NZSAR
New Zealand Search and Rescue

NZ Search and Rescue Environmental Scan

December 2017

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Table of Contents

Executive summary

New Zealand's Search and Rescue sector ("the SAR sector") aims to provide effective search and rescue (SAR) services throughout New Zealand's Search and Rescue Region (NZSRR). This environmental scan looks at the range of both external and internal factors that may impact on the ability of the sector to provide effective SAR services.

The scan does this by exploring the potential impact of external trends on demand and supply of SAR services (and capability), focusing on the following key areas: demography, technology, economy, politics, legislation and the environment. The scan also explores a range of internal drivers that may affect the SAR sector's ability to supply an effective and efficient service in the future. It focuses in particular on the drivers of funding, volunteering and training. We also briefly explore the resilience of the search and rescue service model in light of the environmental trends identified.

Our scan suggests that population growth, tourism, ageing and climate change are all likely to increase demand for search and rescue services. By contrast, growing levels of disability (with the exception of dementia), urbanisation, increased sedentary activity and ethnic diversity will likely offset the demand increase somewhat. On balance, this suggests that demand will remain stable in the short term, but increase in the medium to long term. The most critical environmental factors to watch will be the effects of climate change, increased numbers of people 'wandering' and technology, since these appear to have the biggest potential to swing demand up or down.

We note that the SAR sector's service model has emerged reasonably organically over time, including how it is funded, how volunteers are recruited and trained, and its delivery models. We would suggest that there are particular risks around the business being largely volunteer-based and given the dynamic nature of the New Zealand and general Pacific environment (particularly given climate change). Consequently, we call out the need for a deeper assessment of how well the SAR sector will respond if these different risks manifest at the same time.

A critical observation is that devolved organisations tend to do well in normal times, but strong command and control structures are better for times of crisis. This does not mean we are proposing a shift to a command and control structure at this time; rather the need to better understand how the SAR sector will likely respond when placed under stress – something we think is reasonably likely given the range of drivers emerging that could spike in the next 5-10 years.

Context and background

A note on terminology

Search and rescue activity in New Zealand operates in a devolved context involving many different organisations. Different organisations contribute to an overall sector effort and very few agencies involved in SAR even have it as their sole or even primary function. Given the devolved nature of the sector, it is important for us to define the different terms used throughout this document.

Unless otherwise specified, we use terms as follows:

- "The SAR sector", "the sector" or "New Zealand's SAR sector" are all those organisations involved in search and rescue – i.e. the sector in its totality;
- "SAR Coordinating Authorities" or just "Coordinating Authorities" are the Police and the Rescue Coordination Centre New Zealand (RCCNZ);
- "SAR providing agencies" or "SAR providers" refers those who provide services to the Coordinating Authorities;
- "NZSAR" for the combined entity of the NZSAR Council, NZSAR Consultative Committee and NZSAR Secretariat; and
- "NZSAR Council", "NZSAR Consultative Committee" and "NZSAR Secretariat" for those entities when treated separate from one another.

Purpose

In the same way as coordination is required at the operational level, strategic leadership and direction is required to help the SAR sector to operate effectively and efficiently in the face of a rapidly evolving global and domestic environment. The NZSAR Council has already demonstrated significant strategic leadership through the development of the NZSAR Strategic Plan 2017-2020 and its strategic plan predecessors. The plan sets out the outcome, vision, concept of operations and goals for the SAR sector over the next 3 years. It also briefly touches on key risks the Council sees over that timeframe.

However, in order for the Strategic Plan to be implemented effectively, it is important for the Council and partners across the SAR sector, to understand how the environment in which it operates is changing. This environmental scan is intended to foster a better understanding, among SAR agencies of the various factors likely to impact on the future ability of the sector to achieve its desired outcome:

> *"NZSAR will ensure New Zealand has effective search and rescue services for people in distress throughout New Zealand's search and rescue region in order to save lives."*

Operating Context

Responsibility and expectations

Recent research[1] has shown that people generally expect to be found within two to five hours if lost and or hurt in the bush. The use of helicopters in SAR has become expected to a certain extent. SAR coverage is expected nationwide, 24 hours a day, seven days a week.

It is informative to contrast these expectations with the size of the area for which the SAR sector is responsible. The NZ Search and Rescue Region (NZSRR) is vast, covering over 37 million square kilometres of ocean and stretching north as far as Tokelau and south as far as Scott Base in Antarctica. In this context, it is very easy to get lost or injured and very difficult to locate people when they are.

The challenges of assisting people in distress over such a vast territory were demonstrated in December 2011, for example, when a Russian fishing ship, the Sparta, hit an iceberg in Antarctica, resulting in it taking on water and listing. Vessels speeding towards the stricken ship could not get there fast enough to help, due to heavy sea ice. The RCCNZ determined that the best way to save the crew was to take rapid action to save the ship. So the RCCNZ liaised with the NZ Defence Force to dispatch a Hercules to reconnoitre the area and then to airdrop supplies to fix the hole and get rid of the water. The operation was a success – with the head of the Russian Antarctic Organisation saying the vessel would have sunk were it not for the assistance provided.[2] Further liaison by the RCCNZ led to the Korean Ice breaker Aaron escorting the hastily repaired ship to a dry-dock in Lyttleton, where permanent repairs could be made. This whole operation involved significant coordination both across the various New Zealand SAR agencies but also

various international partners (e.g. Russia and South Korea) in the complex geo-political environment that is Antarctica.

The Russian Fishing Boat, Sparta, stricken in the Ross Sea, Antarctica, December 2011

Source: NZ Airforce[3]

Current demand

Over the 2016-17 financial year, there were 2,643 SAR operations. Of these,

- Police coordinated 1697, with 942 taking place on land and 755 taking place in a marine environment.
- the Rescue Coordination Centre (RCCNZ) coordinated 946, with 329 on land, 244 in a marine environment and 259 involving aviation.[4]

Over the past few years, there has been an increasing number of category II land-based search and rescue operations, rising from 117 in 2010-11 to 329 in 2016-17. The past few years' data shows that the rise is largely on land, and driven by an upsurge in the use of personal locator beacons (PLBs). There are now more than 70,000 personal locator beacons registered, with an additional estimated 30,000 yet to be registered. It is expected that this increase of land-based SAR operations will continue to increase over the next few years as the number of registered distress beacons also climbs.[5]

Land-based demand

In their publication "*There and Back*", the Mountain Safety Council (MSC) have comprehensively analysed the key factors resulting in fatalities, injuries and search and rescue operations on land. Some of the key insights from MSC's analysis in terms of preventing search and rescue events are:

- on average, there were 540 land-based search and rescue operations annually (over a 5-year period), but this has fallen from 584 in 2012-13 to 490 in 2014-15;
- of the 540 SAROPs, 138 were for trampers, 117 for hunters, 37 for mountaineers, 34 for mountain bikers and 13 for trail runners;
- the central north island had the highest number of people involved in search and rescues – it had 10 times the average number of people involved in search and rescues;
- however 71% of fatalities were in the south island, with the highest number of fatalities while out tramping in Queenstown-Lakes and Tasman;
- 51% of fatalities were due to falling, 14% due to firearms incidents, 14% due to water crossings and 7% due to hypothermia;
- 84% of fatalities were male and 73% were from New Zealand as opposed to overseas;
- only 28% of search and rescues were for two or more people.[6]

In short, people falling while in remote areas, drowning while crossing a river, and getting freezing cold were the most dangerous things to happen in the outdoors. The most dangerous places were in the south island (when measured by fatality), but the highest rate of people needing search and rescue is in the central north island (Ruapehu and the Taupo districts). It is particularly telling that in this area, 80% of the search and rescue operations involved only one person (which suggests it's best to always participate outdoors with a friend!). The same trend applies in Queenstown-Lakes with 82% of the search and rescues involving one person. However, there is a much higher fatality rate there, with 15 people dying there between July 2007 and December 2014, of which 13 were due to falling.

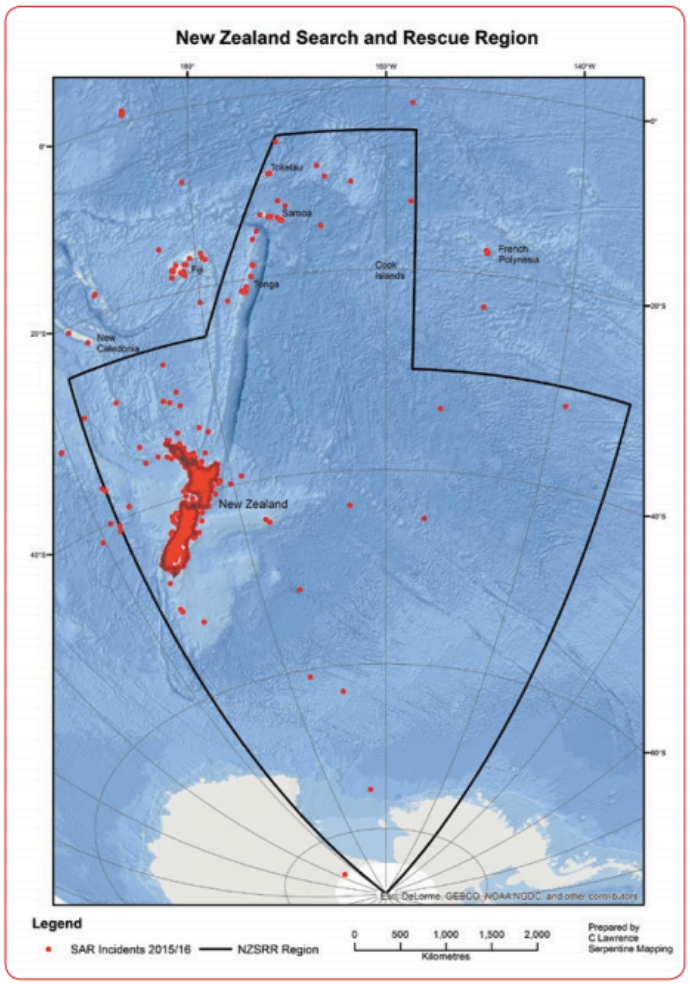
Demand across the broader NZ Search and Rescue Region

In addition to its work close to the New Zealand mainland, significant effort is put into both coordinating and often directly providing search and rescue across the broader NZ Search and Rescue region. This is illustrated in the diagram below. The sheer size of the Pacific Ocean makes it an enormous challenge to provide search and rescue across the region.

While we talk of this as a 'region', in fact it spans multiple jurisdictions, each with their own particular local characteristics and challenges. For example, some jurisdictions involve many small and remote islands with their own obligations and sovereignty. Others have very few search and rescue assets available. Still others run aircraft and ferries that might not be maintained or meet what might be considered 'reasonable' safety standards. There are also different perceptions around the level of safety needed to run a business in different places. For example, one anonymous ferry owner in a Pacific Islands admitted to keeping his lifejackets in a hold under cargo to avoid people stealing them (while meeting the technical requirement to carry them). Another is a ferry operator who regularly picked up new crew for each voyage, none of whom had training in how to operate in an emergency.

It is recognised that the maritime safety culture across the pacific needs to improve. It is in this diverse and challenging context that RCCNZ must often coordinate the search and rescue

operations illustrated with red ‘dots’ below. Examples include the Princess Ashika sinking in Tonga and a ferry sinking in Kiribati in 2009.



While there are fewer search and rescue operations across the broader NZ Search and Rescue Region (and sometimes in international waters), they are typically highly complex, costly and often politically and logistically challenging. Aside from the sheer size of the Pacific Ocean, some of the key challenges include the need to manage:

- highly dynamic weather patterns;
- interactions with nations with diverse levels of economic development;
- limited response capability of some other nations;
- limited access to SAR assets; and
- accessing a wide range of small, highly dispersed island populations.

For example, New Zealand’s search and rescue operations often frequently have to both seek the assent and cooperation of other sovereign nations and the need for NZ SAR agencies to take on a range of roles, including oversight, funding, coordination and response deployment.

Overview of the search and rescue process

The SAR sector responds to people who find themselves in dangerous situations. For example, it provides a rapid SAR when alerted that someone (or a group of people) is:

- lost and/or hurt (e.g. falling off a cliff) while out walking, tramping, hunting or jogging;
- in a capsized boat in bad weather or one that has mechanical problems or has run out of fuel;
- swept away by a rip or rogue wave while out undertaking outdoor sports like swimming or diving; or
- lost at sea and/or hurt following an air crash.

Formally, a Search and Rescue Operation (SAROP) is an operation undertaken by a Coordinating Authority to locate and retrieve persons missing or in distress. The intention of the operation is to "save lives, prevent or minimise injuries and remove persons from situations of peril by locating the persons, providing for initial medical care or other needs and then delivering them to a place of safety".[7]

Prevention

A range of preventative activities is already being undertaken by a wide range of SAR agencies in an attempt to minimise the need for SAR services or reduce the impact of an incident should it occur. A simple, nationally-led framework, has been developed for all stakeholders to use to complement existing environment-specific strategies, such as the 'Water Safety Sector Strategy 2020'.

The NZSAR Secretariat is now structuring a number of initiatives based on the framework to:

- enable a greater collective understanding of the prevention activities underway across New Zealand;
- add to existing research around the behaviour of people recreating; and
- connect and support effective prevention responses.

Those initiatives are likely to result in an overall picture of the prevention landscape, which will ultimately be available from the NZSAR Secretariat. Consequently, this environmental scan does not seek to duplicate that work. That said, it is acknowledged that prevention activity, and the relative investment in prevention versus search and rescue activity, has a significant potential impact on future demand.

Diversion

Many potential calls for search and rescue assistance are averted either by people getting themselves out of trouble or other services (e.g. Coastguard or Surf Life Saving NZ) dealing with the situation. For example, the Coastguard deals with many instances when there is not a formal SAR operation underway but help is needed nevertheless. For example, this can involve going out to give stranded boats fuel so that they can come home under their own power. Such assistance effectively reduces demand for SAR. As one NZSAR Secretariat staff member put it: "because they do that, it reduces demand on SAR because the boaties are not getting caught on the rocks later."

Alert

Alerts occur when:

- a distress beacon is activated;
- somebody calls 111 (e.g. while out tramping); or
- someone requests help via Marine VHF Channel 16 (e.g. while in a boat at sea).

Distress beacons alerts are received directly by the RCCNZ. Beacons are required to be registered at the time of purchase, though around 30% are not. Sometimes calls are also received from automated systems, for example embedded notification systems in many airplanes and on boats. When someone calls 111 seeking search and rescue, the call is received by Police communications centres, then referred to either the Police Search and Rescue Coordinators or the District Command Centres.

When a distress call is made to Marine VHF Channel 16, it is picked up by the New Zealand Distress and Safety Radio Service. This involves both a radio network and operations centre dedicated to issuing weather and navigation warnings and handling distress and safety radio calls within the NAVAREA XIV radio coverage region. The network is a series of radio stations that are tuned to maritime frequencies and linked to Maritime New Zealand's Maritime Operations Centre (MOC) in Wellington.

Often it is not the person who is lost or hurt that makes the actual call for help. Requests for assistance often come from relatives, friends or even third parties such as hotels (e.g. when they notice that a tourist out on a walk has not checked out of a room at the expected time).

Allocation of coordination responsibility

For any SAROP there can only be one Coordinating Authority who is responsible for the management and coordination of the operation. The New Zealand Police and the Rescue Coordination Centre New Zealand are the recognised Coordinating Authorities in New Zealand.

Alerts are sorted into either category 1 or 2. There are protocols in place that determine how responsibility for alerts is allocated and who becomes the Coordinating Authority in a given situation.

Category 1 SAROPs are coordinated at the local level. They include land operations, subterranean operations, river, lake and inland waterway operations and close-to-shore marine operations. By contrast, Category 2 SAROPs are coordinated at the national level. They include, operations associated with missing aircraft or aircraft in distress and offshore marine operations within the New Zealand Search and Rescue Region.[8] During 2015/16, NZ Police coordinated 64.2% of all SAR incidents and RCCNZ the remaining 35.7%. Over time, there has been an increase in the Category 2 SAR coordination efforts.

Diagnosis and intelligence gathering

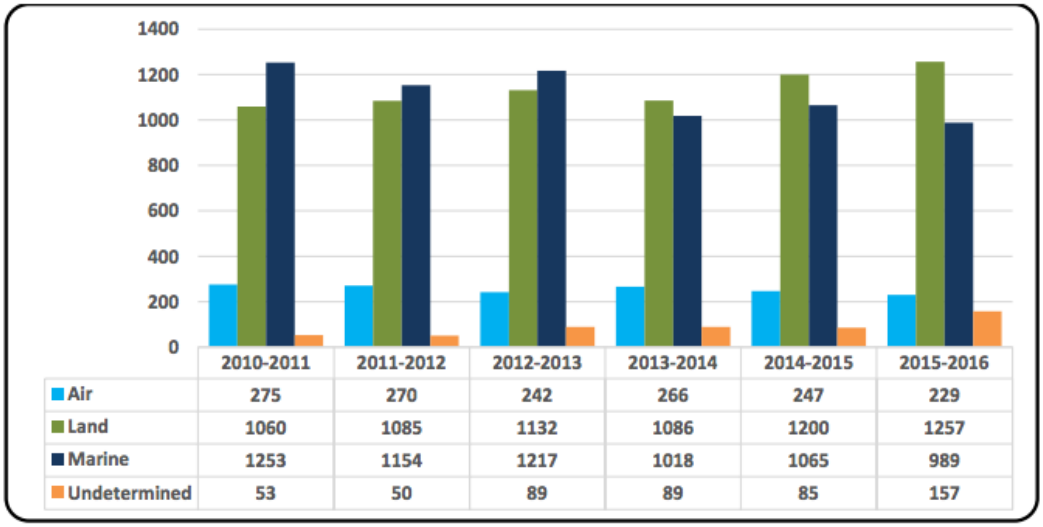
A significant amount of work goes into diagnosing the kind of SAR response required. Each response is treated as unique and depends on:

- the environment – whether the incident has happened on land (bush, urban, cave or alpine), in water (sea, waterway or lake) or air (typically an aircraft lost at sea or in the bush);
- the urgency – for example someone stuck on a mountain or in the sea in freezing temperatures will require more urgent attention than someone who is simply stranded in a hut on a hill surrounded by flooding rivers;
- the distance – whether the event is classified as 'close' or 'far', including whether it is in a remote area either within New Zealand or other part of the NZSRR; and
- the ease of location – whether the location of the distress signal is well pinpointed. A search is required if the location is not known precisely. By contrast, an extraction or recovery can be more easily undertaken if the location is known. Sometimes there is very poor information about the location provided, such as a recent alert that someone's partner was lost in "the Dararuas [sic] for a track that starts with K." In this case, a search rather than extraction would be required at the outset.

The SAR sector responds to a wide variety of situations throughout the NZSRR and occasionally beyond. SAR incidents can be broken down into air, land, marine and 'other' categories. As shown by the graph below, the vast majority of SAR incidents take place either on land or in a marine environment.

While the total number of SAR incidents has remained steady, there has been a decrease in the number of marine incidents and an increase in the number of land incidents over the last 6 years.

SAR incidents by environment



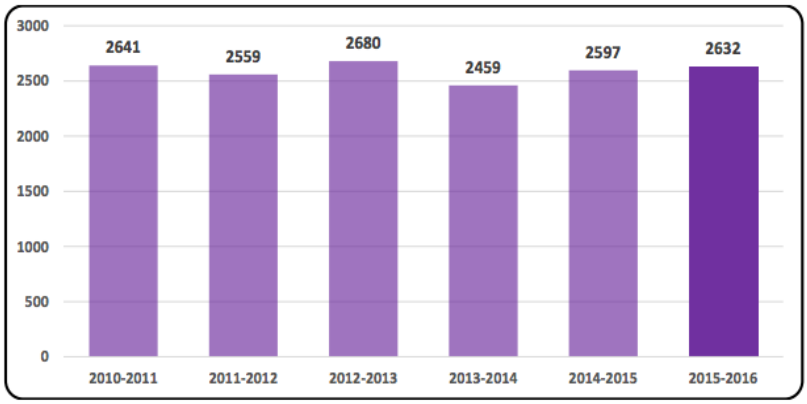
	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Air	275	270	242	266	247	229
Land	1060	1085	1132	1086	1200	1257
Marine	1253	1154	1217	1018	1065	989
Undetermined	53	50	89	89	85	157

Deployment

At the same time as rapid collection of intelligence is taking place, an assessment occurs around which assets and people are available and able to be deployed, and how to coordinate that deployment. During the 2016/17 year, there were 2,643 alerts, and which were then classified as SAR incidents, an average of 7.2 incidents per day (data on actual deployments is not collected at

present). The total number of SAR incidents over the last 7 years has remained steady, suggesting demand is neither spiking nor plunging, as demonstrated by the figure below.

