NSSN
NSW Smart Sensing Network

Annual Report
2019/20

Proudly funded by

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FOREWORD BY BOARD CHAIR

People around the world will remember 2020 as an *annus horribilis*. In late 2019 and early 2020 eastern Australia experienced its largest fire season in recorded history. These Black Summer fires destroyed 19 million hectares of bushland and forest, five times more than ever recorded in a season. Billions of animals were killed or displaced. Many endangered species were driven to the brink of extinction. Fortunately, many were saved a worse fate by the revolutionary technologies deployed to prevent even more loss of life, vegetation, houses and critical infrastructure such as water catchments and electricity supply lines.

Technological innovation played a critical role in responding to the disaster and holds the promise of mitigating future catastrophic bushfires. Smart sensing lies at the heart of much of this technology, including satellites, spatial analysis using high speed statistical and computing power, aircraft-mounted sensors to monitor and map actively spreading fires, firefighter's helmets and suits made out of materials used to protect astronauts in space, and an array of other chemical and physical sensors.

Hard on the heels of the bushfires, COVID-19 reached our shores. Australia's first case of infection with this novel virus was confirmed on 25 January. Shortly after, a global pandemic was declared. It spread quickly, well beyond the people it infected, disrupting society as a whole and smashing the economy. Early March also heralded lockdowns across the country and the slamming shut of national borders. As with the bushfires, modern technologies are mitigating the severity of the pandemic.

This Annual Report outlines how the NSW Smart Sensing Network has responded to these challenges swiftly and decisively, holding public webinars and industry workshops on bushfires and COVID-19. All four of our inaugural Smart Sensing Grand Challenges launched this year - Water, Bushfires, COVID-19 and Ageing - focussed on the current issues that matter to the people of NSW. But there is much more to our work. I invite you to read on for a more detailed report on the NSSN's achievements across FY19/20, all of which are delivering value to the NSW economy and community.

It remains for me to thank and recognise the NSSN staff, led by Co-Directors, Professors Benjamin Eggleton and Justin Gooding, and Chief Operating Officer, Nicholas Haskins, as well as the NSSN Board for their unswerving commitment to the NSW innovation ecosystem and to positioning the state as a leader in smart sensing. I also thank Professor Hugh-Durrrant-Whyte and Christina Newman from the Office of the NSW Chief Scientist and Engineer for their continued strategic advice, advocacy and investment.

Finally, I acknowledge and remain committed to delivering value to our eight member universities and our industry and government partners. Together, we can look forward to an even brighter future as we advance and expand the NSSN agenda.
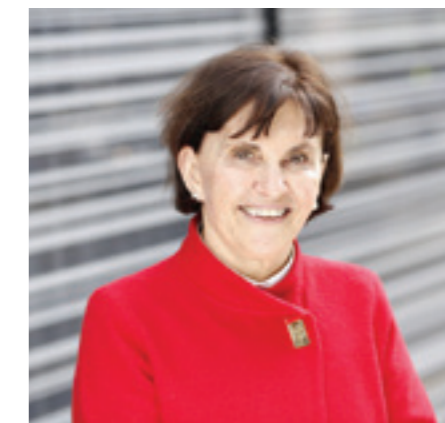
Dr Susan Pond AM
Chair of NSSN Board

CO-DIRECTOR'S MESSAGE

We are proud to deliver the NSW Smart Sensing Network Annual Report for 2019/2020. The period this report covers — July 2019 to June 2020 — was a tumultuous one. From bushfires to floods to global pandemic, the mettle of the world has truly been tested and we continue to face uncertainty and formidable times ahead.

Despite the challenging circumstances, the NSSN quickly pivoted in response to the crises. Harnessing the impressive resources across our network of world-class universities and drawing upon our relationships across industry and government, we mobilised to highlight the integral role smart sensing plays in responding to the great issues of our time.

