support the allocation of risk ownership as part of strategic planning activities. This framework is not intended to replace current risk processes, but to enhance and add value to what is already there" (Young et al., 2017, p.25) See https://www.bnhcrc.com.au/publications/biblio/bnh-3801

Preparing emergency services for a climate challenged world project (REOS Partners, RMIT University, BNHCRC)

- *Scenario-based tools (forthcoming):* "The aim of this project is to build capabilities of emergency service agencies across Australia and New Zealand in testing their capabilities against plausible futures to inform their strategic planning and associated preparedness activities." See https://www.bnhcrc.com.au/research/understanding-and-mitigating-hazards/8023.

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