Total number of SAR Incidents



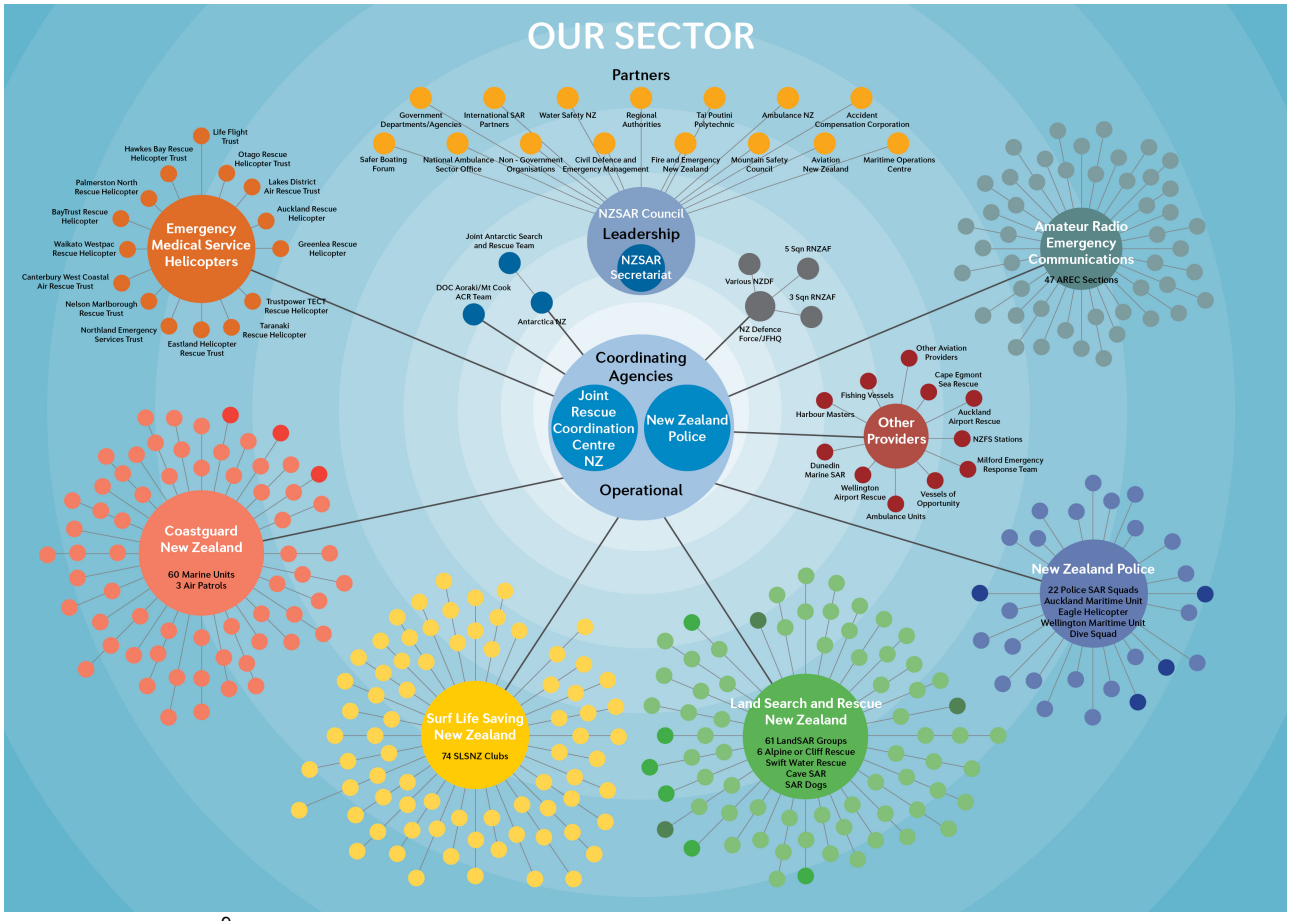
More incidents happen over the summer months between December and February than at other times in the year, presumably because more people are taking advantage of better weather for outdoor recreation at those times. As the NZSAR Secretariat has commented: "if our weather improves, demand spikes...but rapid changes in weather are the real enemy." Over 2016/17, SAR agencies successfully saved 160 lives, rescued 670 people and assisted 927 others.

Handover

SAR operations end when a person has been either recovered (in fatal incidents) or when the person/people are at a "place of safety". This process is defined in the operational manual and usually involves SAR forces handing over to another entity like an ambulance or hospital.

Supply: New Zealand's search and rescue network

The search and rescue sector comprises a highly complex range of organisations including NZ Police, LandSAR, Coastguard, Emergency Medical Services Helicopter, Amateur Radio Emergency Communications, Surf Life Saving NZ and many other providers. The sector is also resource-intensive; with over 12,000 operational people and many vehicles and aircraft.



Source: NZSAR[9]

The SAR sector works as a devolved network. Consequently, in an operational sense, the network depends on the effective coordination efforts of the Rescue Coordination Centre and the New Zealand Police. This coordination is critical to ensure various people and assets are deployed in an efficient and effective manner to provide an effective SAR service.

The NZSAR Council has Service Level Agreements (SLAs) with the following Non-Government Organisations:

- Amateur Radio Emergency Communications (AREC);
- Coastguard NZ;
- Land Search and Rescue (LandSAR);
- Mountain Safety Council; and
- Surf Life Saving NZ (SLSNZ).

The funding provided through these agreements recognises that there is a need for 'behind the scenes' functions, which do not easily attract philanthropic funding in the same way that visible community-based assets do. These include governance and management, research, analysis and involvement in cross-agency initiatives. More information on the various functions funded by these agreements is available here.

The NZ Search and Rescue sector relies on the Defence Force heavily to fulfil its responsibilities. The New Zealand Defence Force (NZDF) do not retain personnel solely for use on search and rescue activities. However many NZDF personnel participate in SAR activities on an "as required" basis and the Chief of the Defence Force is a member of the NZSAR Council.

The NZDF also maintains a roster of personnel on call for any SAR events. These are drawn primarily from the Air Force and the Navy. The resources available for commitment to SAR in the New Zealand Search and Rescue region are:

- Six (6) P3K Orion aircraft
- Five (5) C130H Hercules aircraft
- Fifteen (15) UH-1H Iroquois helicopters
- One Navy vessel at 8 hours readiness for oceanic SAR
- One Navy vessel at 4 hours readiness for coastal SAR
- Army ground rescue parties
- Military manpower, vehicles, equipment, communications and logistic support.

These resources are particularly important for undertaking operations off the mainland of New Zealand. For example, in November 2017, a New Zealand yachtsman was sailing from Vanuatu to Marsden point when his yacht mast broke and went through the hull, causing the 10-metre sloop to sink. The skipper ended up 166 kms east of Norfolk Island on a life raft in rough seas. On activating his distress beacon, the RCCNZ worked with the NZ Defence Force to dispatch one of the Hercules, dropping off a survival pack and monitoring the rescue effort overhead. Arrangements were made for him to be picked up by a cargo ship, the Norfolk Guardian.[10]

In a similar incident, a Norwegian sailor got into trouble on 18 November 2017 about 140 nautical miles east of Cape Brett when his sloop suffered mast and sail damage, a broken window, and a fire in an electrical panel. Just as above, the RCCNZ worked with the NZ Defence Force to dispatch a Hercules to locate the man before coordinating with a container ship, *MV Southern Lily,* to pick him up and take him to safety.[11]

Macro-level considerations

Analytical framework

To effectively scan the environment and understand how changes might impact on the SAR sector's ability to deliver on its key outcome, an organising structure is required. The SAR sector's effectiveness hinges on how it responds to external environmental factors as well as how it operates (its 'internal environment'). This environmental scan explores the impact of both external and internal drivers on its ability to save lives over the next 20 years. Consequently, this environmental scan asks the following main questions:

1. What are the major external Political, Economic, Social, Technology, Legal and Environmental (PESTLE) trends potentially impacting on the SAR sector's effectiveness in future?
2. What are the major internal trends or factors potentially impacting on SAR providers in future?
3. How might these trends impact on SAR services over the next 20 years?

The following framing questions have been used to explore the potential impacts of key macro-level and SAR-specific trends on the ability of the SAR network to operate effectively to save lives:

Demand for SAR services

How might this trend impact on the overall number of people who end up needing SAR?

- Are more people likely to participate in recreation (by land, sea or air)?
- Are new outdoor activities more or less risky than the existing ones?
- How might the trend impact on the effectiveness of prevention activity?
- How might the trend impact on the ability of people to get out of trouble without assistance from SAR?

Supply of SAR services

How might the trend affect the SAR sector's ability to respond rapidly and effectively to distress alerts?

- Will this trend improve or degrade the accuracy and speed of alerts?
- How might this trend affect the accuracy of situation diagnosis?
- Could this trend improve or worsen coordination and deployment of people and resources / assets to assist those in distress?

Sector capacity and capability

How might the trend impact on the SAR sector's overall service capability and capacity?

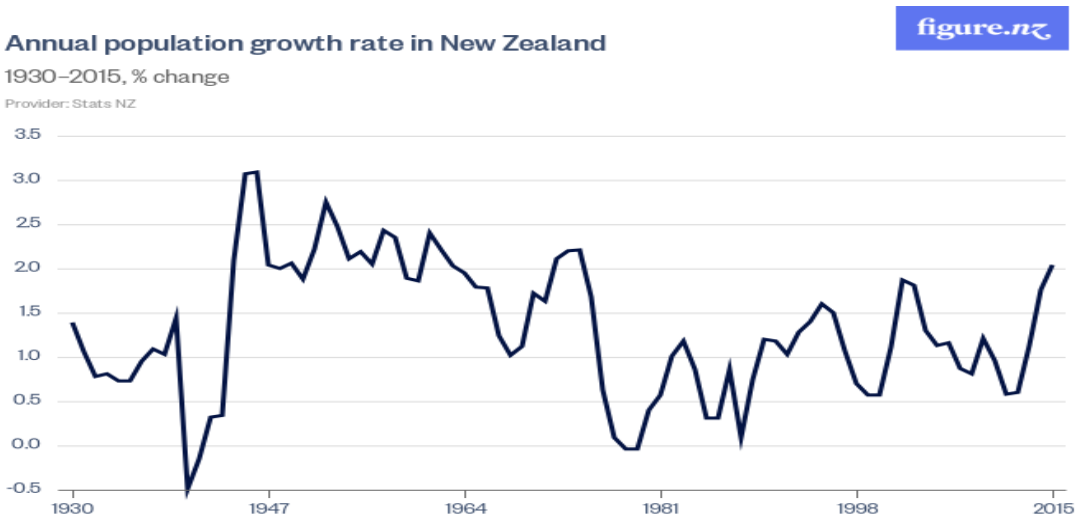
- Will this trend impose new costs, or contribute to, the SAR sector's funding?
- Could this trend make existing assets redundant or alternatively improve them?
- Will it encourage or discourage volunteering in SAR?

External trends

Demography and social trends

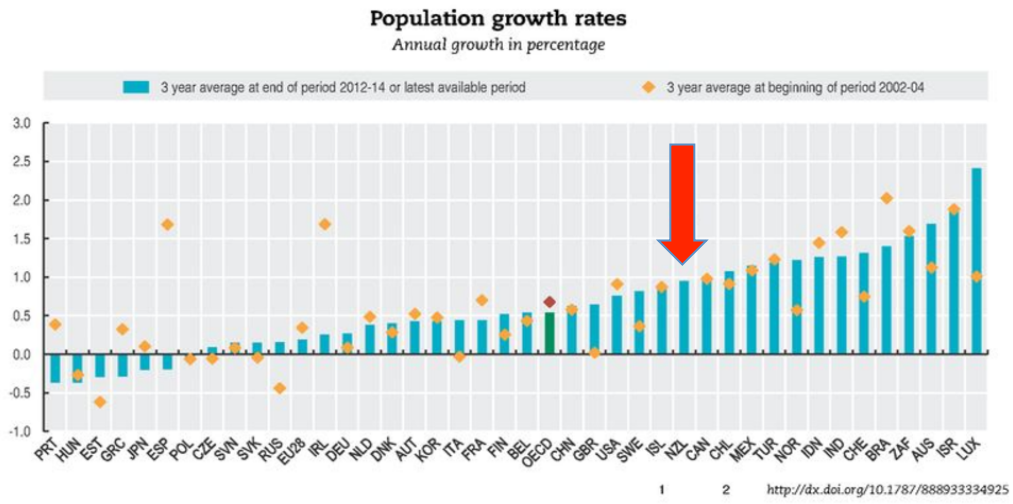
Population growth

New Zealand's population is growing reasonably fast (2.1 per cent in the year ended June 2016), but not at its fastest rate ever.



Source: Figure.NZ[12]

Statistics NZ estimates that there is a 90% probability of the population increasing to over $4.9 million people by 2020 and up to 5.5 million by 2025.[13] This may seem like a lot, but when compared internationally, New Zealand's average population growth sits pretty firmly in the middle of the pack as illustrated below.



Source: OECD[14]

What happens to New Zealand's population in future depends on our fertility rates, mortality rates and net migration. The biggest contributor in recent years has been net migration. Migration flows can change very quickly and changes are driven as much by the decisions of New Zealanders or even by other countries' immigration policies. Over the next four and a half years, the Treasury assumes migration will add 212,000 people to the population. After the end of our forecast period, Statistics NZ assumes net migration will reduce to 15,000 per year by 2022.[15]

The impact of population growth on demand is likely to be marginal

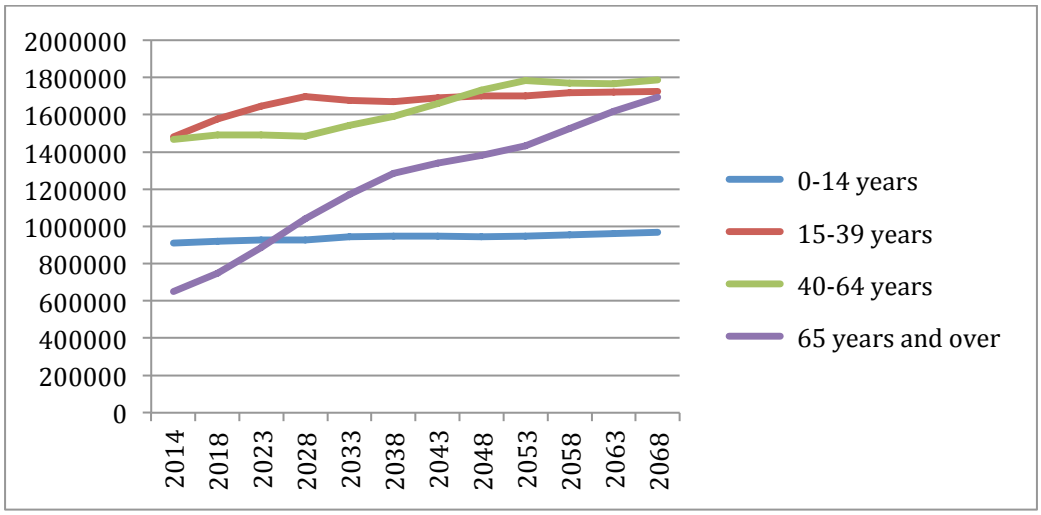
With only 2600 incidents a year, only around 0.05% of New Zealand's population is part of a SAR operation each year. Consequently, it seems unlikely that New Zealand's population growth will substantially impact on the demand for SAR services. Instead, it will relate more directly to the actions of those participating in (primarily recreation) activities on land, in the water and in the air.

In 2015, 74% of adults (2.5 million people) took part in sport and recreation in any given week. Of these, walking, cycling, jogging and swimming were most popular.[16] However, 91.3% of these were undertaken in man-made facilities, the most popular being paths, walkways or cycleways in cities or towns.[17] This means only 9.7% of activities were outside of such facilities (and logically more open to the need for SAR). This is probably a key reason why demand for SAR is so low relative to the overall population.

Ageing

New Zealand's population is ageing. Between 2013 and 2031, the population is projected to continue to age, with proportionately more people over 65, and proportionately fewer under 50. One in five New Zealanders will be aged 65+ by 2031 (1 in 8 in 2009)[18] and the numbers of people aged 85 years and older will more than triple, from about 83,000 in 2016, to between 270,000 and 320,000 in the next 30 years.[19] What these statistics don't say is that the actual number of people aged ***under*** 65 years old will also continue to grow, albeit at a much slower pace, as illustrated in the figure below.

New Zealand Population Increase by Age Group, 2014 - 2068



Source: Statistics NZ[20]

Consequently, we can expect demand from under 65 year olds to expand as well as demand from the over-65 cohort. In other words, despite the ageing population, we cannot expect demand to fall. Instead, we might expect the growth in demand due to population growth to be mitigated a little by the greater proportion over 65 years old.

What impact will the increasing proportion of 65+ year olds have on demand?

It's not entirely clear what impact the increased proportion of 65+ year olds will have. It depends on both how active they are and the extent to which they engage in risky outdoor activity.

We know that older people have generally tended, until now, to be less active than younger people. For example, Ministry of Health data suggests that:

- adults aged 65 years and over are more likely to be sedentary than those under 65 years
- adults aged 75 years and over are less likely to be physically active than those under 75 years.[21]

As an example, we know that between 80-90% of the recreational boating population is aged under 65 years old[22]. Consequently, as we have a large shift of the population into the 65+ category, we might predict less demand for SAR from recreational boaters. We also know that participation in higher risk activity generally declines once people pass the age of 65.

However, we can't assume that past trends will necessarily predict the future in relation to the ageing population. It may be that future 65+ year olds are both more active and participate in riskier/more adventurous outdoor activity than previous ones. As one participant in a feedback workshop for this environmental scan put it "70 is the new 40". For example, we know that government communications, the media and social media are all providing strong messages to the community emphasising the importance of staying active as we age for both longevity and quality of life reasons.

Healthier lifestyles and medical advances could also enable older people to stay active much longer in future. As just one example, the development of 'e-bikes' or electric bicycles, gives older people the opportunity to cycle and "conquer hills with ease" through a motor integrated into the bike. Furthermore, greater wealth may be giving older people better access to equipment and technology (e.g. personal locator beacons, satellite communicators).

There are some signs that older people are already getting more active. For example, a recent Sport NZ survey found that more than three quarters of New Zealanders aged 65 – 74 years take part in sport or recreation each year[23]. Similarly, LandSAR report that they are seeing more older people, "particularly in 'moderate' wilderness areas (i.e. not extremely rugged backcountry, but well away from road ends, usually on tracks)".[24]

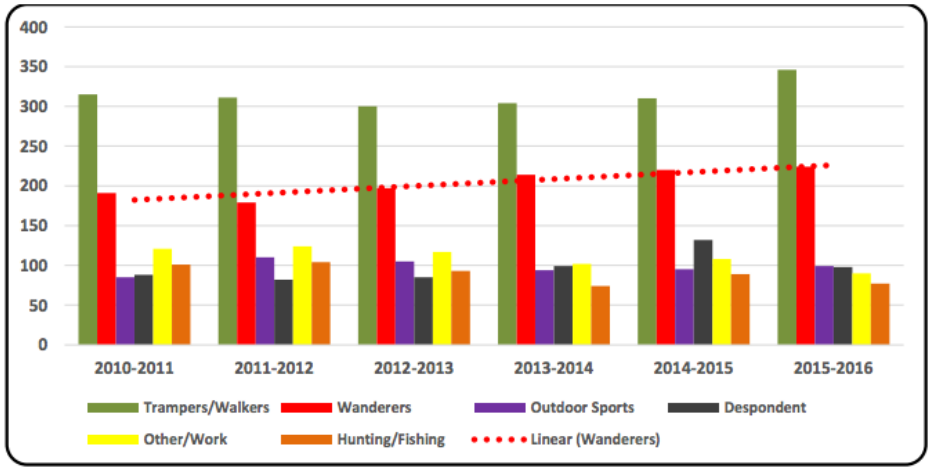
While clearly staying fit and active while ageing is a good thing, LandSAR note that the total number of active older people (particularly those engaging in slightly more risky / adventurous activity than previous generations) could result in more slips, trips and medical flare ups when

undertaking backcountry activities. In fact, they comment that they are already starting to see such events reflected in the SAROP statistics. For example, statistics from the Mountain Safety Council show that while over 65 year olds represent 5% of those participating outdoors on land, they represent 7% of all injuries and 8% of all those involved in SAROPs.[25] By contrast, 35-49 year olds were less likely to be involved in a search and rescue. [26]

Question for reflection: How plausible do you think it is that the baby boomer generation will engage less in risky outdoor activities as they age and why?

But population ageing means more dementia, driving 'wandering' and growing demand for SAR

It also seems likely that as the New Zealand population ages, we will see an increase in the numbers of people with dementia[1]. This is likely to have a flow on effect in increasing the number of people simply wandering away (e.g. into the outdoors), potentially putting themselves in physical danger, triggering a SAR response. Over the last six years there has been a slow but steady increase in the number of category 1 land incidents for people in the 'Wanderer' category. These are dementia-related illnesses, autism spectrum disorders, intellectual impairment, and missing children.