We launched our Grand Challenges program focussing on four key areas where innovative solutions are critically needed and where NSW & ACT expertise is leading-edge. Across COVID-19, Bushfires, Water and Ageing, the NSSN Grand Challenges are responding to the issues that matter right now to the people of Australia and are taking our expertise to the world.

The COVID-19 pandemic has taught the world many important — and some painful — lessons. For us, three stand out as being particularly valuable.

The power of collaboration. We're all in this together is a phrase that is quoted all too often during a crisis and while it may be easy to dismiss as a truism, it

cannot be denied. When confronted by a challenge, the best outcomes are achieved when we work together, pooling resources and combining unique strengths.

Collaboration is at the core of the NSSN. As an embodiment of the triple helix model of collaboration, we bring together universities, industry and government to address complex environmental, economic and social challenges.

The importance of science. While Australia burned across its black summer or while the coronavirus swept the globe, leaders and society alike turned to science for answers.

The NSSN is driven by science. We draw upon some of the world's foremost minds in areas like physics, chemistry, engineering, artificial intelligence, data analytics and biotechnology. We serve as a single portal by which government and industry partners can access the latest scientific discoveries and we help translate them into real-world solutions.

The promise of innovation. The pandemic has shown us that it is those that were quick to innovate in response to fast-changing circumstances are the ones that survived and thrived. There is no doubt that innovation will drive economic recovery and human-centred technology will ensure we build a more resilient future.

We are proud innovators at the NSSN. We look at the possibility of what could be and we apply world-class research to develop solutions that have impact and which contribute to our prosperity.

As the pages of this Annual Report demonstrate, the NSSN is responding to the challenges and opportunities we have faced over the past year and is delivering well on its promise to its members, partners and the people of NSW.

Professor Benjamin Eggleton
Co-Director, NSSN

Professor Justin Gooding
Co-Director, NSSN

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ABOUT THE NSW SMART SENSING NETWORK (NSSN)

The NSW Smart Sensing Network (NSSN) was established in July 2016 with funding from the NSW State Government through the Office of the Chief Scientist and Engineer.

It was founded on the premise that the economy and people of New South Wales face key challenges in energy, resources, manufacturing, the environment, transport, agriculture, space and health that cutting-edge research in smart sensing could play a critical role in solving.

The market for smart sensing across a broad range of industries is immense and growing. The NSSN brings together the world class research taking place in NSW universities with state government agencies and industry to develop innovative solutions to these key challenges and, at the same time, position NSW as a leader in sensing technology.

Our Mission

We bring together expertise in academia, industry and government to position New South Wales as a recognised global leader in smart sensing innovation.

Our Vision

We will transform the New South Wales smart sensing ecosystem and advance the prosperity of the state through the solutions and opportunities that we create.

Our Objectives

Our objectives enable us to realise our vision and achieve our mission.

1. Create value for industry and government.
2. Be a global thought leader in smart sensing and its deployment.
3. Strengthen our network.
4. Generate prosperity for New South Wales.

Members

We bring together smart sensing expertise from across the leading universities in NSW & the ACT to develop innovative, interdisciplinary solutions to complex challenges.

Australian National University

NATURAM PRIMUM COGNOSCERE RERUM

UNIVERSITY OF CANBERRA

MACQUARIE University
SYDNEY · AUSTRALIA

UTS

THE UNIVERSITY OF NEWCASTLE
AUSTRALIA

UNSW
SYDNEY

MANU ET MENTE

THE UNIVERSITY OF SYDNEY

WESTERN SYDNEY UNIVERSITY
W

People

Co-Directors

The NSSN is led by two internationally recognised scientists who are leaders in their respective fields of physics and chemistry and bring a wealth of expertise to the network's ambitious program of research, innovation and industry collaboration.

Professor Benjamin Eggleton

Professor Justin Gooding

Board

The NSSN Board, chaired by Dr Susan Pond AM, and consisting of experienced leaders across the policy, research and industry spectrum provide guidance and oversight on network strategy and direction.