Graph 9: Subject Behaviours – trend line added for 'Wanderer' category

Source: NZSAR

The NZSAR Secretariat expects that the number of 'wanderer' incidents will continue to rise as the New Zealand population continues to age. This is intuitive, particularly given we know the number of people with dementia-related illnesses will increase. It is estimated that currently more than 40,000 New Zealanders have dementia.[27] There are currently up to 40,000 people estimated to have Autism Syndrome and Related Disorders in New Zealand.[28] By 2026, it is projected that there will be almost 75,000 people with dementia. By 2050, this estimate rises to 150,000 cases.[29]

LandSAR NZ is leading the implementation of the Wander Framework to respond to the expected increase in this type of land incident. A particularly challenging part of this problem is dealing with

[1] "Dementia" is an umbrella term used to describe a group of diseases that cause physical changes and damage to the brain. Causes include Alzheimers disease, Lewy Body disease, Vascular disease, fronto-temporal dementia and alcohol-related dementia.

[2] Portable emergency notification and locating devices can include beacon, a Satellite Emergency Notification Device (SEND) or

the potential for wandering before it occurs. This is why the SAR Institute is placing particular focus on detecting the potential for wandering early and identifying ways to prevent wandering through education for at home caregivers[30].

LandSAR are confident that in the future, "new technologies, whilst not preventing wandering, will change the response from emergency to routine, and give greater surety of outcome. Some of this technology will be sufficiently cheap and unobtrusive, that it will become a more realistic precautionary measure for families who are concerned about the increasing vulnerability of a loved one."[31] More detail on the benefits and constraints around such technologies is provided in the section on technology below (see 'improved location technology').

Question for reflection: What else might be done to better identify potential wandering and prevent it?

Disability

New Zealanders are living longer than ever before and spending more of that time in good health. A boy born in 2006 could expect to live 67.4 years in good health and a girl 69.2 years. However, while we can expect to live longer, some of that extra life will be lived in poor health.[32] The overall leading causes of health loss are cancer and cardiovascular disease.

However, as we age, the incidence of disability grows: 35% of disabled people are over 65 years old – that's 370,000 people. Disabled people are also more likely to have lower incomes than non-disabled people. It's a fact that disabled children are less likely to do social things, such as spending time with friends outdoors (according to the Office for Disability Issues). We can expect a significant growth in disability while our population continues to age (at least until technology catches up).

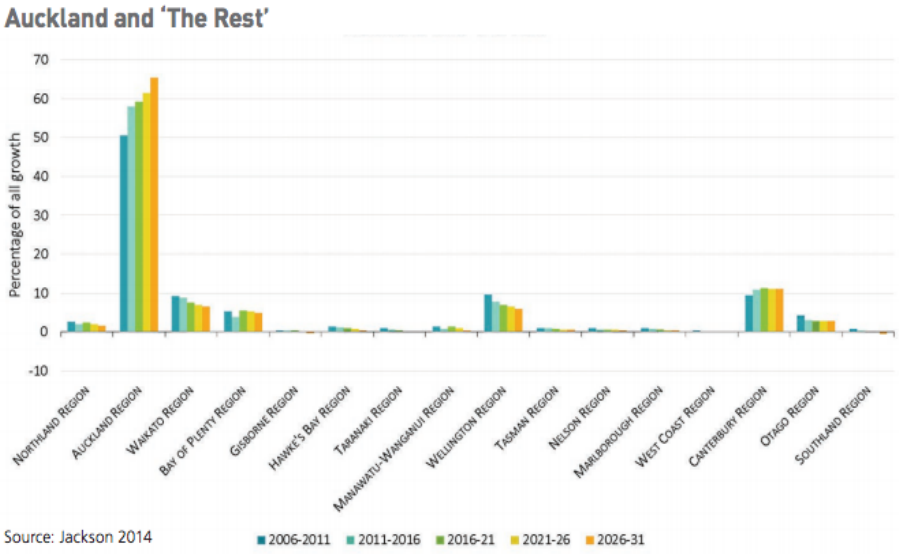
Source: Statistics NZ

In a recent *Active NZ Survey*, 'Poor health, injury or disability' was listed as the third highest barrier to participation in sport and recreation, with about 10% of those surveyed affected by it. It is plausible to expect that rising disability will also reduce the demand for outdoor activity, with a flow-on impact on demand for SAR. Of course, this might be mitigated by efforts and new technologies that may enable people with disabilities to get more into sport and recreation in future.

Urbanisation

Of the total New Zealand population, 86% live in urban environments. Population growth is predicted to slow or end in most rural areas. Urban centres are more ethnically diverse (particularly for new migrants) and rural areas tend to have older populations.

Auckland will continue to have the largest share of the population growth in the foreseeable future.[33] More than half of New Zealand's population growth between 2013 and 2043 will be in Auckland and it is expected to reach 2 million people by 2033.[34]

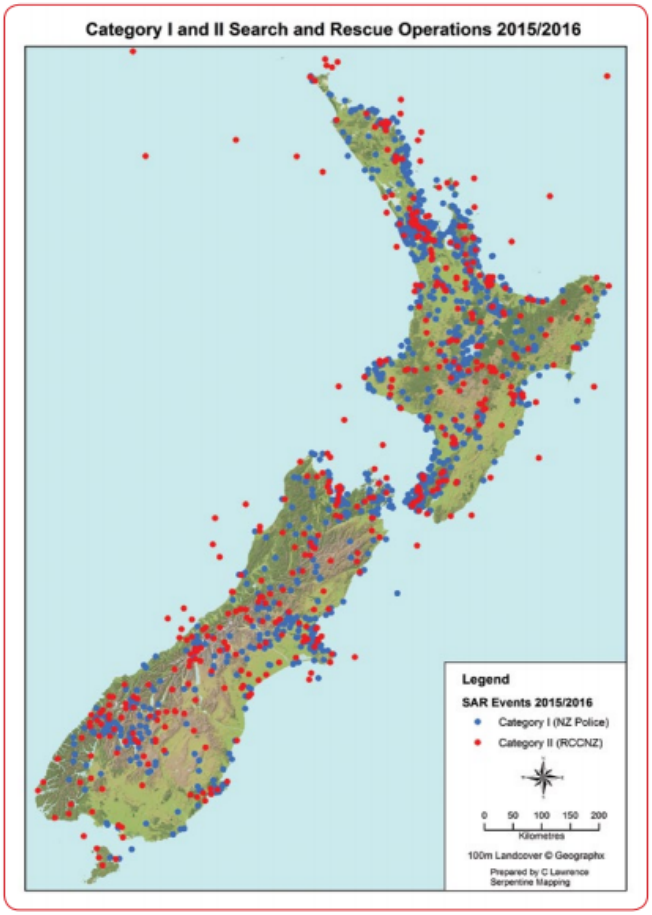


Source: Sport NZ[35]

The percentage of the population living outside of Auckland is projected to be static or decline over the next 30 years. Outside of Auckland, the rest of the north island is projected to increase by just 0.6 per cent a year from 2013 to 2043.[36] While 15 of New Zealand's 16 regions will increase in population over this time, 17 Territorial Authorities will actually have fewer births, and deaths will outnumber births in three-fifths of territorial areas by 2043.

The impact of urbanisation

It is unlikely that urbanisation will have much effect on the overall demand for SAR services. This is because while people are increasingly living in urban areas, as their cell phones reveal: they still choose to travel to spend time outdoors.[37] We can also see this through the data on the distribution of SAR operations (below), which are distributed around the country. This means that while urbanisation means people live in cities, they still spend a lot of time out of them in the outdoors all around the country.



Source: NZSAR Annual Report[38]

However, one impact that population concentration may have is on the supply of SAR services. This is explored more in the section on volunteering below.

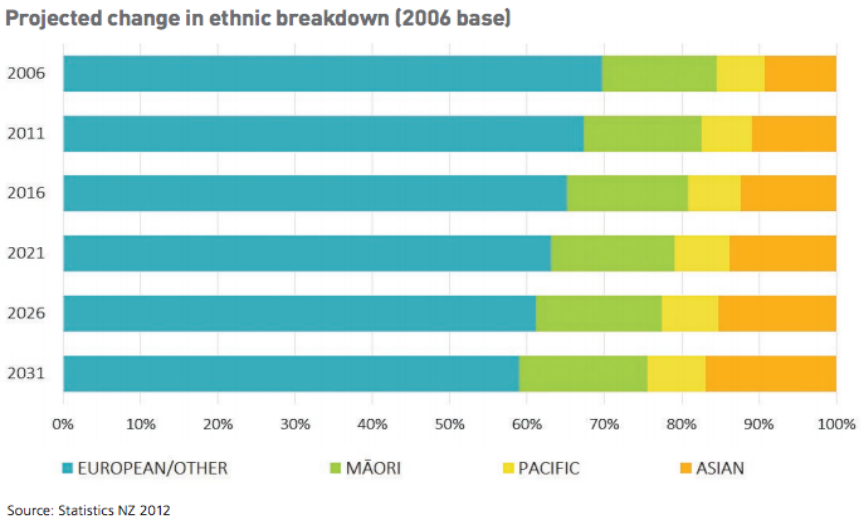
Question for reflection: What impact do you think urbanisation might have on the need for, and quality of SAR services?

Ethnic diversity

New Zealand is increasingly a country with multiple cultural identities and values. There are now 213 ethnic groups in the country, with an increasing number of people identifying with multiple ethnicities, particularly in the younger population. In 2014, migrants came from: India (7,000), China (6,300), the United Kingdom (5,500), the Philippines (3,000), Germany (2,200) and France (1,900). Migration also impacts across the country. Thirteen out of 16 regions had a net gain of international migrants, led by Auckland (17,800), Canterbury (5,600), Otago (1,100) and Waikato (800).[39]

Over the next 20 years, we can expect the proportion of New Zealanders self-identifying as NZ European to decline from 70% of the total population to just 60%. The proportion of people identifying as being of Asian descent is expected to increase by the same proportion.

New Zealand also has one of the biggest Pacific populations in the world, and this population continues to grow. Auckland's Pacific population is projected to grow by almost 60,000 by 2021, and a further 30,000 in the rest of New Zealand.



The changes in the ethnic makeup of Auckland will continue to be significantly different from the rest of New Zealand, with major growth anticipated in Asian populations in Auckland and a relative higher increase in European and Maori populations anticipated outside of Auckland.

Impact of New Zealand's changing ethnic make up on demand for SAR

New Zealand's current population growth is almost entirely driven by immigration. We know that, as New Zealand grows, it will become more ethnically diverse and preferences around outdoor recreation will evolve. Recent Ministry of Health research data has also suggested that Asian and Pacific people are less likely to be physically active than their non-Asian counterparts[40]. Further research by the University of Otago suggests that migrants in particular tend to have lower participation in recreation (and particularly the outdoor variety) than NZ-born people[41]. This finding was also recently reinforced by Active New Zealand Survey findings.[42]

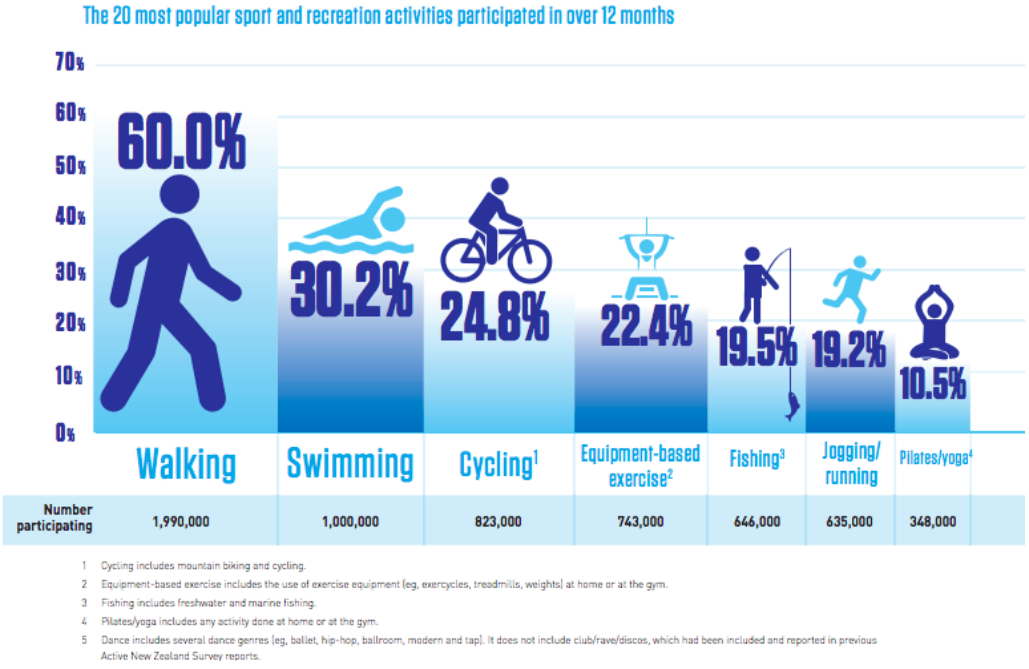
It remains to be seen whether efforts to increase participation in sport and recreation including outdoors, like *ActiveAsian*, will remove these discrepancies. But given we know that the proportion of Asians to NZ Europeans will increase by around 10% to 2031, we can expect the number of people spending time outdoors to drop a little. It is important to remember though that the proportion of people requiring SAR is much smaller than the overall population of people spending time outdoors, so this downward pressure on demand for SAR services is likely to be modest, and probably offset by other environmental drivers (e.g. increased 'wandering') which increase demand over time.

Time use

The top five activities that New Zealanders aged 12+ spent most of their time on has mostly stayed quite stable since 1998/99. These activities are sleeping, paid work, watching television, eating and drinking, and socialising with others. The exception to this is the rise in time spent consuming

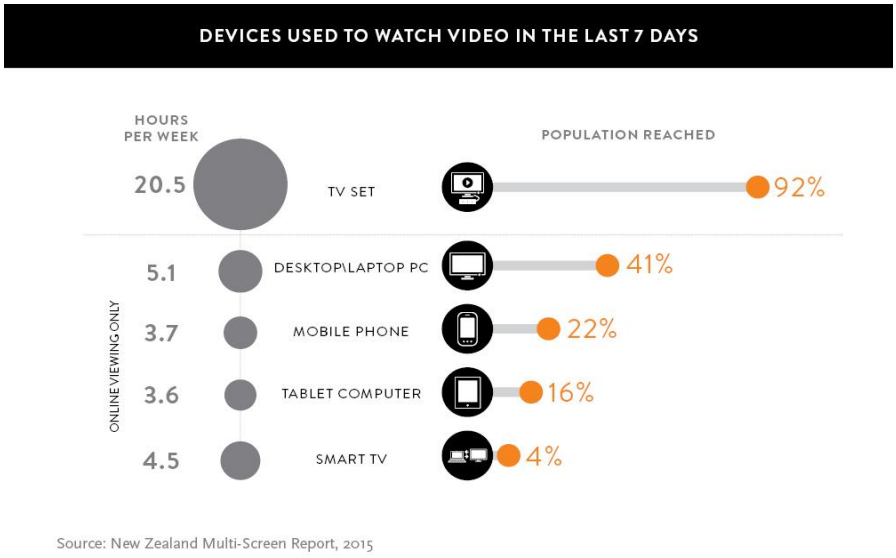
content through devices. On average, New Zealanders aged over 12 spent over 80% of their leisure time on passive media and social entertainment activities (such as watching TV, playing computer games, or socialising).[43]

NZ remains a very active nation overall. Nearly 2 million New Zealanders go on walks regularly, 1 million swim and over 800,000 enjoy cycling. Thousands also enjoy fishing and jogging as well.[44] As Nielsen comment, in its survey of New Zealanders: *"Walking, camping and working out has increased in popularity as many traditional sports such as rugby, league, cricket and netball slip back."*[45]



Source: Sport NZ[46]

This said, kiwis' sedentary behaviour is trending upwards, with 14% of adults in 2013/14 doing little or no physical activity (less than 30 minutes in total) in the seven days prior to being surveyed compared with 10% in 2006/07.[47] The situation for New Zealand children presents a particular challenge. Younger New Zealanders already watch an average of 12 hours of video content online each week.[48]



Source: Neilsen[49]

New Zealand children also have the third highest level of obesity in the OECD (11% of 2 to 14 year-olds are obese and a further 22% overweight with higher levels among Maori and Pacific children[50]). This may mean that future generations are not being taught to get active as successfully as older generations were (something Sport NZ is now very focused on helping to address). This may be in part because new technologies are currently competing with sports and recreation for children's free time. However, in the future, with the rise of augmented and virtual reality, this may no longer be the case as set out below.

Attitudes and preparedness

Demand for SAR is linked to the extent that people prepare well prior to going outdoors. Good prevention and effective training in how to stay safe when in trouble are clearly critical for reducing the need for SAR. At present, the level of public preparedness appears to be very mixed, particularly across different environments. As this scan has previously noted, NZSAR reporting shows that demand for SAR on land is increasing at the same time as it declines on water. LandSAR comment that:

> *"The most pressing needs on land relate to urban fringes (particularly occasional users, with very limited outdoor experience, who are overly complacent) and back country (where grossly inexperienced and under-prepared people are lured out of their depth because they have seen others visiting a place on social media)."*[51]

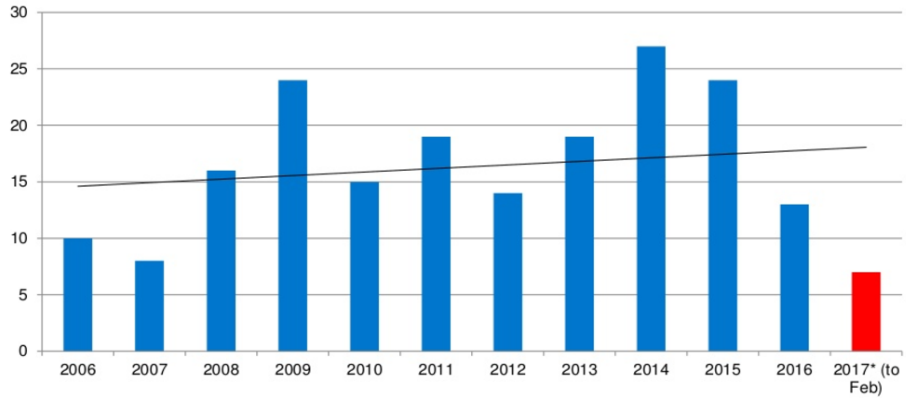
NZSAR Secretariat analysis suggests that the increase in category 2 land incidents has been, at least in part, driven by the increase in Personal Locator Beacons (PLB) that have been registered with RCCNZ[52]. Their analysis also shows that 69% of the category 2 alerts are for people participating in tramping, hunting, or outdoor sports related activities (matters that would previously have been dealt with by the NZ Police as category 1 incidents). The rise in the category 1 demand appears to be driven by an increase in wandering activity as noted earlier.

The observed reduction in the number of marine SAR incidents is possibly driven by an increase in awareness around safe boating practices in particular. Possibly through the extensive efforts of

Maritime NZ, there has been an increase in awareness and commitment to preparation before going into the water, and a drop in fatalities over the last 2 years[53]. Whether this recent dip is part of a longer-term trend remains to be seen, but the signs are hopeful. Maritime NZ's own analysis (below) suggests that over the long term recreational fatalities on the water are increasing even while they have decreased over the last 2 years.

Historical view of recreational fatalities

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Fatalities (number)	10	8	16	24	15	19	14	19	27	24	13	7



Source: Maritime NZ[54]

Messages around maritime safety and air safety may be getting through better than those in relation to land-based recreational activities. This may mean that simply getting the right set of messages around land safety is the trick for reducing further demand for SAR in the future.

Questions for reflection:

- Do you agree that more focus is needed on reducing the risk of incidents occurring on land in particular? Why / why not?
- What are the positives and negatives of relying on personal responsibility to ensure people keep themselves safe when enjoying the outdoors? What might be alternative approaches?

While some of the water safety messages appear to be getting through (e.g. 'wear a lifejacket'), there is clearly still space to improve prevention results both on water and land. There are numerous examples of New Zealanders not preparing adequately for the outdoors. These include, for example:

- only 45 per cent of New Zealanders bring enough food for emergencies with them on an outdoor trip. And only 56 per cent of New Zealanders bring a warm hat with them on outdoor trips[55];
- in one survey, although many people thought it was their responsibility to carry a beacon when walking and hiking in New Zealand's wilderness, they were not actually carrying a beacon on the trip they were doing[56]; and
- in a survey by Maritime NZ, only 63% of those surveyed said they wore a lifejacket 'every time' and more than a third did not rate emergency communications as 'very important'[57].

Possibly exacerbating this situation is the fact that club membership has fallen through the floor. Now only around 8% of New Zealanders are part of a club[58]. Clubs typically provide a measure of guidance on how to deal with outdoor situations – guidance that would be missing if people 'go it alone'. NZSAR sector participants refer to a phenomenon they call 'recreational snacking' – whereby more people engage in certain outdoor activity with no real expertise in any particular form of recreation. This may be driving some of the situations where people are going into situations not as prepared as they should be – e.g. out for a day walk with insufficient warm clothing and not telling others of their plans.

Recent research has suggested that people coming to NZ from overseas do not understand how quickly weather can change here. Recent research found that while a majority (74 per cent) of New Zealanders strongly agree you should plan for and expect weather changes in New Zealand, slightly less than half (48 per cent) of international tourists gave the same response[59]. Furthermore, international tourists were less likely than New Zealanders to bring clothing for all possible weather, enough food for the trip and sunscreen on outdoor trips. By contrast, advice on how to stay safe more generally appears to get better traction with people from overseas than kiwis[60].

Conclusion: Impact of changing demography on demand for SAR

New Zealand's population is growing steadily, ageing, and becoming more urbanised and ethnically diverse. As we age, we are experiencing more disability and we are likely to spend slightly less time in active outdoors pursuits in relative terms, but a lot of time outdoors overall. If the numbers of people spending time outdoors continues to be high, but people are not better prepared for rapid changes in their environment (e.g. due to weather or accidents), we can expect demand for SAR to remain stable or even grow.

People living in rural areas are less likely to take part in activities at manmade facilities and more likely to take part in activities in natural settings than people from urban areas. So as we urbanise, we might expect more participation in recreation in safer settings. Asian participants, those from low socio-economic backgrounds and those living in large urban areas are less likely to take part in activities in natural settings. So as we become more ethnically diverse and as inequality rises, we might expect a small drop in outdoor participation in outdoor recreation, with a flow on to reducing demand.

However, we can expect significantly more demand for SAR due to wandering behaviour of older people, except if there are major breakthroughs in treating illnesses like dementia, if prevention efforts are successful or if technology makes it much easier and more routine to deal with people going missing. This may be offset slightly by reduced participation in riskier outdoor settings of people who are more ethnically diverse and who are attracted by alternative forms of entertainment. Reduced demand for SAR services may also be driven by the tendency of older people to opt for safer and shorter stays in the outdoors – e.g. walking on established tracks.

Advice on how to prepare well for outdoor activities appears to be a useful way to help people avoid getting into trouble. It will never eliminate the need for SAR (e.g. due to mechanical failures of boats or accidents while tramping). However, evidence suggests that we are not yet at the point

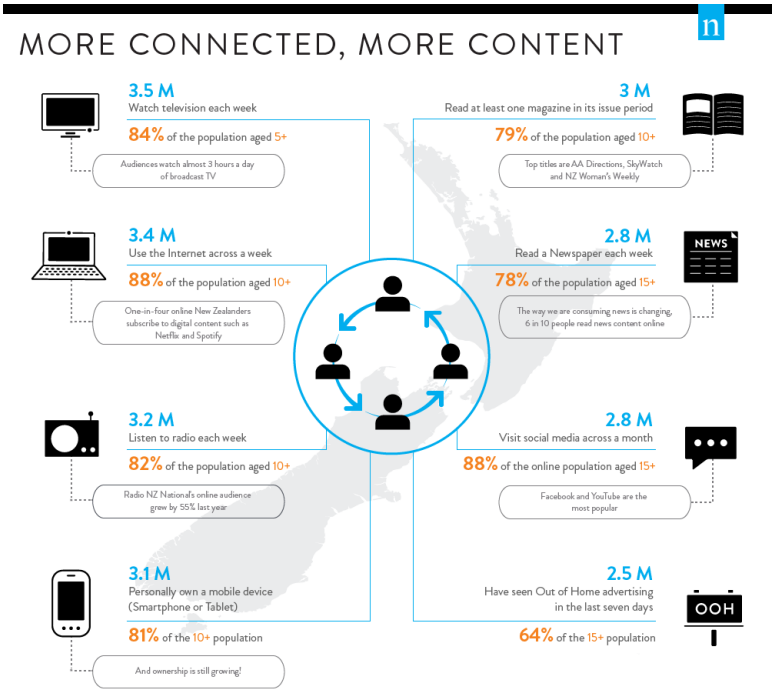
where the full benefits of such activity have yet been tapped. As New Zealand becomes more diverse and attracts more tourists, such efforts will be more rather than less important over time.

It is important to remember that only 0.05% of the overall NZ population is ever the subject of a search or rescue effort. Consequently, broad changes in population trends may not translate directly to changes in the subset of the population who end up needing SAR services. We would recommend further targeted work to better understand the range of factors most likely to lead to a SAR incident. This should enable more effective prevention activity, reducing the need for SAR services in future. It may also be useful to explore specifically how to change behaviours of those going out on walks and tramping – e.g. to take a beacon rather than just talk about it. While this may increase demand for SAR services, it will also help keep the public safe.

Technology

Always connected

As we enter the digital age, New Zealanders are more digitally connected than ever before. Over 83% of the population has a smartphone and 76% has access to Internet. By 2018, New Zealand is projected to have 90% smartphone and 78% tablet ownership levels.[61]



Source: Nielsen

We are rapidly approaching a time where nearly 100% of New Zealanders are constantly connected with a device or sensor of some sort. This presents significant potential for tracking, and thus finding, lost people more easily. It is also possible that new technologies (and existing ones used more) will help people to self-locate and recover, reducing the demand for search and rescue.

However, there is also a possible downside of the sense of always being connected: over-confidence. At a workshop on the draft version of this scan, a range of NZSAR agencies pointed to the risk of over-confidence that people have when venturing into the outdoors due to having technology. They suggested that often people assume that because they have a mobile phone, they are findable. This, of course, is not currently the case and can lead to over-confidence on the part of those going out onto the water or into the wilderness. As one participant in a workshop with the NZSAR sector put it "New Zealand terrain is not conducive to easy communication technology, especially in the wilderness areas, where there are many areas of poor communications, even for search." [62]

Possibly worsening this risk is that it is also becoming increasingly affordable for a wider range of people to get into more and more remote places (e.g. due to the cost of boats and jet skis falling). This issue may be worth considering further, for example, as a communications message to be included in future NZSAR sector prevention efforts.

Accelerating pace of technological improvement

The pace of technological change is accelerating exponentially. McKinsey estimates that the current pace of change is 300 times the scale, and with roughly 3,000 times the impact, of the industrial revolution.

Until now, much of this acceleration was driven by the ability of those making microprocessors to halve computing chip size and cost every 18 to 24 months. Known as Moore's law[63], this phenomenon has led to the incredibly fast growth we have seen in computing power without proportionate increases in expense and has led to laptops and pocket-size gadgets with enormous processing ability at fairly low prices. Moore's law itself appears to be coming to an end but recent advances in quantum computing and 3D molecular computing are being predicted by some theorists as being likely to continue the trend of improved computational capacity over time.[64] Some experts are predicting that quantum computers will be widely available within the next 5 years[65] due the massive investments and progress being made by Google, Intel and Microsoft. To get a sense of how much this will impact, Google is aiming at producing a computer 100 million times faster than the average laptop.[66]

When considering the rapid pace of technological improvement, it is important to acknowledge that across the NZ Search and Rescue Region, there are vastly different economies and capability to take up technology. Samoa and Tonga, for example, do not have the same new technology purchasing power as New Zealand, just as New Zealand does not have the same adoption potential as Australia. In this context, we can expect the adoption of technology across the Search and Rescue region to be somewhat variable in the future. However, just as Australia or New Zealand occasionally purchases a rescue vessel for smaller nations like Niue or Tonga now, smaller nations across the region may have expectations or aspirations to access new technology with the support of larger players like New Zealand.

Artificial intelligence, data analysis and big data

Critical to every SAR operation is intelligence. As described in the section on the SAR process above, the NZ Police and RCCNZ put a lot of work into gathering and interpreting information to

inform a successful SAR operation. As one NZSAR Secretariat staff member put it "if a SAR goes wrong, it's usually because we end up looking in the wrong spot, are sent with the wrong asset or not enough assets. It's all about the decisions made by the coordinating authority."

In the past few years, the cost of storing data has plummeted while the ease with which it can be captured has increased exponentially. However, the storage of data itself is useless. In order to become useful to assist decision-making, data needs to be turned into information, and information into knowledge. Currently, only around 0.5% of the world's data is actually analysed[67]. The NZSAR sector has, itself, identified the potential for more of its own data to be analysed and used to predict and prevent the need for SAR. This is already being done in certain parts of the NZSAR sector (e.g. the Mountain Safety Council and Maritime NZ already take a data analytics-led approach to much of their prevention activity).

Computer assistance is no longer just restricted to data analysis. In particular, in the last five years, significant advances were made in the fields of computer vision, speech recognition, and language understanding. All of these advances were made with the assistance of narrow artificial intelligence (AI). In the future, we can expect computers to get exponentially smarter at understanding, reasoning, seeing and learning. In other words, they will get more useful for the real world.

In particular, the improving ability of computers to capture, store and analyse vast amounts of data cheaply can considerably improve the quality of decision-making. This is partly because computers, with their ability to store information perfectly and rapidly analyse vast amount of it, have access to insights that humans alone do not. However, it takes active effort on the part of organisations to actually capture the relevant data, store it, analyse it, then inform decision-making with it.

As AI becomes much more able to interpret data, it may be that certain elements of the SAR intelligence process could be streamlined and fast-tracked further by AI systems. In particular, AI systems are increasingly proficient in areas relevant to SAR, including perception analysis, decision-making, mapping, path planning and victim detection.[68]

For now, the NZSAR sector appears to be struggling to keep up with the rapidly increasingly available technological advances. For example, LandSAR have commented:

> *"We lag considerably behind in how we capture, store and use SAR data. Even new projects…reflect old style thinking and are unlikely to get us to where we could/should be. The problem lies not so much in the technology, but in the human willingness to engage with it, to its full potential.*
>
> *[It is]…limited by the availability and inclination of operators to collect and enter data (ie. If we were to collect all the salient data, the job would be too big and people would avoid doing it). Even once the data is available, there is a widely varying degree of ability to apply meaningful insight to it. Using the data to discern useful patterns (such as key success / effectiveness factors) requires subjective judgements that can be lacking."*[69]

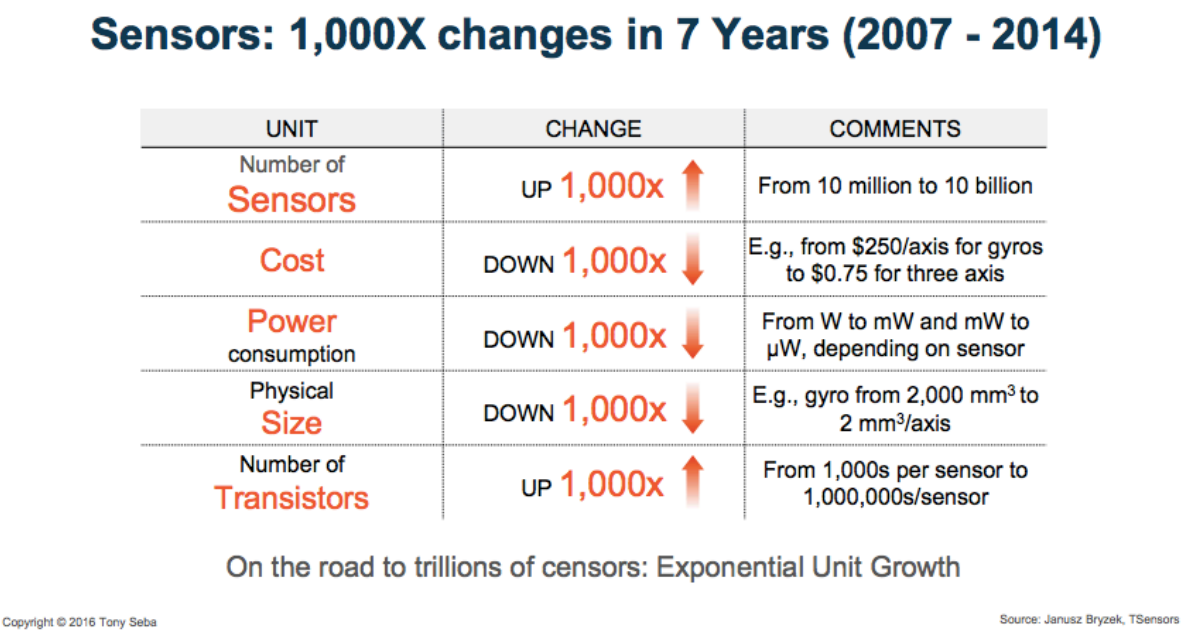
Another area identified by the NZSAR sector as potentially useful for further exploration and investment is capturing lessons from operations and sharing them (e.g. to support training efforts).

Questions for reflection:

- Do you believe the SAR sector is making the most of its data by capturing all useful data, storing it appropriately and using it to improve decision-making? If not, what more could be done?
- What opportunities to improve the efficiency and effectiveness of SAR operations might be available through new AI systems?

Improved location technology

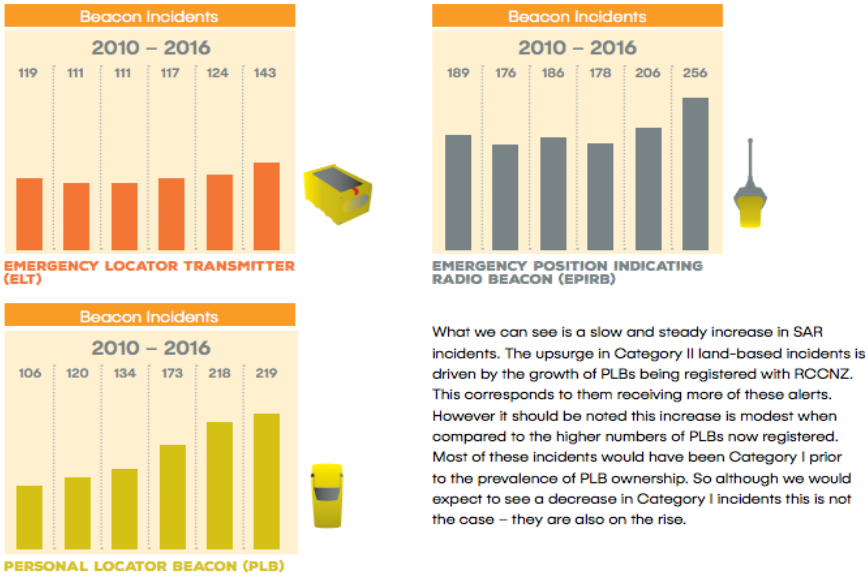
Technology offers significant potential to reduce the 'search' part of 'Search and Rescue' given improvements in the ability to locate people on land, water and in the air. For example, locator beacons are getting ever more powerful and cheaper as the cost of sensors drops dramatically and both satellite imagery and drones improve. The rapid decline in the cost of such sensors is set out below[70].



System improvements that enable improved ability to correctly identify a person or vessel in trouble, and to define the most efficient plan for SAR activities, can save many hours. This is why the array of beacons for people and craft on land, on the water and in the air, is so important. As LandSAR have commented:

> *"It is reasonably apparent that GPS and GPS-enabled smartphones are reducing the incidence of people becoming truly 'lost' and phones (including better phone coverage) and PLBs [Personal Locator Beacons] are resulting in many SAROPs, that may have been previously protracted, being resolved quickly."*[71]

We also know that the more that people have access to effective tracking devices that can locate their precise location, the more people use such devices to seek help when needed. For example, we can see a slow and steady increase in SAR incidents with the upsurge in Category II land-based incidents driven by the growth of PLBs being registered with RCCNZ.



This is particularly useful when needing to tackle tricky trends like the predicted increase in the number of older people wandering. As LandSAR put it

> *"in the medium term, technological advancements will reduce the SAR component of the response, when vulnerable person strays or is noted as missing. Real-time GPS tracking or RFID monitoring will mean that subject locations will be known immediately, or very quickly, and a care-giver going and collecting them will be a more appropriate response than a SAR call out."*

But for now, there are certain limitations of existing approaches to gathering and interpreting location data. For example, much data that would be useful for locating people on land is often not available because either a person does not have a beacon or has failed to register it. That said, certain members of the SAR sector are highly optimistic about uptake in future, commenting:

> *"We expect a lot more beacon and satellite messenger uptake without any additional promotion or change of approach. I would anticipate 80% of backcountry users carrying PLBs within 5 years. RFID tagging…will become a significant tool (eg. The introduction of the flyable Recco detection system for wilderness SAR)."*[72]

Question for reflection: Do you think it should be compulsory to carry an appropriate portable emergency notification and locating device[2] when going into the NZ outdoors? Why / why not?

[2] Portable emergency notification and locating devices can include beacon, a Satellite Emergency Notification Device (SEND) or shipping Automated Location System (AIS) and the soon-to-be introduced aviation equivalent.

Similarly, traditional approaches to tracking the positions of aircraft (radar, transponder, Automatic-Dependent Surveillance Broadcast) have come under scrutiny recently when MH370 was able to disappear without a trace.[73]

Extrapolating from this, we might expect improved ability to locate people in the future as a combined impact of:

- more satellite-based communication opportunities generally, making it easier to locate people;
- wider cell phone coverage; and
- more recreation closer to cities where coverage is likely to be better
- more devices available that claim to aid SAR responders or people in distress.

The SAR sector is already drawing on new technologies in a number of areas to improve its effectiveness. For example, a new distress signalling system was introduced a few months ago that automatically provides the location of the signal. Furthermore, as one staff member put it "we're becoming less search and more rescue. This is great because it leads to better outcomes."

Questions for reflection:

- Is the SAR sector making best use of emerging technology to assist with locating people as efficiently and effectively as possible?
- What assumptions underpin the SAR sector's ability to locate people in distress?
- Could changing any of these assumptions (e.g. "people should be responsible for their own planning") improve the efficiency and effectiveness of operations?

Tracking systems like SARTrack[74] and SKYTRAC[75] offer the ability to improve the quality of tracking by exploiting the increasing availability of satellite imagery. Next generation tracking technologies are likely to improve exponentially in the coming decade and are worth NZSAR Secretariat monitoring continuously to establish opportunities to improve its capability in this critical area.

Automated vehicles, robots and drones

In the future, much of our lives will involve automated machines. For example, already automated navigation systems are increasingly being adopted globally. NZIER estimates that driverless cars will have a $1.4 trillion dollar impact on the global economy.[76]

Automated navigation will affect car and truck drivers, ship navigation, manufacturing, agriculture workers, pilots, people working in the food and drink industry and many other jobs. Norway is spearheading the effort to create autonomous cargo ships[77]. Given that 37% of boating emergencies are caused by human error, with others being caused by 'man overboard' or medical injury, taking the human out of the equation altogether should ultimately reduce the need for SAR by nearly half (when it involves a commercial vessel).

One major potentially useful implication of automation in the SAR space is the ability to get machines to do the jobs that are too dangerous for humans. A recent example of this was the proposal to use robots to explore the Pike River Mine following the disaster there. Other similar

robots already exist overseas.[78] Such robots were used, for example, to rescue people following the 9/11 attacks in New York.[79]

Another significant use of this rapidly improving technology is drones. Global Market Insights forecasts that the agricultural drone market size will exceed $1 billion and 200,000 units shipped by 2024. Drones are already being explored for use in SAR missions in New Zealand[80] and overseas. Recently, for example, the Royal New Zealand Navy backed a search and rescue drone project proposed by Paraparaumu College's robotics club. The proposal involves finding a way to launch a drone from ship which has the intelligence to locate a lost person overboard.[81]

However, it appears there are several factors slowing down the adoption of drones in the New Zealand SAR context. As one person put it:

> *"[There is] lots of potential for drone use in SAR but this needs to be supported by coordinating authorities (ie. the bill payers) and by a more accommodating regulatory environment (eg. being able to easily close airspace for SAROPs would get around the safety issues that are there with drones operating beyond line of sight).*
>
> *Incorporating some algorithms (based on lost person behaviour, spatial data, best practice and SAR response guidelines) into SAR management software would probably prompt better decision making from managers."*[82]

Overseas, drone swarms are being developed[83] to help in SAR operations, including through global networks of drone enthusiasts such as the "SWARM network".[84]

Over the last few years there has been rapid development in the field of drone technology that can operate autonomously. While no approved autonomous drone systems are publicly available yet, the technology is being tested and developed[85], particularly in a military setting[86]. MIT's system involves wheeled, autonomous drones that can switch between flying and driving.[87] A team of Swiss research has developed a specific SAR drone, which also includes AI in the form of a "deep learning", neural network that mimics the human brain: this allows the drone to process and recall visual experiences.[88]

Impacts of emerging technologies on SAR

There are likely to be positive impacts from new technologies both as a result of the kit that members of the public have (e.g. mobile phones, wearables) as well as the improved technology available to SAR agencies.

There are unique challenges in the New Zealand context, including the vast area of our SAR region and the challenge of penetrating dense bush and mountainous environments. Combining drone technologies, automation, AI and night vision / new water scanning technologies could provide game-changing operations for fast and efficient SAR in future. This could go well beyond just using drones as platforms for sensors as they are now. Furthermore, drones could provide a much more cost-effective solution for SAR activities over assets like planes and boats which are very expensive both to purchase and maintain by comparison.