Dr Susan Pond AM,
Chair

Nick Campbell,
Board Member

Dr Marlene Kanga AM,
Board Member

Peter Runcie,
Board Member

Dr Paul Scully-Power AM,
Board Member

Jo White,
Board Member

Frank Zeichner,
Board Member

Christina Newman,
Board Member

Eliathamby Ambikairajah,
Ex-Officio

Julie Cairney,
Ex-Officio

Members' Committee

The NSSN Members' Committee consists of senior representatives of each of the member universities and the NSW Office of Chief Scientist & Engineer. It ensures that member university and government imperatives guide the strategy and activities of the network.

Professor Michael Cardew-Hall,
Pro Vice-Chancellor
(Innovation), ANU

Professor Leigh Sullivan,
Deputy Vice-Chancellor

Professor Sakkie Pretorius,
Deputy Vice-Chancellor (Research),
Macquarie University

Professor Frances Kay-Lambkin,
Acting Pro Vice-Chancellor
(Research & Innovation),
University of Newcastle

Professor Eliathamby Ambikairajah,
Deputy Vice-Chancellor
(Enterprise) (Acting), UNSW

Professor Julie Cairney,
Pro-Vice-Chancellor
(Research - Enterprise &
Engagement),
University of Sydney

Professor Kathryn McGrath,
Deputy Vice-Chancellor
(Research), UTS

Professor Deborah Sweeney,
Deputy Vice-Chancellor and
Vice-President,
Research & Innovation,
Western Sydney University

Staff

A lean central team of talented staff lead the research programs and co-ordinate the operations of the network.

Nicholas Haskins,
Chief Operating Officer

Ivan Chua,
Business Development
Manager

Dr Don McCallum,
Development Manager

Jasmine Logaraj,
Project & Policy Officer

Dr Tomonori Hu,
Environment & AgTech
Theme Leader

Jane Evans,
MedTech Theme Leader

Dr Ramanathan Vaidyanathan,
Manufacturing & Fluidics
Theme Leader

Dr Zhitao Xiong,
Data & Built Environment
Theme Leader

Dr Eric Magi,
Engineer

Jimmy Tran,
Electronics &
Development Engineer

Dr Ayu Saraswati,
Engineer

Shahrzad Abbasi,
Media and Public
Relations Officer

ANNUAL PERFORMANCE STATEMENT

Executive Summary

In FY19/20, the NSSN cemented its position in the NSW innovation ecosystem and contributed to NSW's position as a leader in smart sensing innovation. We continued our commitment to delivering value to our eight member universities and enhanced our engagement with the NSW smart sensing industry – the designers, manufacturers and deployers of smart sensing.

In a year in which NSW sharpened its focus on innovation through the commendable *Accelerating R&D in NSW* initiative, the NSSN serves as the embodiment of the triple helix model of innovation. Further, in a year where NSW faced twin catastrophes of bushfires and COVID-19, the NSSN demonstrated its ability to swiftly pivot to respond to the crises and focus on issues that matter to the people of NSW.

FY19/20 was the most active yet for our **R&D program**, successfully delivering on 7 programs including the *Advanced Pipe Sensing to Reduce Leaks & Breaks* program with Sydney Water and the wider Australian water utility industry, phase 1 of the Plan Jericho program with the RAAF, the *Remote Soil Moisture Sensing with RF* project with the Sydney Institute of Agriculture, and concluding the *Low-cost Optical Particle Sensor* project with NSW DPIE. The NSSN manages these programs, ensuring smooth coordination, stakeholder satisfaction and ultimately the delivery of outcomes and impact to industry and government clients.