Already, certain key elements of SAR coordination are rapidly becoming computerised with NZSAR increasingly looking for people with computer networking, information management, and/or keyboarding skills.[89] Preparing to employ both robots and drones for rescues could be a useful way of offsetting a decline in the numbers of volunteers. For example, due to its demographic changes, Japan is running out of people to care for its elderly, so it is using robots to replace this workforce instead.[90]

There is some suggestion from members of the SAR sector that the regulatory environment (ie. Civil Aviation Authority regulations) is currently the major impediment to using autonomous drones for search and rescue. Consequently, working with the CAA to unblock this impediment could well prove worthwhile for helping the sector access these powerful tools in future.

Interestingly, the CAA itself has commented on the potential for more use of drones in future, saying:

> *"Particularly in areas where the risk to public is low (e.g. over water at a beach), small drones might be used to quickly deliver emergency lifesaving equipment like flotation devices. If the technology develops sufficiently, they might also be used for virtual or remotely monitoring at unattended beaches. They might be used for searching for missing persons. They might also be used as aerial communication relay stations where there is insufficient coverage in a particular area – they are being trialled overseas for this purpose already."*[91]

Question for reflection: Do you think drones and robots could replace certain parts of the SAR process? If so, which parts?

Enhanced human ability through technology

Advances in technologies like exoskeletons are being used to enable those with disabilities to undertake physical activity that would be otherwise impossible.[92] Such technologies are already enabling humans to perform feats of strength and endurance – things that could be very useful in a SAR context. For example, in Italy they have created a bionic arm, commanded by the human brain or a limb extension, which allows rescuers to lift rubble off people after disasters.[93]

Significant advances come when multiple technologies are combined – such as the DJI drone[94], which combines with a 3D printed exoskeleton to become a dedicated SAR tool. These tools are getting improved battery life and more opportunities for cameras allowing them to perform much better. They are also being made better at dealing with obstacles.

In the future, such systems will become exponentially better as they benefit from the general research into AI. Already, we are seeing the power of AI in other fields – for example, IBM's Watson is already better than doctors at diagnosing and enabling treatment of certain disease like skin cancer and Leukaemia. This same processing power could be usefully applied to SAR challenges.

Rise of virtual and augmented reality

Worldwide revenues for the augmented reality and virtual reality market are projected to approach $14 billion in 2017, according to IDC, the market research firm. But that's forecast to explode to $143 billion by 2020.[95] The development of new apps like Pokémon Go, which use an augmented overlay on reality, could see more people using the outdoors in non-traditional ways, especially young people. This could create some risks, as people get distracted by the technology while in risky situations. In the USA, for example, it was reported that Pokémon Go caused more than 110,000 road accidents in just 10 days[96].

However, the ubiquitous nature of such new technologies could also make it easier to locate people in distress as such devices increasingly signal a person's location. For example, increasingly systems are being made available, with GPS included, to track the location of both children[97] and older people[98] to help prevent wandering. Furthermore, new augmented reality platforms (e.g. Google glass) could assist in SAR efforts by providing rescuers an overlay of information or data relevant to the search effort (e.g. clarifying which areas have already been searched to avoid duplication of effort).

Question for reflection: On balance, do you see augmented reality presenting more risk, or more opportunity, in the context of SAR? Why?

One highly anticipated area of development is the growth of 'personal clouds', which will assemble personal health, lifestyle and consumer information, in ways that individuals will themselves control. They will support people to make sense of their schedules and fit their lifestyle and social activity into their days and link with the products and services they value (Cameron 2013, Summers 2013).[99]

These clouds will also provide a useful potential mechanism for those searching for missing persons by helping identify where they were located last. Cell phones are already used like this, but when wearables also transmit to personal clouds, this could present a whole different layer of information to assist searchers.

Question for reflection: If you were lost or hurt, would you be ok with authorities accessing your personal data to help find you?

Looking ahead, we are looking at humans being ever more tethered to sensors of one sort or another. Not just phones, but a wide range of wearable devices, machines and clothing will all increasingly contain sensors. Known as the 'Internet of Things', technology giant Gartner estimates that up to 26 billion devices will be connected to the Internet by 2020.[100] These sensors combined with AI will make objects more intelligent. People and things will be ever more traceable than before – something that may prove very useful in a SAR context, particularly if people have not necessarily prepared adequately for outdoor activities themselves.

Conclusion: Impact of technology on SAR

The pace of technological advancement is rapid and only going to get faster. Overall, these advancements offer considerable potential improvement in the ability to conduct SAR operations

efficiently and effectively. These improvements are likely to come from a range of sources, including:

- better ability to locate people because they are always connected;
- better sensors capturing (location and other) data;
- more automation, meaning fewer people at sea (e.g. autonomous ships) and reduced human-error induced incidents; and
- better machines, such as drones and robots, able to go where humans can't go easily, and do so faster and more cheaply than sending humans.

There is also considerable potential for significant transformation of how SAR is both prevented and conducted. Data analytics (including predictive analytics), big data, artificial intelligence and automation/robotics combined offer powerful opportunities for both reducing demand and conducting SAR operations effectively and efficiently in future. We can confidently predict that in the near future, images collected by drones and satellites will provide real-time global information that artificial intelligence (AI) can and will use to find and rescue people with a high degree of accuracy. AI offers significant potential here because computers are much better than people at filtering large volumes of information (e.g. maps covering vast areas) and spotting anomalies (e.g. a person-shape floating in an ocean).

But even small changes in how technology is used now can make a difference. For example, one simple suggestion made by one SAR sector person was to disseminate knowledge regarding the capability and best use of emerging technologies to the SAR community – especially to Incident Management Team (IMT) members. Another was to establish authoritative advice, or help desks, for IMTs to access during operations.

According to some members of the SAR sector, the main barrier to progress in exploiting new technology for improved SAR services is a human one. As one person put it:

> *"It is almost limitless – the technology is there, it just needs human thinking to guide it. It is a struggle to get SAR people on board with the potential because of the demographics of the sector (i.e. dominated by older age groups).*

Others in the sector noted that financial changes within the sector are potentially holding back adoption of new communications technology, particularly for Police, the Department of Conservation and the Ministry of Civil Defence and Emergency Management.[101]

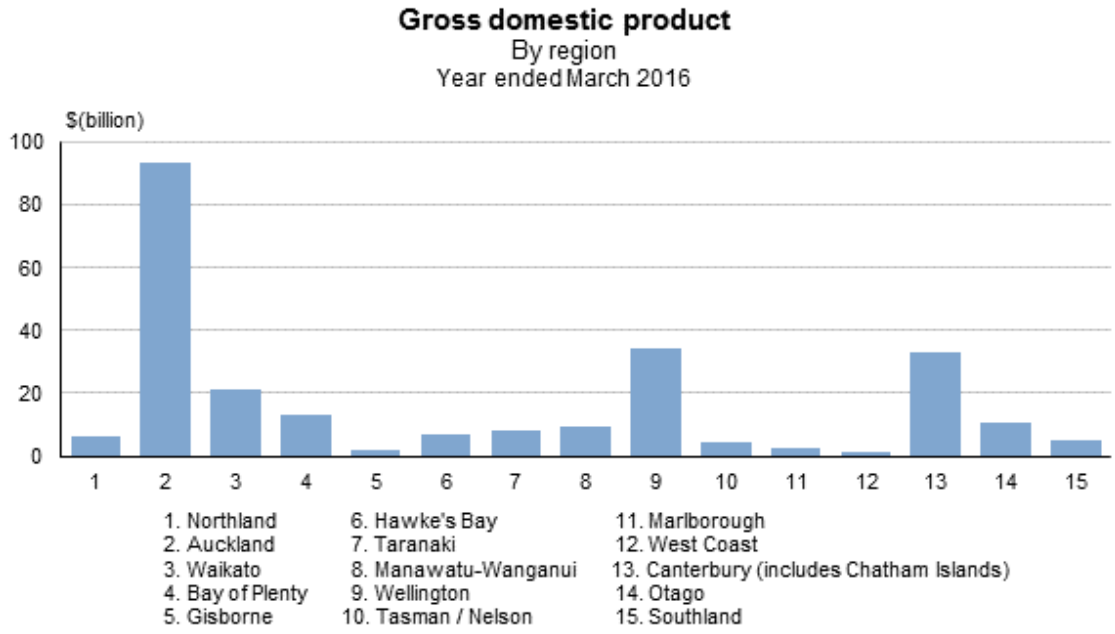
One other thing the SAR sector has raised which may warrant more attention is technological asymmetry – when some older technology is in use at the same time as some new technology. For example, when the NZ Police recently switched off some of their analogue radio channels, this had a flow on impact for a range of agencies involved in the SAR sector. Such transitions from older to newer technologies will need to be very carefully planned in order to avoid disruption to SAR services. As one SAR sector person put it "the current downward trend for HF radio usage and support is placing SAR teams at risk and potentially can have fatal consequences for team members and missing persons."[102] Another person observed there will also be a need for increased knowledge and experience to support new technologies being adopted.[103]

Economy

A steadily growing economy

New Zealand's economy is growing steadily. Annual real GDP growth is expected to rise to a peak of 3.8% in 2019, from about 3% at the moment. High net inward migration, construction, exports including tourism and low interest rates are supporting this growth. The longer-term forecast sees real GDP growth slow to 2.4% in 2021 as interest rates rise and spare capacity in the economy is used up.[104]

Our GDP closely follows our population distribution, with the biggest contributors to economic growth being Auckland, Wellington and Canterbury in that order (see below).



Source: Stats NZ

High employment levels but falling real incomes

New Zealand's employment levels are high. At 75%, the employment rate in New Zealand is the third highest among OECD countries.[105] Youth are one group that was badly affected by the global financial crisis in New Zealand and hasn't recovered. Despite recent improvements, the youth unemployment rate still stands near the OECD average of 15%, up from 9% in 2007.[106]

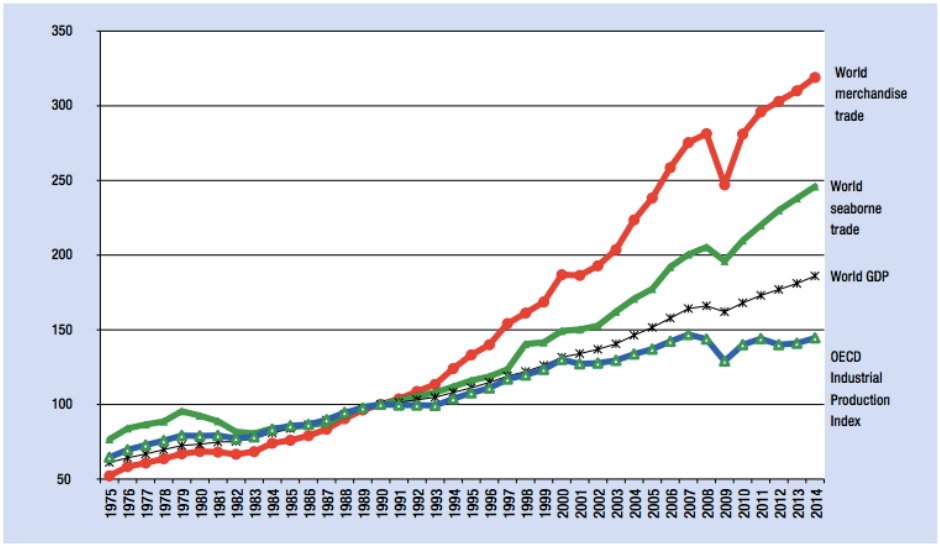
The 2013 census showed the median personal income was $28,500. This was an increase of 17% ($4,100) from 2006.[107] However, once you adjust for inflation, the picture is not quite as optimistic. Real hourly wages have fallen markedly over the past five years.[108] This is likely to reduced job losses during the downturn following the GFC and promoted employment growth in the recovery. However, it has also created hardship for affected workers and families.

Further out, the Treasury expects the number of people with a job will grow faster than the number of people looking for employment. This will lower the unemployment rate to about 4.25%. As this happens, businesses will find that competition for job openings decreases and they will need to raise wages to attract people.[109]

Rapidly rising (sea and airborne) trade

Global trade merchandise trade has increased massively over the past 20 years as set out in the diagram from the Organisation for Economic Cooperation and Development (OECD) below.

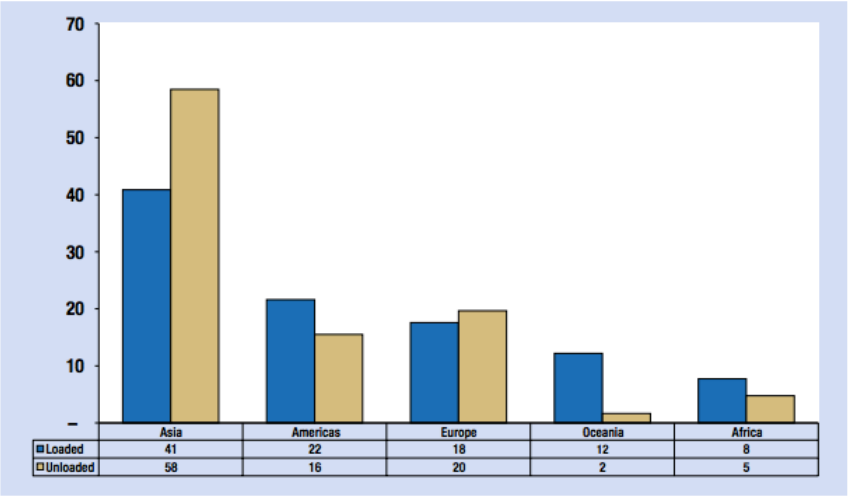
Figure 1.1. The OECD Industrial Production Index and indices for world GDP, merchandise trade and seaborne shipments (1975–2014) (base year 1990 = 100)



Sources: UNCTAD secretariat, based on OECD Main Economic Indicators, June 2015; United Nations Department of Economic and Social Affairs, 2015; LINK Global Economic Outlook, June 2015; UNCTAD *Review of Maritime Transport*, various issues; WTO, appendix table A1a, World merchandise exports, production and gross domestic product, 1950–2012; WTO press release 739, 14 April 2015.

Source: UNCTAD Review of Maritime Transport[110]

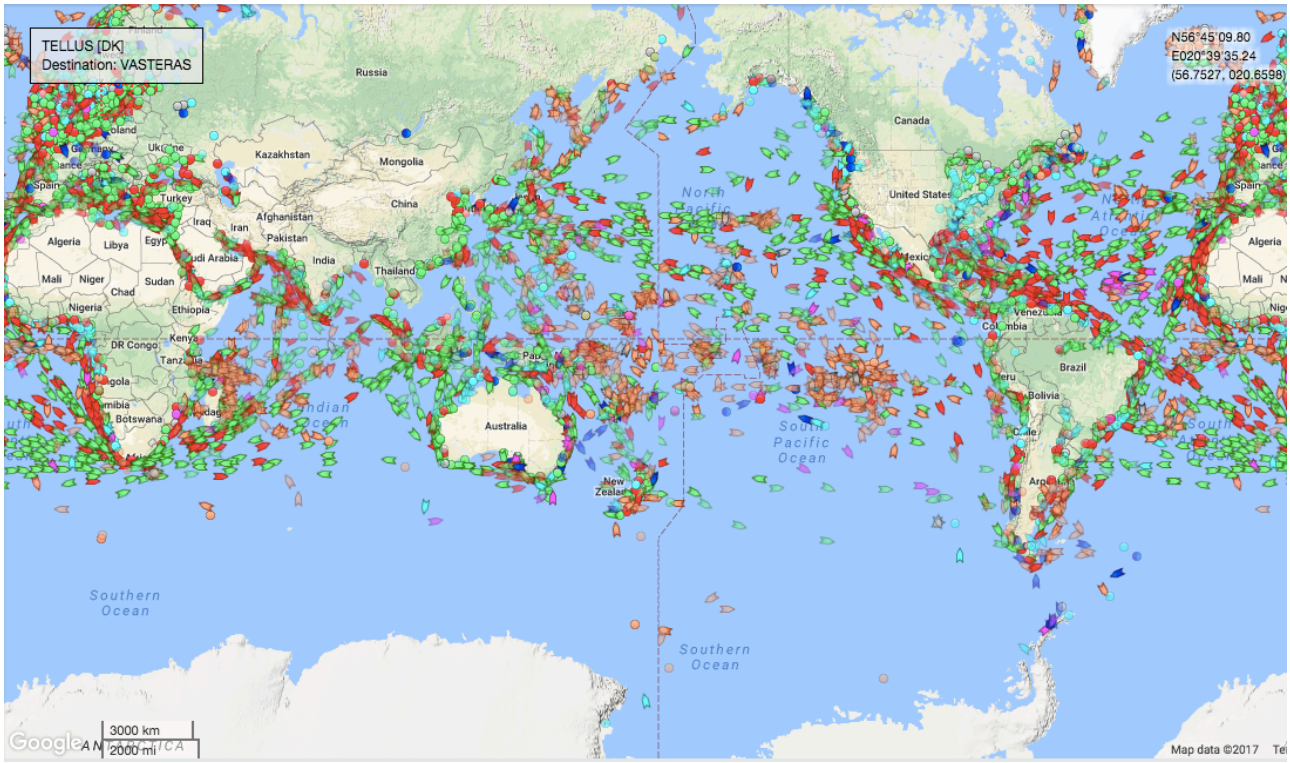
The Asia-Pacific region dominates the picture of growth in world seaborne trade (see the diagram below) and, while an adjustment in demand for gas and oil (due to cheap solar power) could occur in the next 5 years, there is likely to continue being growth in the trade of other merchandise for some time to come.



Sources: UNCTAD secretariat, based on data supplied by reporting countries and as published on the relevant government and port industry websites, and by specialist sources. Estimated figures are based on preliminary data or on the last year for which data were available.

Source: UNCTAD Review of Maritime Transport[111]

The map below gives some idea of just how crowded the seas are becoming as a result of much more seaborne trade, fishing and more passenger vessels.



Source: Marinetraffic.com

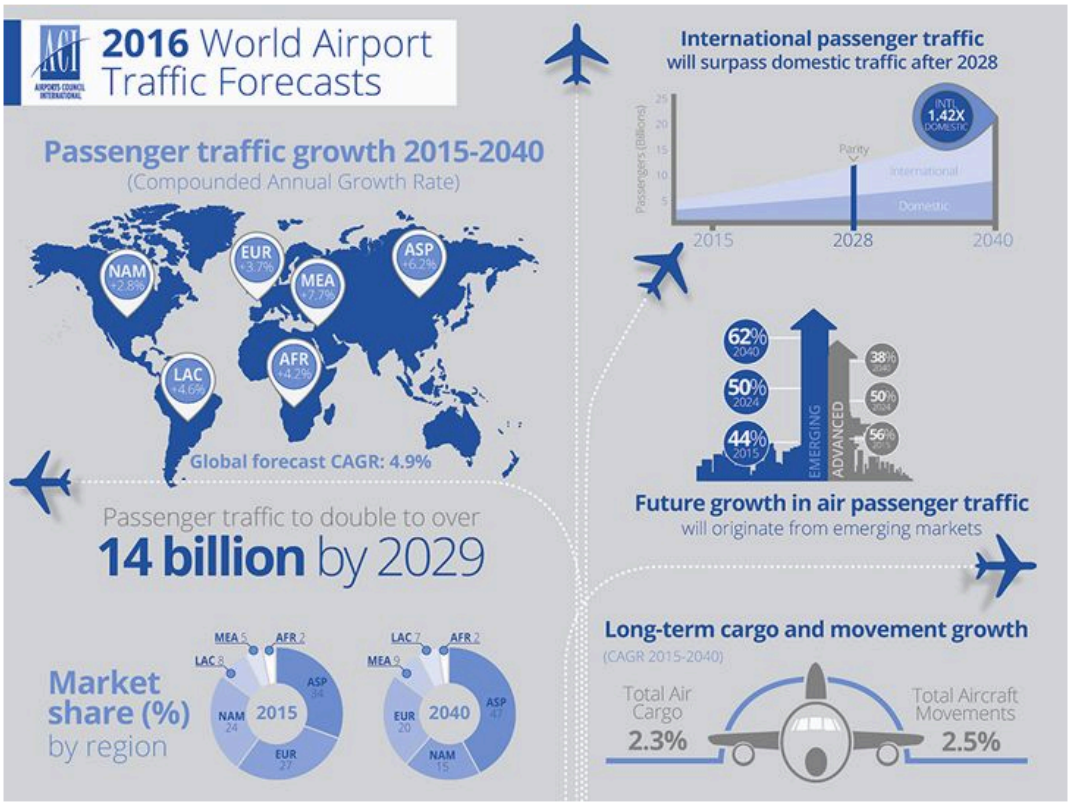
A further complicating factor could be the rise of unmanned ships in the future. Current international shipping law states that ocean-going vessels must be properly crewed, so fully autonomous, unmanned ships aren't allowed in international waters. However, earlier this year the UN's International Maritime Organisation (IMO) began discussions that could allow unmanned

ships to operate across oceans. Rolls Royce demonstrated the first remote-controlled, AI-supported unmanned ship earlier this year with planned release date of 2020. In addition, several Japanese shipping firms, for example, are reportedly investing hundreds of millions of dollars in the technology. This raises the prospect of cheaper shipping with fewer accidents in future.[112] Some people think that without experienced crew aboard, accidents that do happen could be much more severe. However, in its 2016 annual overview, the European Maritime Safety Agency found that 62% of the 880 accidents occurring globally (2011-2015) were caused by "human erroneous action".