With the applications of smart sensing proving so broad, the NSSN introduced its Grand Challenges in early 2020 to bring greater clarity on its broad range of programs for industry and government partners and to focus the resources of the Network. The four inaugural Grand Challenges launched in 2020 were chosen for their currency and importance to NSW: Water, Bushfires, COVID-19 & Ageing. These programs are being developed throughout 2020, with future Grand Challenges such as Smart Cities to be launched in 2021.

Our **Business Development program** continues to attract contract research to our member universities and has established a pipeline of business for the future. In FY19/20, the NSSN attracted $1,580,000 in commissioned research across 3 projects. A pipeline of future work is in development, valued at over $16 million across 19 prospective projects. COVID-19 slowed the conversion of these opportunities in early 2020.

Our **Industry Engagement program** was accelerated in FY19/20. 15 events across 4 series were hosted by the NSSN, aimed at engaging the NSW sensing ecosystem and attracting delegates from SMEs right through to industry primes like Bosch. As part of a nationwide response to COVID-19, the NSSN worked with industry partners to coordinate smart sensing capability. The NSSN was acknowledged for playing a key role in NSW-based electronics manufacturer, Circuitwise, securing a $350,000 contract to build 2,100 breathing circuits for ventilators.
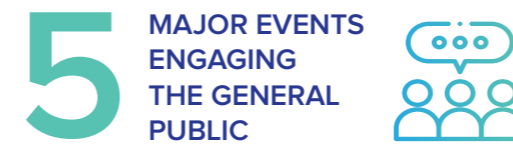
Our **Public Outreach program** educates, informs and engages the public on smart sensing and NSW's leading-edge innovation. The NSSN hosted 5 public events in FY19/20. In March, at a time when the public were seeking informed answers to questions on the pandemic, the NSSN hosted a COVID-19 Q&A Forum featuring experts from NSW universities, hospitals and the WHO. The Forum attracted 350 attendees and was followed in May with a second Forum. In May, the NSSN hosted its annual flagship event, the Frontiers in Sensing Forum, on the subject of Smart Sensing for Bushfire Prevention, Response & Mitigation. The event attracted an online audience of 260 and featured speakers from the NSW Rural Fire Service, the Bushfire & Natural Hazards CRC, Minderoo Foundation and NSW DPIE.

We continue to broaden our audience reach across digital, social and traditional media channels. Our Twitter reach grew an impressive 94% to **1,938 Twitter followers**. Even more remarkable was the 256% increase our LinkedIn followship experienced, rising to **1,125 LinkedIn followers**. The NSSN averaged **1,890 website** visits per month and we secured **38 media mentions** across TV, radio and print media. All of this indicates that the NSSN is saying things people care about and having a meaningful impact on stakeholders and the broader public.

As this report demonstrates, the NSSN made significant advances across all key measurables in FY19/20, despite constraints faced in the final reporting quarter as a result of COVID-19. The Network pivoted with agility in a time of rapid change and economic uncertainty. The promise of technological innovation to ameliorate the crisis is providing the NSSN with opportunities that we are actively leveraging. Building upon previous success and a very active FY19/20, the NSSN is positioned well for sustained success.

We invite you to read on for a more detailed report on the NSSN's achievements in FY19/20.

FY19/20 By The Numbers

7
Active R&D Projects under management

$1,580,000
IN NEW CONTRACT RESEARCH FUNDING

4
Grand challenges established

15
Industry engagement events across 4 series

5 MAJOR EVENTS ENGAGING THE GENERAL PUBLIC

1,938
TWITTER FOLLOWERS

1,125
LINKEDIN FOLLOWERS

7
ACADEMIC PUBLICATIONS

NSSN R&D PROGRAM

NSSN R&D Program

The NSSN runs an active research and development program, with 7 active R&D projects under management in FY19/20:

1. Advanced Pipe Sensing to Reduce Leaks & Breaks

Value: $3,421,710
Partners: Sydney Water (principal), Hunter Water, Melbourne Water, SA Water, Intelligent Water Networks, Queensland Urban Utilities, Water NSW, UKWIR, Downer.
University partners: UTS, UNSW, University of Newcastle, ANU, University of Canberra.