The Rolls Royce prototype unmanned ship

Source: Rolls Royce

As well as significant growth in volume in our seas, we can expect ongoing increase in air traffic. The graph below illustrates that the Asia-Pacific region is expecting one of the high growth rate in air traffic in the world over the next 25 years. This will reflect both growth in passenger traffic and cargo movement around the world.



Source: Airports Council International

With more sea and air traffic, there is the potential for more accidents, errors and (both machine and human) malfunctions, leading to increased need for search and rescue in the short to medium-term. However, as more human error is taken out of the equation, we might expect a reduction in demand from these sources in the long term.

High income inequality

The distribution of wealth among households in New Zealand is skewed heavily in favour of those at the top of the income spectrum. The wealthiest 20 per cent of households in New Zealand hold 70 per cent of the wealth, while the top 10 per cent hold half the wealth.[113] Research by Sport NZ has demonstrated that people from low socio-economic backgrounds are less likely to participate in sport and recreation in outdoor settings[114]. Consequently, the continued increase in inequality in New Zealand could reduce our overall enjoyment of the outdoors. A minor benefit of this negative trajectory would be a small potential reduction in demand for SAR services.

More automation of work

In the longer term, one of the implications of rapid advances in AI and robotics is that more and more work will be able to be automated. This is particularly the case for jobs that involve repetition or following a list of instructions (otherwise known as an algorithm). People all around the world have predicted many jobs being automated. In Britain, commentators are predicting that more than 10 million workers are at high risk of being replaced by robots within 15 years.[115] In the USA, estimates are as high as 60 per cent.[116] In New Zealand, NZIER has estimated up to 46% of jobs are at high risk from automation over the next 20 years.[117]

However, some commentators are beginning to suggest that the future may not hold mass unemployment as much as mass adjustment and evolving employment. In particular, these analyses suggest that the direction, at least in the short term, will be towards humans working alongside automated and robotic systems to get the best of both worlds[118].

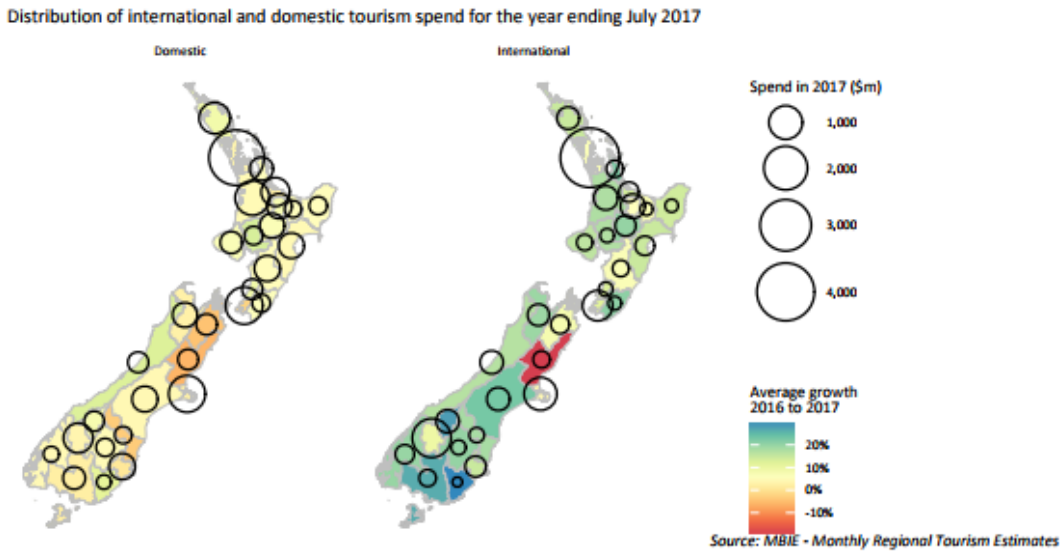
With increased automation, it is possible people will have more time for leisure. However, this has not been the case to date. In 2013, 61.5% of people worked 40 hours or more per week in their main job; this was an increase from 59.2% in 2006. In the long term, particularly with the event of quantum computers, it is possible that humans will be less needed. In this scenario, unless we retrain a large number of people in non-automatable work reasonably rapidly, we can expect that large numbers of people will have less work due to automation. This is likely to lead to less income to participate in certain leisure activities – e.g. those requiring money such as boating, flying or using jet skis.

Question for reflection:

- How might more automation of work impact on the demand for, and supply of, SAR services?

More tourism

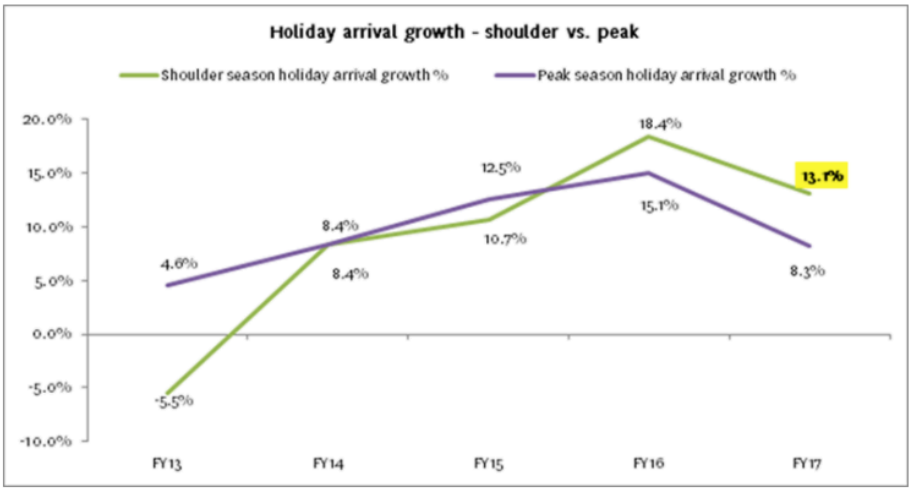
Tourism has become big business in New Zealand and across the whole search and rescue region. In 2016, international tourism expenditure contributed $12.9 billion to the New Zealand economy, or 5.6 per cent of GDP and 20.7 per cent to New Zealand's total exports of goods and services.[119] In the year to August 2017, there were 3,670,000 visits to New Zealand by tourists from overseas, a growth of 9% on the previous year.[120] The graph below gives an indication of where these tourists go in New Zealand.



Source: Key Tourism Statistics, Ministry of Business, Innovation and Employment[121]

Visitor arrivals to New Zealand are expected to grow 4.8 per cent a year, reaching 4.9 million visitors in 2023 from just over 3.5 million in 2016.[122] Total international spend is expected to reach $15 billion in 2023, up 52 per cent from 2016. [123]

Furthermore, there is an active drive by Tourism New Zealand and Tourism Industry Aotearoa[124] to promote the shoulder seasons (October, November, March and April) and get tourists to less popular locations around New Zealand. This strategy is getting results: Statistics New Zealand data shows holiday arrivals in the spring and autumn grew 16.1 per cent and 10.2 per cent respectively over the last year. This compares to the summer peak season holiday arrivals growth of 8.3 per cent[125].



Graph comparing shoulder and peak season growth.

Source: Tourism NZ

The impact of increased tourism over the shoulder seasons on the search and rescue sector remains to be seen. It is possible that the the tourism strategy above could have an unintended flow on impact on the search and rescue sector. For example:

- tourists spending more time in the New Zealand in seasons with more variable weather could increase demand for search and rescue (more people getting into trouble); and
- tourists going to more remote locations where search and rescue services are less well equipped could raise difficulties in undertaking SAROPs.

In addition to more tourists coming in the shoulder seasons, it appears that tourists are increasingly using social media to get information on places to visit. Traditional sources of visitor information have been used in the past to convey safety messages to tourists. These safety messages can be missed when people access their information about where to visit via social media instead. As one member of the NZSAR sector put it "social media carries no responsibility and we are already seeing it result in tourists end up [sic] out of their depth."[126]

Question for reflection:

- What impact might more tourists coming to New Zealand have on demand for SAR services?
- Do you think the increase in tourists coming during the shoulder season might increase SAR demand?

- How do you think the SAR sector should plan for more tourists coming to NZ for the outdoors, tourists coming on the shoulder season and going to more remote locations? If so, what should it do?

More cruise ships

The cruise sector is growing rapidly, affecting both New Zealand and the other countries across the NZSRR. During the 2016-17 season there were 235,900 passengers that undertook a cruise in New Zealand. Over the coming two seasons it is expected that the number of passengers could increase to over 344,000, which is equivalent to a growth rate of 21% per annum[127]. The total value added (synonymous with GDP) to the economy by cruise tourism for the 2016-17 season, was $447 million, which is expected to increase to $640 million by 2018-19.

Number of cruise ships visiting NZ, by region 2016-17

Cruise Season	Port days			Economic Contribution		
Region	Vessel*	Passenger*	Crew*	Expenditure ($m)	Value Added ($m)**	Employment (EC)**
2016-17 - Port Calls						
Northland	49	93,200	37,300	$ 15	$ 15	297
Auckland	142	244,500	96,200	$ 419	$ 197	3,165
Waikato	conf	conf	conf	$ 0	$ 10	143
Bay of Plenty	86	170,300	69,500	$ 39	$ 38	853
Gisborne	11	25,500	9,900	$ 3	$ 3	65
Hawke's Bay	54	99,400	37,100	$ 17	$ 17	419
Taranaki	conf	conf	conf	$ 0	$ 4	41
Wellington	87	169,000	66,000	$ 39	$ 55	808
West Coast	conf	conf	conf	$ -	$ 1	11
Canterbury	85	141,300	59,300	$ 37	$ 49	956
Otago	83	163,600	64,500	$ 32	$ 34	738
Southland	102	171,700	67,600	$ 11	$ 9	201
Nelson-Tasman	7	3,100	2,300	$ 1	$ 2	42
Marlborough	38	78,400	28,400	$ 12	$ 10	218

Source: m.e consulting[128]

Cruise ships are generally a very safe way to travel. However, they do sometimes suffer from a range of problems, most of which are very low level. For example, globally:

- between 1990 and 2011, there were around 79 fires on cruise ships;
- From 1980 to 2012, about 16 ships have sunk
- there are around 3-4 preparations to evacuate ship, though actual evacuations are very rare; and
- around 2 ships a year run aground.[129]

According to a recent report from research firm G.P. Wild, globally each year an average of 10 people die and 60 more are injured on a cruise as a result of so-called "operational incidents," which are basically mishaps — things like fires and explosions, collisions, technical failures and ships getting stranded, grounded or sinking — that cause delays, injuries or fatalities[130]. The bottom line is that things will occasionally go wrong on cruise ships (e.g. power failures or insufficient fuel), but lives are very rarely put at risk on a cruise ship. Consequently, it is possible that demand for SAR will rise as a result of New Zealand's burgeoning cruise ship industry but it is likely that the Coastguard should be able to divert most of this potential demand for SAR.

While mostly New Zealanders are helped by the SAR sector, visitors to the country and region are also assisted when required. It is important to note that non-New Zealanders only account for around 10% of total people helped by SAR providers. Typically one in four holiday visitors during the last five years participated in a walking or hiking activity during their visit to New Zealand. This equates to over a million international visitors, at an average of 254,000 per year.[131]

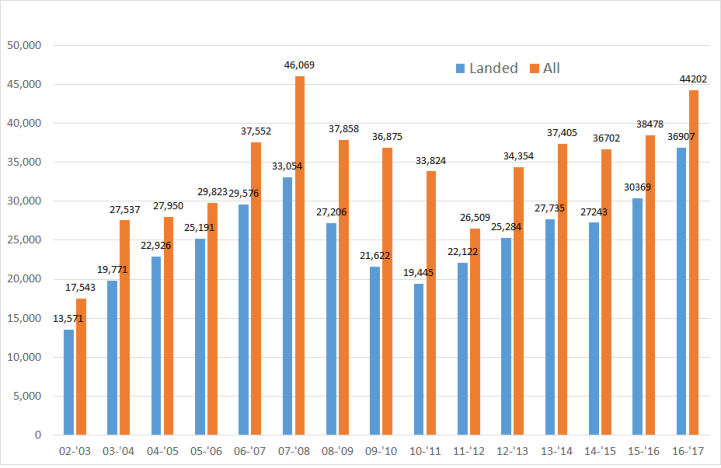
More aircraft

Back in 2014 Auckland Airport released a 30-year vision, which showed it expected more than 40 million passengers per year to be passing through the terminal by 2044. Already the growth trajectory is pressuring those expectations with passenger growth up 26% in the last three years and a 61% increase in the number of international airlines at Auckland Airport over the same time period. Today around 19 million people per annum pass through Auckland Airport (which grew by 10.6% over the previous year)[132]. Wellington and Christchurch both service around 6 million passengers each and Queenstown is servicing around 2 million.[133] All of these airports are facing increased demand over time.

Visits to Antarctica

Tourist expeditions have ventured to Antarctica every year since 1966. In recent years, these expeditions largely are conducted aboard some 40 vessels, each carrying from six to 500 passengers. The ships sail primarily to the Antarctic Peninsula region[134]. Tourism to Antarctica is steadily on the rise and is nearly at its highest levels again as set out in the diagram below. The most recent figures for the 2016-17 season show that there were 44,202 visitors.

Tourist numbers to Antarctica, landed[3] and all, 2002 - 2017



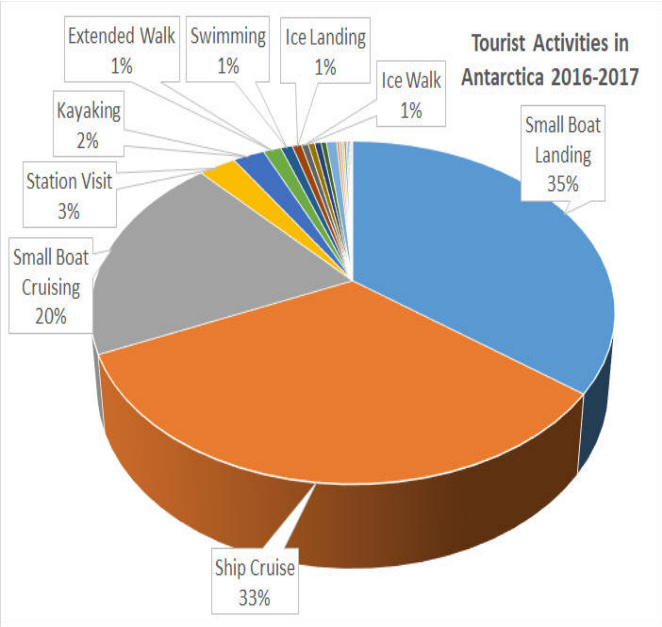
Source: Ward P. *Cool Antarctica*

Both large and smaller groups going to Antarctica present risks in terms of potential demand for search and rescue. Even when in larger boats and planes, visitors may face dangers due to mechanical failure, running out of fuel, storms or ice. As more and more cruise ships and aircraft

[3] Landed - those who set foot on the continent or an island in Antarctica whether they arrived by ship or air, such tourists typically spend 6-30 days in Antarctica. The difference represents those people who went but didn't land, this group typically cruise for just 3-4 days in Antarctic waters as part of a longer cruise trip and also includes those who overfly in a sight-seeing flight taking a matter of hours.

visit Antarctica, we may also see increased numbers of older people having medical misadventures there also.

Another threat comes from smaller expeditions that are becoming increasingly common by individuals and small parties. This is demonstrated by the graph below:



Source: Ward P. *Cool Antarctica*

As one commentator puts it:

> *Antarctica requires careful planning and a series of fail-safe rescue procedures if anyone gets into difficulty. These smaller expeditions sometimes fail to do this adequately and resort to "humanitarian" requests for aid from shipping or nearby national bases when they get into difficulty. A few years ago for example a small helicopter (totally unsuitable for the task) crashed into the sea off the Antarctic Peninsula[135] requiring rescue and an attempt to fly across Antarctica via the pole in a small aircraft ended with the aircraft crashing and the pilot being rescued by nearby base personnel."*[136]

The weather in the Southern Ocean is nature at its most extreme, with the potential for hurricane force winds and waves as high as 18-23 meters. With modern safety and ship design the odds of sinking are low, but the odds of being thrown about by a wave are high.[137] Generally, numbers of SAR incidents in Antarctica are rare at present, but when they do occur they are highly costly and tricky to coordinate. This is because they rely on coordination across the multiple nations to negotiate issues around territorial sovereignty, occasional international tensions and accessing the closest and best assets to effect a timely search and rescue operation. Even more difficult is that such search and rescue operations must operate under critical timeframes with little room for error, and lives at stake in very remote areas.

Impact of increased tourism

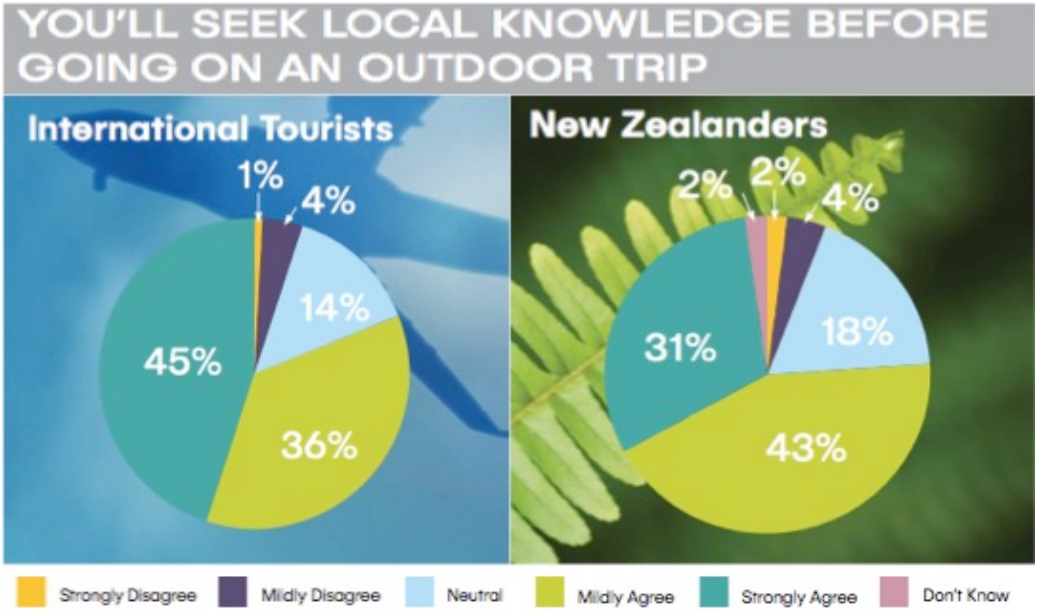
While the overall numbers of tourists entering New Zealand and across the whole New Zealand Search and Rescue Region is large and growing, the proportion of people needing SAR services is actually reasonably flat. Over 2015/16, only 15% of people needing SAR services were international tourists.[138]

Category 1 and 2 SAR Incidents

	2013/14	2014/15	2015/16	2016/17
Citizen / Resident	2236	2223	2258	2178
International Tourist / Visitor	364	400	408	432
Not known	250	158	279	357
Total	2850	2781	2945	2967

Source: NZSAR Secretariat email, 3 Oct 2017

Furthermore, in a survey of tourists that came to New Zealand in 2015, more than 80% said that they would seek local knowledge before going on an outdoor trip.[139] There was actually a higher proportion of international tourists who 'strongly agreed' with the suggestion than New Zealanders as set out in the graphs below.[140]



Source: NZSAR Annual Report[141]

These findings reinforce the vital role that SAR people and others such as tourism operators, play in ensuring that visitors have the necessary information (which is often specific to the activity or area you work and play in) to keep themselves safe. It also suggests that the preventative strategies used for New Zealanders may need to be different to those used for tourists.

Conclusion: Impact of economic change on SAR

In the future, the biggest economic impacts on the SAR sector are likely to come from two main sources:

- increasing tourism, bringing a large number of visitors and tourists to New Zealand who engage in outdoor activity with highly variable levels of preparedness;
- more automation of work, potentially leading both to more leisure time for everyone (not guaranteed), but certainly meaning SAR staff will increasingly need to work alongside both computers and other machines (e.g. drones and robots).

New Zealanders love spending time outdoors and many millions are likely to continue doing so in the future. A steadily improving economy and improving employment levels put this in reach for many Kiwis. However, for some people (e.g. those on very low incomes), there are barriers to participating in the outdoors (e.g. the need to take on multiple jobs or shift work). However, overall it is clear that Kiwis will continue working and playing in the outdoors, leading to a small proportion requiring the assistance of SAR.

Politics, policy and legislation

Potential for politicisation

According to NZSAR Secretariat staff, SAR is not a highly politicised area among political parties, at least with respect to the New Zealand mainland. There is broad agreement among New Zealanders that search and rescue is a valuable and critical public service and New Zealanders get great value for money from the service (which is confirmed by NZSAR's research, suggesting a benefit-cost ratio for the service of 30-1). The political consensus reflects this view on the mainland also.

The main concerns brought into the political arena have been around whether search and rescue agencies receive adequate funding to fulfil their roles and, in particular, to train staff and volunteers properly. In a survey of SAR's operations, respondents said they expect all SAR agency staff to be well trained – something that comes with a cost.[142] Both the government[143] and the opposition[144] have explored whether training and facilities for SAR are adequate over the last few years. It is possible that political parties take different perspectives in future on the correct funding model for SAR services (see 'funding' below).

Apart from the funding, other reasons that the SAR sector (on the NZ mainland) could be politicised in future would include, for example, evidence coming to light that:

- a rescue was severely mishandled, leading to severe injury or death of either the person(s) being rescued or rescuers;
- SAR were not sufficiently prepared or able to assist people making distress calls in a major disaster such as earthquake and/or eruption.

It is important to note that the politics with respect to the operation of search and rescue on the New Zealand mainland are very different to those operating across the wider search and rescue region.

When undertaking search and rescue in the broader region, the SAR sector must operate very carefully to get a good result. For example, as highlighted earlier, it takes careful coordination across multiple nations to effect successful search and rescue operations in Antarctica. This is both because a range of different nations owns Antarctica, and limited available assets must often be shared in order to save lives. For example, the USA owns the world's largest ice breaker – which the RCCNZ has sought to access in the past – to assist with search and rescue efforts. While there is a general understanding among nations in Antarctica of the need to share assets, this often takes careful negotiation in practice for it to work for all concerned.

Similarly, across the various Pacific Islands to the north of New Zealand, the RCCNZ must negotiate carefully with multiple nations to get the right people, right assets and right access to effect successful operations. For example, Kiribati technically operates outside of the NZ Search and Rescue region – it technically resides within Fiji's region of responsibility. However, sometimes the nation requests help from the RCCNZ if there is a need for search and rescue and New Zealand is best placed to help. In this context, the RCCNZ must negotiate effectively and rapidly with Fiji on agreed roles and responsibilities to get the best result possible. As a further example, the RCCNZ now has a Service Level Agreement with Korea in order to enable rapid and effective responses if and when Korean fishing boats catch fire (which they often do).

Questions for reflection:

- How likely do you think it is that the SAR sector could come under political scrutiny due to a failure in its funding, training or delivery?
- What more do you think should be done to mitigate this risk?

The devolved nature of the sector does pose certain risks. In particular, if leaders or staff of different organisations in the SAR sector, have strong personality conflicts or differences of view about how the overall system should operate, this could translate through to dysfunction at the operational level, potentially even compromising operations. That said, high quality memoranda of understanding and conflict resolution protocols may be sufficient to resolve any such problems if and when they arise (rather than something more costly and dramatic, like a merger as occurred recently in the fire services). Further strengthening the case for this is the fact that most of the organisations participating in the SAR sector only undertake SAR activity a small proportion of their time.

Questions for reflection:

- How well do you think the SAR sector operates as a single coherent whole?
- What changes, might be needed to help it operate better as an integrated system?

It is important that in the future the effective operation of the SAR sector be systematised from the national, all the way to local level, rather than leaving it to informal personal connections. There are indications that the sector is moving in this direction already. The Ministry of Civil Defence and Emergency Management is currently reviewing its operations in this regard and may identify some lessons that could prove valuable for the SAR sector as well.

Policy and legislative environment

Decisions around policy and legislation impact a lot on the demand for SAR activity. Legislation sets out the responsibilities of agencies for promoting safe outdoor recreation. For example, under the Maritime Transport Act, Maritime NZ has a range of responsibilities to promote safe recreational boating on seas, rivers and lakes. It also has a range of enforcement powers to prevent unsafe practices[145]. For example, the fact that there is currently no legislative requirement for mandatory skipper licensing or vessel registration has a direct impact on the ability of Maritime NZ to oversee and regulate safe practice on the water[146]. It also means there is a missed opportunity to potentially impose user charges which could subsidise SAR activities.

Furthermore, even adjacent legislation such as that regulating the use of drones and the speed with which vehicles can travel close to shore, can impact on the ability of the SAR sector to operate effectively. For example, Surf Life Saving New Zealand has to get dispensation to use Inflatable Rescue Boats (IRBs) and jet skis within 200 meters of the shore. Similarly, current Civil Aviation rules[147] require drone users to both only operate during daylight and maintain a line of sight with a drone and there are restrictions on using drones near airports. NZSAR Secretariat staff note that during both the Kaikoura response and dealing with the Port Hills Fires, they had to stop the response for a time because someone was flying a drone nearby. In the future, as drones become more able to operate autonomously and potentially more useful for SAR operations, the review of relevant legislation and regulations may be in order.

Similarly, changes to the legislative environment, structure, funding and operations of SAR partners can all have an impact. Recent examples include:

- the merger of rural and urban fire services creating Fire and Emergency NZ;
- changes to the contracts between the Ministry of Health and Air Ambulances;
- the introduction of 2015 Health and Safety at Work Act; and
- changes to the structure of the NZ Police.

We can expect policy, legislation and funding changes to continue happening in future as the NZ public service continues to evolve. For example, in future, we might see policy initiatives around:

- consolidation of 24/7 monitoring and alerting functions;
- new consideration of how emergency services work together following the FENZ review;
- the funding model for air ambulances, police and health services (e.g. ambulances, hospitals);
- continued professionalisation of accounting and human resources practices; and
- changes to the funding arrangements – e.g. changes to the fuel excise duty or road funding model (e.g. as a result of electric cars), would have a direct and material impact on the funding of search and rescue activity (for better or worse).

The international legal framework and policy environment is also critical for the ability of the NZSAR sector to mitigate and manage demand for search and rescue. For example, the RCCNZ, as well as managing day-to-day relationships with international partners to effect successful SAROPs, also look to proactively prevent the need for search and rescue in the Antarctic. They have worked hard to progress work on the International Code for Ships Operating in Polar Waters (the "Polar code") to ensure that vessels which are not fit-for-purpose do not venture into the unforgiving waters of the Southern Ocean.

This involves negotiations with a range of other nations and aims to improve the standard of vessels, which can both reduce the need for search and rescue in future and improve the likelihood of survival for those aboard such vessels. The agreement also seeks to reduce the potential damage that unsalvageable ships and boats can have on the pristine Antarctic environment.[148]

As another example, the RCCNZ is also an active participant in work with International Civil Aviation Organization (ICAO) to promote a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector. There is significant ongoing effort being put towards agreeing standards of international aviation safety, then working nations across the NZ Search and Rescue region to build capability and meet these standards. This is work, which if completed well represents an important way to prevent or reduce demand for SAR services in future (e.g. through fewer plane crashes).

The important thing is that the NZSAR sector continues to actively monitor emerging policy, legislative and funding changes (both within NZ and internationally) and actively engages across government to understand the potential impact on their effective functioning as part of its risk management process. For example, in the course of preparing this environmental scan, several members of the SAR sector commented that they had concerns that the new Health and Safety legislation could inadvertently deter volunteers. These kinds of concerns are usefully expressed as inputs into government legislative processes, so that they can be factored in, rather than after the legislation has passed.

There are also implications of certain Acts and regulations that need to be considered after the fact in terms of their impact on the obligations, risks and liabilities of the SAR sector. For example, one NZSAR member has commented that

> *"LandSAR uses people without demonstrated competencies unlike Coastguard and Surf. This will have to cease at some stage under the Health and Safety legislation. At present LandSAR does not have a framework on place to support structured competency assessment and management. They have a project to address this but it has a long way to go."*

Questions for reflection:

- How effectively does the SAR sector interact with other parts of government to assess and manage risks and opportunities arising from broader policy, legislative and political processes?
- Is anything more needed in this space?

Conclusion: Impact of politics and legislation

SAR is not a highly politicised area at present. There is broad consensus that what the SAR sector does is very important and the main areas of disagreement will likely be point-scoring around whether they have enough resourcing to do it. The big potential for this to change is if persistent underfunding is revealed and/or operational failure occurs.

The ability of the SAR sector to function effectively does depend on having fit-for-purpose legislation across the myriad of Act and regulations spanning land, air and sea activity and the

organisations working in these different environments. It is possible that the SAR sector could use more of a presence in the Wellington policy community both to scan the range of changes across agencies that could impact on its functioning and to ensure there is a top-down perspective on the sector happening somewhere. This would enable the sector to advise Ministers and influence the direction of legislation and policy that could impact meaningfully on both its role and its ability to fulfil that role in the future.

Environment

Each year, New Zealand's SAR partners (particularly Maritime NZ) are involved in around 100 SARs in the Pacific region, both within our SAR region and outside it.[149] The region faces unique challenges for SAR with small countries and populations spread over the world's biggest ocean. SAR must be conducted across over 30 million km^2 of ocean, across many array of small dispersed island groups and often in highly dynamic weather patterns. There are also significant communications challenges and limited access to SAR assets[150].

Pacific countries work together to build SAR capability throughout the region. This includes, for example, providing clear guidance to those living on Pacific Islands about how to stay safe on the water.[151] It has also included funding $8.1 million of maritime projects in Tokelau, Tuvalu, Niue, Cook Islands, Tonga and Kiribati (in 2016-18). This includes upgrading maritime VHF radio channels, lights, navigation beacons, other navigation aids and, in some cases, SAR vessels. Most of the projects are not SAR specific but they help reduce the number of SAR incidents.

Climate change

The impact of temperature increase on the planet is likely to be felt particularly strongly across the Pacific region due to many low-lying coral islands being located at sea level.[152] Parts of the Pacific are already experiencing sea-level rise of more than three times that of the world average. That in itself is a major threat to nations whose land consists of low-lying coral of with no more than a couple of metres' elevation.[153] This was highlighted in 2012 when Kiribati began buying land in Fiji so that it could move islanders under threat from sea levels.[154] Ocean warming, frequent tropical cyclones, flash floods and droughts are likely to have a dramatic impact on the Pacific Islands.

In the future, the Pacific region can also expect widespread increases in extreme rainfall events, large increases in the incidence of hot days and warm nights. While uncertainties remain for tropical cyclone projections, they are projected to occur less frequently in the Pacific Ocean over the 21st century. But projections do suggest an increase in the proportion of storms in the more intense categories.[155]


Heaviest rain in a month swamps fields and floods streets in Tauranga, with more to come

29 May, 2017 7:00am · 2 minutes to read

Rain swamped the sports field at Greerton Marist Rugby Club on Saturday. Photo/Maxine Paterson

Source: NZ Herald[156]

Question for reflection: How well prepared is the SAR sector to accommodate increased calls for help (both in New Zealand and from Pacific neighbours) as a result of climate change driving more flooding and extreme weather events?

Conclusion: Impact of environmental change on SAR demand

Climate change is likely to drive increased demand for SAR services, both in New Zealand and across the Pacific, in the future. All nations in the Pacific are likely to be subjected to rising sea levels, causing more flooding, and much more severe weather such as cyclones and storms. There are already good SAR networks operating across Pacific partners. However, with frequently less than ideal communications ability and access to assets across this vast area, excellent planning for increased demand will be needed in future. There is also likely to be increased need for NZSAR agencies to cooperate with other government agencies like the Ministry of Civil Defence and Emergency Management given the increased risk of environmental emergencies (e.g. floods, storms) in future.

Internal SAR-specific factors

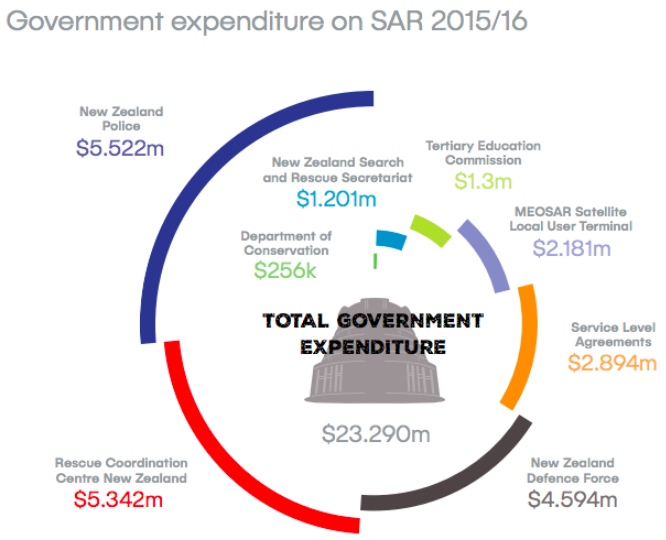
This section provides an analysis of key internal drivers. It is partly based on NZSAR Secretariat documents made available, feedback from NZSAR Secretariat staff and input from the SAR sector both during and after a workshop on the draft environmental scan.

Funding

Funding sources

It is currently very difficult to obtain a comprehensive and clear picture of the funding available to the search and rescue sector. This is because it originates form multiple sources and is received by a wide range of organisations with varying degrees of clarity. The complexity of the funding picture is illustrated below.

For example, only around a third of the SAR sector's funding is received through government appropriation and even this funding from government is not managed as a single coherent package. Government funding for SAR activity is appropriated through a range of different mechanisms as set out in the figure below.



Source: NZSAR[157]

The NZSAR risk matrix comments that funding levels for SAR agencies can be volatile due to profit variances with key gaming or lotteries trusts & boards. Grants policies also frequently change which can affect eligibility. Public appeals & donations are susceptible to change. NZSAR notes that volatile funding inhibits long term planning and investment. It also degrades sector effectiveness and efficiency. Furthermore, sometimes the funding is put to actual SAR activities, but anecdotal evidence suggests that sometimes it may be diverted to other uses by different organisations.

The devolved SAR sector model means that funding for the service is highly fragmented across multiple Votes. NZ Police, the NZ Defence Force and Maritime NZ all seek funding for SAR, with a hypothecated fuel excise levy paying for other coordination and administrative functions.

Furthermore, a surprisingly high amount of the sector's funding comes from volunteer organisations that seek funding through other channels (e.g. BP sponsors surf lifesaving, the Coastguard runs its own raffles / lottery[158] and other lotteries grants are also accessed by the sector).

In a recent survey, most people said they were aware that central government doesn't cover all SAR costs. But it is "fair to say most respondents assumed that central government pays more than it actually does". Many people also stated that they expected ACC to cover injury costs and possibly SAR operational costs.

This disaggregated funding model appears not to be challenged at present. However, it could come under scrutiny in future if, for example:

- the SAR service were considered to be significantly and persistently under-funded increasing the risk of poor outcomes;
- SAR staff and volunteers did not have sufficient training to save lives;
- SAR organisations' kit was severely out of date, compromising major operations; and/or

- population concentration, and associated 'hollowing out' of regions led a large number of operational units (e.g. LandSAR units) to shut down. It can be a battle for some of these units to recruit and retain people already.

When asked whether the funding model was fit for the future challenges and opportunities ahead, one person commented:

> *"No, the government funding for SAR should be coordinated in a single SAR Vote. Many of the real costs are hidden at the moment and there is not an efficient mechanism for getting funding to where it may be most needed. Investing in volunteers brings massive benefit (compared to cost) but the government funding input is relatively meagre."*

Agreeing with this sentiment, another SAR agency person suggested that the NZSAR Secretariat could be a useful home through which to coordinate and channel the sector's funding.

However, at present no case has been made to Ministers suggesting that the SAR sector is underfunded or its funding model is not working. Furthermore, if a new government or the Treasury were to look for savings, an exploration of the potential to rationalise perceived "double-dipping" is not inconceivable in future. It would be advisable for the sector to undertake its own work in advance to demonstrate the efficiency of the existing shared services model, including showing (e.g. using independent peer review) that no such double-dipping exists and the funding appropriated is indeed being spent on its intended purpose: SAR activity. In a recent workshop on the draft version of this environmental scan, one proposal was to take a hard look at rationalisation of the sector, which could result in a significant change to the nature of the service.

Questions for reflection:

- Do you consider the SAR funding model fit for the future challenges and opportunities? Why?
- What risks can you see around the SAR sector's disaggregated funding model?
- Can you demonstrate that the funding appropriated for SAR activity (including training and capability building) ultimately is spent on that?

Free at point of consumption

There is broad-based public and political acceptance that search and rescue should continue to be provided free at the point of consumption. In a survey of SAR's operations, all respondents expected a SAR operation to be free to them, though a number said that they did not expect them to be free to international tourists.[159] The minor exception to this is research that has identified a small number of people expressed that they don't think SAR should be free to those who have exhibited risky or 'stupid' behaviour in the New Zealand wilderness.

Other countries, like France, have a 'fee-for-service' or other charging model for SAR services. There are a number of ways that SAR services could do this. For example, these include exploring funding options through ACC, marine salvage fees and charging people for service. It would be difficult to actually introduce fees at the point of consumption because it would conflict with public expectations and it could create perverse incentives on those who might otherwise benefit from being rescued. Furthermore, complications could arise with existing international obligations such as the International Convention for the Safety of Life at Sea.

Funding not linked to demand

At present, there is no demand model underpinning the funding arrangements of the SAR sector. This has not been a significant problem to date given that demand has remained reasonably static over a long period of time. Where the tension can be detected is the need for a lot of negotiation across different parts of government to access limited assets. For example, Customs, Fisheries and Search and Rescue agencies must all frequently share access to surveillance assets in order to fulfil their roles. This requires excellent relationships and ability to negotiate between competing pressures.

However, if demand does rise in future as a result of the environmental trends described above, the lack of a demand-linked model could mean the sustainability of the funding model comes into question.

Questions for reflection:

- Do you think the way that SAR is funded is working well? Why / why not?
- Should the SAR sector develop a funding model that is explicitly linked to demand? How might such a model accommodate the fact that much of the SAR sector's resource is dedicated to capability building and training activity?