This program, which commenced in early 2019, continued throughout FY19/20 under the NSSN's project management and coordination. Five work packages spanning quantum, acoustic & LIDAR sensing, as well as multi-modal data analytics all delivered on expectations. An extension through to November 2020 has been granted due to COVID-19 related staffing constraints and restricted access to Sydney Water test pipe facilities.

Two of the work packages on acoustic sensing and data analytics are already advancing to operationalisation phase at Sydney Water, with the LIDAR work package slated for future implementation by Hunter Water. The hydrophone array work package is advancing to commercialisation (currently at TRL7) with Sydney Water, Thales and NSW-based SME, Zedelef. The quantum sensing work package currently remains at a relatively low TRL but is showing promise, with Sydney Water publicly declaring its commitment to the project in both academic publications and broadcast media.

The NSSN's core role as project manager involved coordinating multiple stakeholders, project governance, quarterly reporting and communications & outreach. This complex program of work involving multiple work packages, universities and clients would not have been possible without the NSSN.

Image: Sydney Water technicians installing acoustic sensors developed through the NSSN-led Advanced Pipe Sensing to Reduce Leaks & Breaks project in Sydney CBD in December 2019.
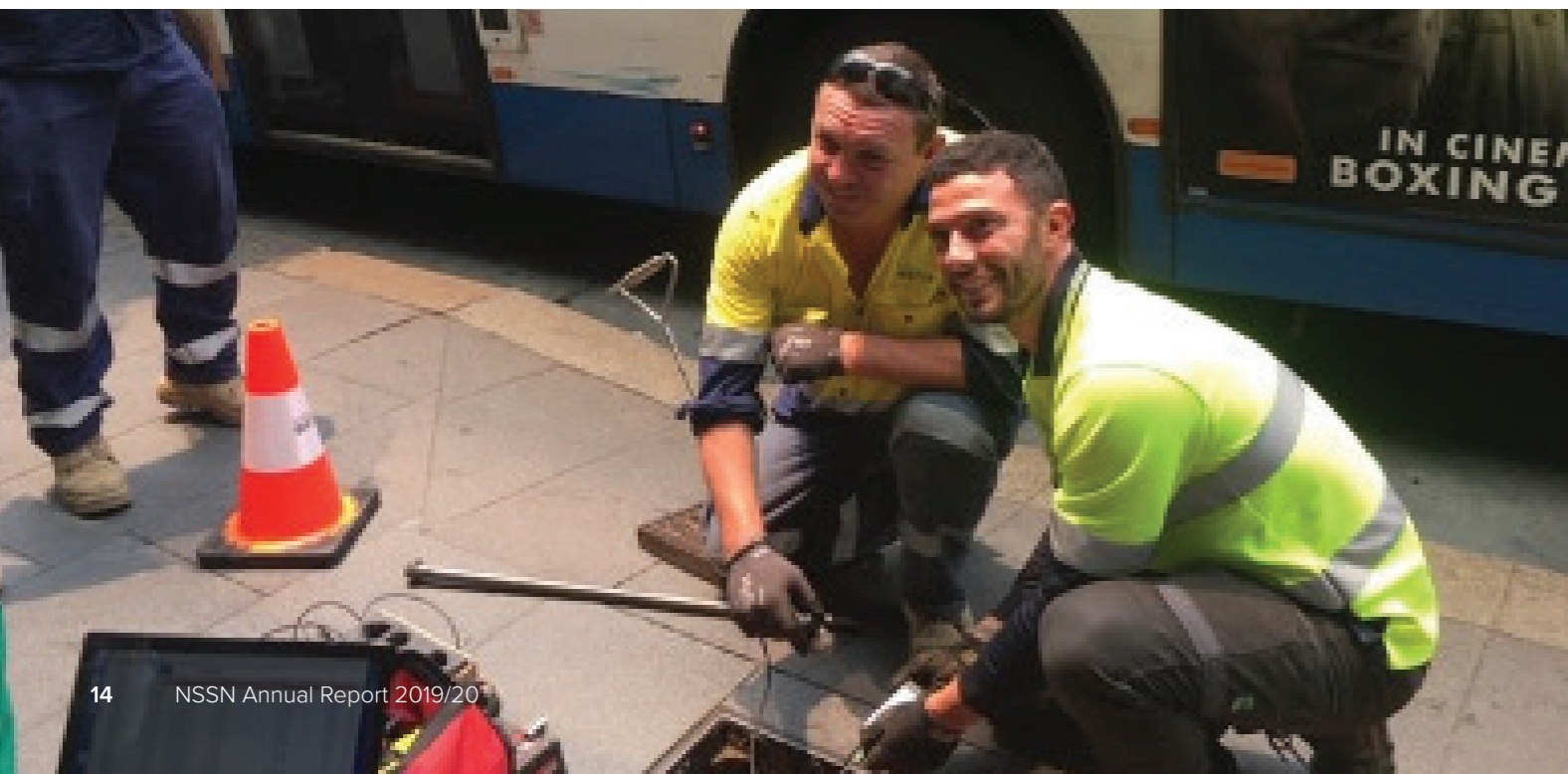
2. Plan Jericho

Value: $3,000,000
Partners: Royal Australian Air Force (RAAF)
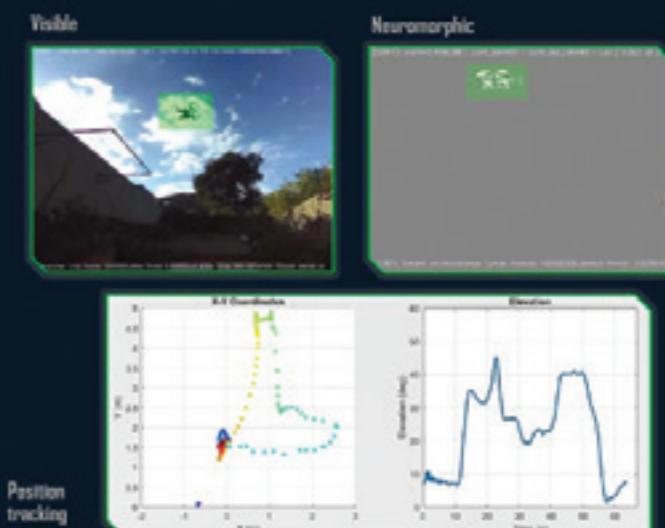**University partners:** University of Sydney

The Jericho Smart Sensing Laboratory at the University of Sydney deepened its work with the RAAF to develop next generation sensor fusion technology that can assess the physical, acoustic and electromagnetic environment.

The project consists of three streams of work: UAV swarm detection, radio frequency shaping and sensing, and detecting patterns of life. The project incorporates design concepts at the development stage to ensure the cutting-edge technology has maximum benefit for the end-user.

The project has been successful in securing a second round of funding (not reported in FY19/20) to rapidly develop prototypes with optimised size, weight and power for real- life environments. Working with the RAAF, the sensing technology arising from this cutting-edge R&D project will be deployed in a simulated battle-field setting.

Image: Visual tracking guided by acoustics as part of the Plan Jericho project.

3. Increased Recycling of Plastics by Sensing & Treating Label Contamination

Value: $1,500,000
Partners: Visy, Labelmakers Group, Pegras
University partners: UNSW, UTS, University of Sydney

The NSSN led a successful CRC-P bid focussed on increased re-use of HDPE plastic. Bringing together three member universities with major industry players, Visy and Labelmakers, as well as NSW-based SME, Pegras, the NSSN coordinated and wrote the bid that secured $650,000 funding from the Commonwealth program along with industry funding.