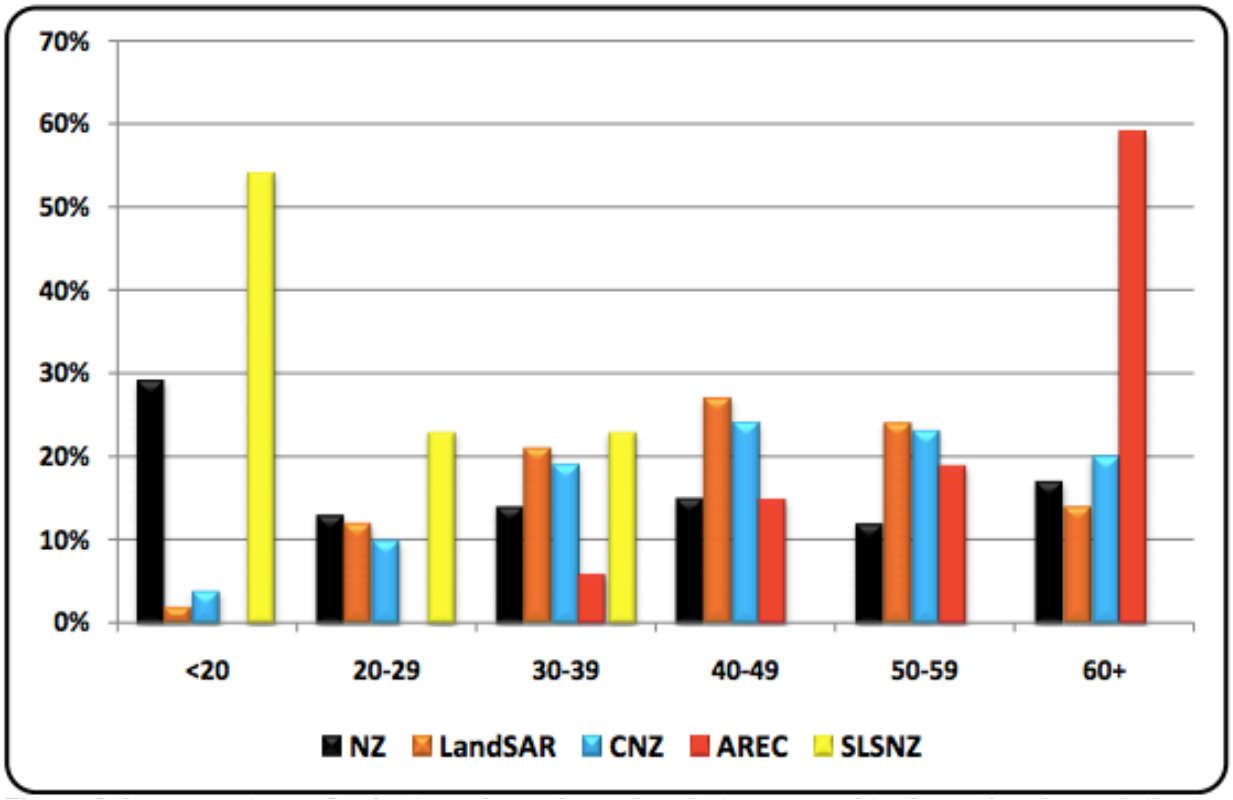
Volunteering

Profile of the NZSAR sector's volunteering workforce

New Zealand has one of the highest rates of volunteer SAR involvement in the world, with a workforce that is 95% volunteers who are unpaid. In 2016/17, NZSAR's SLA partners provided a total of 44,822 volunteer hours in direct operational assistance to the SAR Coordinating Authorities during SAR operations. This is an increase of 31% compared to the previous year.[160]

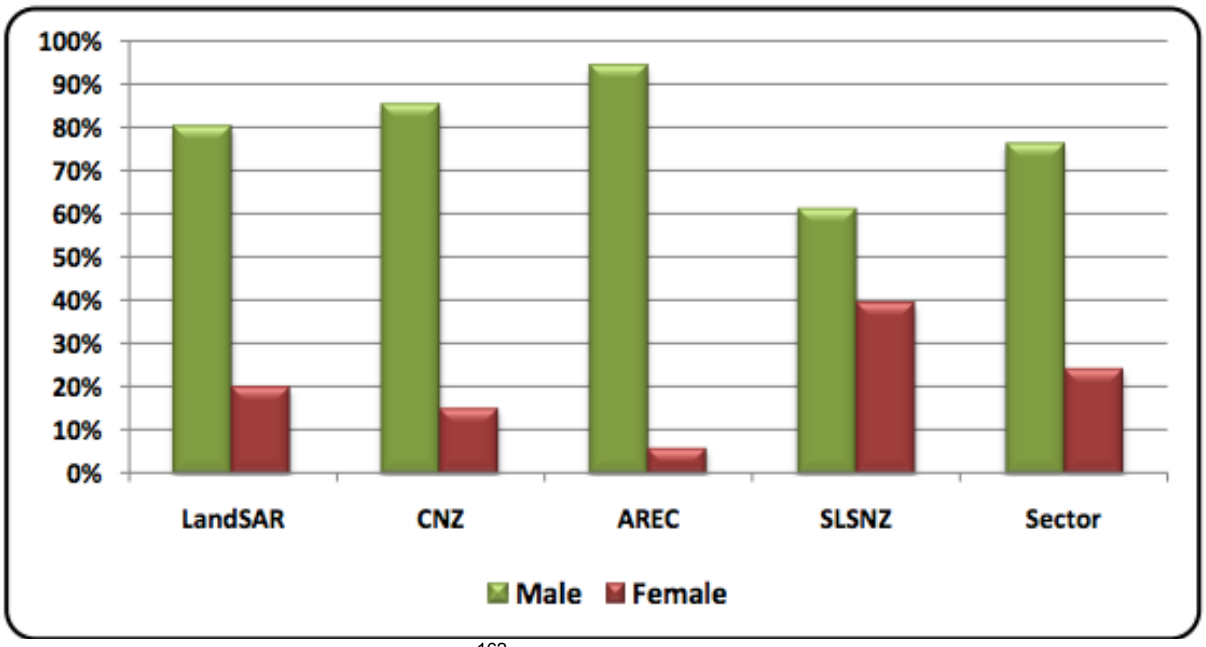
The New Zealand SAR sector is heavily reliant on males, two thirds of whom are aged over 40 years. The exception to this 'older male' volunteer profile is Surf Life Saving NZ, which has a significant amount of younger and female volunteers and the amateur radio Emergency Communications (AREC) volunteers who tend to be 60+ years old. This is illustrated by the figure below. One particular risk arising from the age profile below is that, as the NZ population ages, there may be fewer available amateur radio participants. It also raises the broader question around what the NZSAR sector's strategy is for replacing and supporting older volunteers – based on the figure below, these appears to be questions for LandSAR, CoastGuard and AREC in particular.

Percentage of NZSAR sector volunteers by age, compared to NZ national population, 2009



Source: NZSAR Volunteer Study, 2010[161]

Search and Rescue Sector by gender, 2009



Source: NZSAR Volunteer Study, 2010[162]

Changing availability of volunteers in future

There appears to be a mixed picture with respect to available volunteers across the sector. For example, LandSAR has commented:

> *"the general feeling in LandSAR is more that we may still have too many people. Some Groups, in high SAR demand areas (such as Wanaka) actually operate closed membership and are regularly turning away prospective new members. I wouldn't expect LandSAR, as a whole, to struggle to get sufficient volunteers in the next 10 years.*[163]

Another person went so far as to suggest that not enough demand for search and rescue was actually deterring volunteers from maintaining their skills and keeping them current. There was also a concern expressed that, particularly in Incident Management Teams, the need to meet higher competency requirements (particularly to meet new health and safety standards under the new legislation) could lead to some volunteers choosing to drop out rather than up-skill.

Interestingly, this contrasts with feedback from observations from the NZSAR Secretariat that people in the sector are "definitely finding fewer volunteers - they volunteer the same number of hours but spread themselves around a bit more." Another NZSAR person asked the question "if the workforce changes from volunteers, how will this affect culture, response-times, ability to respond to large geographic areas?"[164]

Possibly what we are seeing in this 'mixed picture' is a difference between urban and rural volunteers. A 2009 study of volunteering across the SAR sector noted that the main urban areas do have strong and generally large, or oversubscribed, volunteer groups. Other strong groups are located in areas where there is a significant amount of SAR activity; notable examples are the Tasman District and Wanaka. By contrast, it noted that volunteer groups that face issues caused by population problems are generally in the smaller rural population areas with low levels of SAR activity.[165]

Drivers of SAR sector volunteer supply in future

Looking at what might affect the supply of volunteers in the future requires considering what motivates them to volunteer in the first place, what might put them off and how this might change in the future.

Most SAR sector volunteers are currently motivated to join in the first place by a public good / altruism motivation.[166] This contrasts with a consumption motivation (loving the activity itself) or an investment motivation (e.g. getting work experience) or recognition motivation. While the public good/altruism motive is the most important driver for becoming a volunteer, it is the consumption motivation that keeps volunteers involved in the sector.

In looking ahead, it should be acknowledged that different generations may have different motivations for volunteering. For example, Generation Y (born 1980 – 1995) will be the next main generation of volunteers. As one study put it "they are used to receiving immediate feedback for their actions. One identified characteristic for this generation is that they will leave a voluntary task immediately if they are not getting rewarded." This raises the question around whether the SAR

sector has a robust enough framework for recognising volunteers in a way that appeals to Generation Y in the future.

A further issue that could affect volunteer retention is the cost of training (in terms of both time and money) and the cost of equipment. As one person in the SAR sector put it "The volunteer part of the sector is under-financed – we struggle to maintain standards (including training and equipment) with too much of the financial burden falling back on the volunteers." The demand on volunteers' time is "consistently raised by volunteers, volunteer managers, and partner agencies."[167] Over the 2016-17 year, volunteers provided a total of 786,903 hours of their time supporting the SAR sector. However, only 5.8% of that time was spent directly on SAR operations.[168]

Question for reflection: Do you think it's getting harder or easier to find volunteers for search and rescue? Why?

And there is a supply of volunteers to tap in the short term

Over the next 5-10 years, it is possible that, with the number of available volunteer hours could actually spike as the baby boomers retire. The question will be how to attract, and best support, this potentially enthusiastic volunteer workforce.

Question for reflection: How might the SAR sector tap into the population of baby boomers retiring over the next 5-10 years to boost its volunteer numbers?

This opportunity may be offset to some extent by the fact that much SAR voluntary activity requires people to take a certain amount of personal risk (e.g. rescuing people off cliff faces or other high risk areas). However for people wanting to be engaged in 'healthy ageing' there may be significant and mutually beneficial opportunities through tapping into this population.

Longer term, it may be harder to find volunteers

While there has been an overall increase in the number of hours volunteers are providing, there is a sense within the SAR Secretariat that this may not be the case in the future. There are multiple factors that may impact on the level of volunteering in the future.

Furthermore, as NZ becomes more urban, diverse, older and sedentary, and New Zealanders use their time differently, volunteers for SAR could become more difficult to find. For example, NZSAR Secretariat staff have commented that "urban people don't want to volunteer so much" and we know the rate of SAR volunteering in non-NZ European ethnic communities is lower. Over the 10 years to 2009, as highlighted in the figure below, the amount of time people spent on unpaid work actually shrank while we spent more time working and engaged in other forms of entertainment. This may signal a longer-term shift away from seeing the value of volunteering (in the absence of corrective action).

By contrast, many in the NZSAR sector itself appear fairly relaxed about the future of volunteering. Some have pointed to the current glut of volunteers in some areas and others have commented that 'volunteering will change by definition, so it's difficult to say that it will reduce."

Question for reflection: What would it take for the SAR sector to attract volunteers from a broader array of backgrounds?

It is also likely to be more difficult to get volunteers where you need them. For example, if most volunteers are based in Auckland and many SAR incidents are in remote areas like Fiordland, there is a considerable logistical issue in getting them to the right place quickly. As one NZSAR Secretariat employee put it "we are not a designed system...our services are based around the concentration of where people live and where they recreate...so there can be issues between supply and demand".

In the long term, the SAR sector may need fewer volunteers

Furthermore, as AI, big data and better location technology reduce the challenge of finding people, it may be that physical assistance in search activity declines. If this happens, there will be a natural attrition of volunteers. As one NZSAR Secretariat staff member put it: "are the volunteers going to stick around if there's no work for them? What's going to keep your LandSAR volunteer engaged when you only call them occasionally?" The key will be ensuring that the transition is managed carefully so that the change process does not compromise service quality and availability. One way to do this is to focus on ensuring that the existing volunteer workforce can be deployed efficiently and rapidly anywhere they are needed.

Question for reflection: How likely do you think it is that the SAR sector will find it difficult to get enough volunteers in future?

Training

The NZSAR sector involves more than 12,000 people. It is a major exercise just train and retain these people, whether they are staff or volunteers. SAR Adult and Community Education (ACE) provides fees-free SAR training. The Adult and Community Education (ACE) Fund provides for community-based education that meets community learning needs. It is funded by the Tertiary Education Commission and delivered by Tai Poutini Polytechnic. LandSAR is the main beneficiary of this. By contrast, the Coastguard (CGNZ) and Surf Life Saving NZ both pay for their own training.

The SAR (ACE) Fund supports volunteers to get the relevant class and level of training and accreditation they need to perform SAR operations.[169] Tertiary education organisations (TEOs) are funded to provide SAR training to learners nominated by NZSAR, or an organisation recognised by it. This quality of the training provided in this system has come under scrutiny of the Labour party in the past.[170]

Peoples' expectations for how to learn are constantly changing. In the future, the SAR sector may want to consider providing opportunities for learning involving virtual and augmented reality. The technology enabling realistic simulations of SAR operations is likely to improve exponentially over the next decade. Furthermore, in the future, new systems for knowledge transfer, commonly known as 'Massive open online courses' (or MOOCs) could prove a cost-effective way to keep people well trained. However, care would need to be taken to ensure the quality of training and assessment prior to being involved in operations was up to standard.

Questions for reflection:

- How might the SAR sector use emerging technologies to provide new and engaging models of training for its volunteers and staff?
- How well is the SAR sector capturing insights from its operations and feeding them into training?

Service model resilience

New Zealand's search and rescue service model grew organically in response to the SAR requirements of a relatively stable population interacting with a relatively stable physical and climate environment. In terms of system resilience, the question to answer is whether that system will remain fit-for-purpose in the event of either two inputs changing. That leads to importance of identifying what the thresholds are in critical areas that will lead to system breakdown.

The resilience definition most applicable to New Zealand's SAR system comes from the United Nations Office for Disaster Risk Reduction (updated on 2 February 2017): "*The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.*"

Disaster risk events, including transport and climate incidents (both of which apply to the SAR system) have been shown to have the potential to escalate dramatically in a short period of time. When things go wrong, they can go very wrong on multiple levels, very quickly. So it's important that we understand how well New Zealand's search and rescue 'service model' will respond under different kinds of scenarios.

We can begin to identify how resilient the New Zealand SAR sector is by identifying how quickly a normal SAR incident could escalate to a full blown nationally significant one, and exploring how well the system responds under these different conditions. We do this by identifying two scenarios:

1. "Normal SAR event" – a normal instance where the SAR sector receives an alert seeking help for someone in distress
2. "Significant SAR event" – a situation where a normal SAR event escalates to a point where it risks overwhelming the current system capability.

In particular, it is worth looking at what can cause the first kind of event to turn into the second kind, and how quickly the change can happen. To do this, we first look for a set of elements within the system that, when combined, can lead to a rapid escalation in severity.

As part of this assessment, there are two specific system risk combinations to consider:

- a ‘cascade failure’ - where one part of the system (or a ‘sub-system) fails and leads to a significant knock on effect for other parts within the same system;
- a ‘common mode failure’ - where the failure of one subsystem elements knocks out several adjacent subsystems. For example, common mode failure often originates in a technology system and spreads to associated human decision making systems.

Both events can occur in the same system.

A cascade or common mode failure could occur, for example, if there is a reduction of the number of volunteers below the level required to meet ongoing service demand. As we have discussed above, changes in demography, funding and natural renewal of the existing number of volunteers could all lead to a situation where there are not enough volunteers available to respond in situations of abnormally high demand.

Cascade or common mode failure might also occur when messages are relayed between the alerting and communication subsystems, and associated allocation of resource and responsibility. This basically means that a message received at the ‘alert’ stage gets garbled, leading to the wrong or inadequate deployment of people or assets.

The very models used to identify how to respond to different incidents can embed cascade or common mode failures. For example, if the way threats are modelled do not usefully or appropriately show how inputs (e.g. data about the threat) should translate into action (the response), they can lead to failures on multiple levels.
In reality, unsurprisingly mostly the SAR sector faces ‘normal SAR event’ situations (we can rate its risk as ‘likely’. By contrast, the ‘Significant SAR event’ risk can be classed as ‘rare’. However, we know that the risks associated with SAR incidents do not escalate in a linear or steady way – instead they tend to escalate rapidly (more like a logarithmic or exponential curve).

As outlined above, we have also identified multiple potentially volatile changes in the environment that will significantly affect both the demand and supply of search and rescue services in the next 5-10 years. These include both external factors (e.g. shifts in weather, demography, tourism levels and politics) as well as internal factors (e.g. changes in numbers of volunteers and funding for search and rescue work).

When you combine the potential for SAR events to escalate quickly with major system-wide changes due to the environment, a highly dynamic medium-term picture emerges. This leads us to the tentative conclusion that the system could come under significant stress within the next 5 years, and more probably within 10 years.

In considering the resilience of New Zealand's search and rescue system, the main issue is what combination of changes to the two primary inputs of population and environment will lead to a system failure, either locally or leading to a National Security System response. For a public with a very high expectation of delivery quality, all it takes is for one significant combination of events to overload capacity.

To illustrate, even if we hold the population, volunteer numbers and operational area relative to assets stable, we can explore three climate change projections that would impact both category 1 and 2 operations:

1. Higher temperatures in the summer holiday period, with heat stress increasing mortality risk.
2. More intense rainfall, leading to an increase of flooding events.
3. Higher winds with an increase in serious storm events, heavier swells and more significant storm surges in areas of prevailing westerlies. This will impact exposed and elevated areas, as well as Cook and Foveaux Straits.

Assuming that the present system can account for a climate event like intense rainfall, the question to ask is at what point does a local failure become un-manageable. This could occur, for example, if any of the following kinds of events happen at the same time as another one:

- the 1991 collapse at Aoraki/Mount Cook
- the 1995 Cave Creek or the 2010 Outdoor Pursuits Centre tragedies
- the Ansett Flight 703 crash in the foothills of the Tararuas
- the LandSAR incidents as experienced in July 2017
- the widespread 2017 flooding event in the South Island.

This is the kind of risk that emerged recently for the Ministry of Civil Defence and Emergency Management when a single earthquake based in Kaikoura had a wide range of impacts at multiple points across New Zealand, including deaths, severe infrastructure damage, liquefaction, land slips and so on.

To conclude, our environmental scan combined with our analysis of the New Zealand SAR model suggests to us that there is a risk of the system needing to deal with a major and multi-dimensional risk event in the next 5 years. This could be one of the risks outlined above which impact directly on demand or supply of search and rescue services. But there could also be indirect risks that emerge. For example, at a November 2017 workshop with the NZSAR sector, one participant saw a risk of investing in assets that could prove to be redundant if were to be a downturn in tourism because of a future economic crash. Given history is littered with regular economic crashes of one sort or another, this situation is plausible.

When asked how prepared they thought the SAR sector was for such an event, one SAR sector member said the sector was "quite well prepared". Commenting on a draft version of this scan, they said "the focus on major environmental events as a SAR risk is questioned. This is more to do with Civil Defence. Not to say, though, that we should not do more to encourage contributing in a civil defence emergency…The promotion of the "One SAR" concept including all community emergency response organisations may be worth exploring."

LandSAR also appeared to be relatively relaxed about culminating major event risks ahead, while observing that the sector, as currently run and resourced, may never be able to fully meet the public's expectations, saying:

> *"The sector is generally well prepared. Rare, large SAR events would likely expose some shortcomings. Standards may fail to fully meet changing societal expectations (ie. people increasingly expect the highest quality service where human life is at stake, and volunteer SAR models cannot always deliver this).*
>
> *The sector is prepared to a certain degree, but there are always limits that could be exceeded. I think it very unlikely that terrestrial SAR services will be overwhelmed by any alignment of purely SAR responses. Some of the climate based scenarios fall more in the realm of Civil Defence responses and the SAR sector's ability to assist with these could be tested, in large events of this nature."*[171]

Conclusion

This environmental scan suggests that *underlying or "normal"* demand for SAR services will likely generally continue to stay steady (or grow) in the short term (next 5 years). Upward pressure from demand is likely to come from multiple sources, including:

- population growth;
- more wandering activity as a result of population ageing (a significant driver);
- increased numbers of tourists (especially in the shoulder seasons);
- continued growth in people spending time outdoors unprepared (particularly due to an increase in those venturing into the outdoors unprepared or going into more remote / inaccessible areas); and
- extreme weather events or flooding caused by climate change.

Some of this demand is a reasonable side effect of New Zealanders indulging our passion for outdoor activity in natural settings. On a macro scale, engaging in just over 2,500 SAR operations a year to save lives, and enable the rest of us to enjoy the outdoors with peace of mind, does not seem unreasonable.

Of course, much of the potential future growth in demand is not a foregone conclusion. Already significant effort is being put into reducing the growth through prevention efforts aimed at ensuring people (both Kiwis and tourists) are prepared when going outdoors and dealing with the impending effects of an ageing population on demand. However, other drivers of demand have considerable momentum behind them. For example, Pacific nations face ever-higher seas and more violent weather, which is likely to lead to greater demand for SAR over time.

In the longer term, certain demographic trends (with the exception of ageing) are mitigating against demand growth. For example, an increase in sedentary behaviour, more urbanisation, increased diversity, changing recreation patterns and increased inequality are all likely to dampen participation in the outdoors, potentially reducing demand. Furthermore technology is likely to continue making our lives safer – e.g. through the rise of automated systems in both the air and water that remove human error.

Technology also offers huge potential for improving key elements of the SAR process. These include improving the ability to locate people in distress, the ability to collect, synthesise and interpret large amounts of relevant data and the potential for drones and robots to support in SAR operations. There is also considerable potential for augmented reality to provide 'live feeds' of relevant data to people engaged in SAR operations in the future. In the medium to longer term, it is likely that robots and drones, as they get smarter, will be able to play a much larger role in undertaking SAR activities, potentially reducing the need for as many volunteers. A deliberate strategy to gain good capability in this area might assist with the potential for reduced numbers of available volunteers due to the demographic changes ahead.[172]

New Zealand has a stable economy and improving employment levels. Most people make use of our country's abundant natural beauty and try to get outdoors from time to time. But some miss out due to their economic position.

Over time, tourism is likely to continue growing which will feed demand for SAR to some extent. This potential for increased demand for SAR can be mitigated through good prevention and diversion strategies

NZ's SAR sector has emerged and evolved reasonably organically as a network of organisations with a common commitment to saving lives. Everyone agrees that search and rescue is critically important. However, this does not make NZSAR or the broader SAR sector immune from potential criticism that its models of operation, risk management practices and response to emerging trends (e.g. climate change, technology, demography) are not sufficiently agile. The best way to avoid such criticism is to develop strategies, plans, operational responses and risk management approaches that explicitly build in consideration of the trends afoot.

On a note of caution, our brief and necessarily high level scan of the SAR service model suggests that there are multiple risks stemming from the environment that may converge over the next 5 years. In particular, we see potential for:

- the number of volunteers to decline in future, undermining response capacity and capability;
- there to be increased demand due to the effects of climate change and ageing (increased wandering); and
- the ever-present possibility of a high profile response failure.

We would recommend that NZSAR undertake a more systematic assessment of these risks in the short term and test a range of possibilities against the proposed service response. As Louis Pasteur once put it "fortune favours the prepared mind."

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