The project has the potential to divert hundreds of thousands of tonnes of plastic waste from landfill by eliminating residual contaminates on recycled HDPE chips. It will increase yields of uncontaminated recycled HDPE — a valuable commodity for recycling companies to sell. The project has the potential to not only give Australian companies a competitive advantage but will lead to NSW R&D know-how informing international best practice in a burgeoning industry.

Image: Labelmakers Group NSW Division. From left to right, Aiden Lyons, Ian Dixon, Nicholas Haskins, Stephanus Peters, Nick Florin, Melita Jazbec and Benjamin Madden.


4. Field trials of a low-cost optical particle sensor

Value: $30,000
Partners: NSW Office of Environment & Heritage
University partners: University of Sydney

This project, beginning in 2018, reached its conclusion in 2019 with a successful field trial in Sydney. Low-cost particle sensors developed at the University of Sydney were packaged and fully telemetered to report real-time data remotely. The sensors were deployed in early 2019 to measure air quality over a period of three months while being compared to reference instruments. High agreement was achieved without any data loss — achieving the goals for the contract.

In addition to this, periodic peaks of aerosol pollution were noticed, which were not detected on the mass-based reference instruments. By investigating the environmental conditions coinciding with these events, the source was determined as emission from a nearby industrial site. Though the levels were not of a health concern, it acted as a useful case study for low cost sensors to identify local sources of pollution.

Image: Low-cost optical particle sensor field trial unit, along with an example of readings extracted.
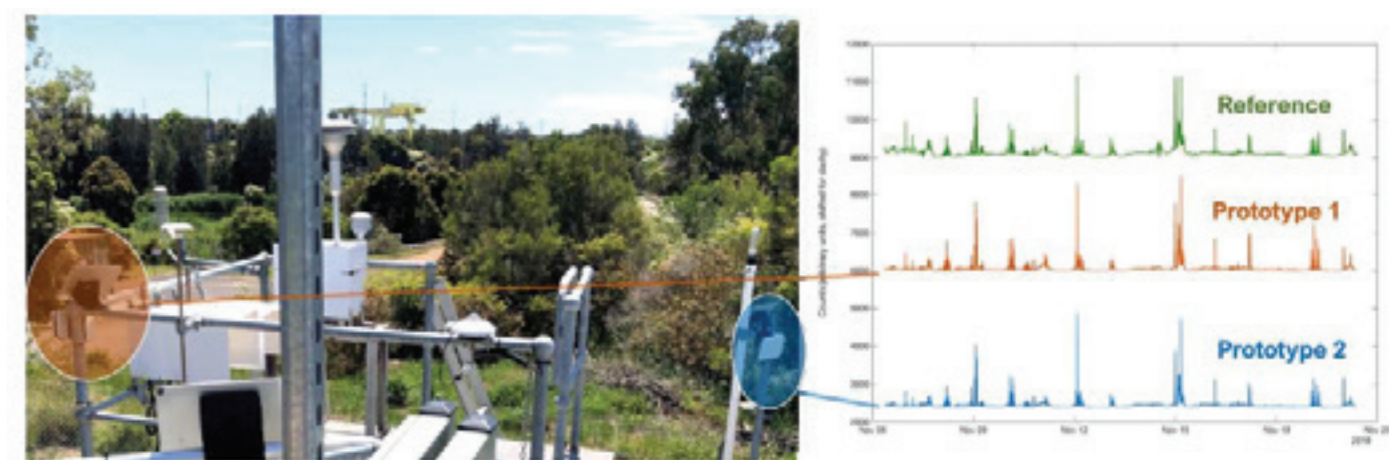
5. Remote soil moisture sensing using RF technology

Value: $78,000
Partners: Sydney Institute of Agriculture
University partners: University of Sydney

This project aims to develop a non-invasive soil moisture sensor. A crucial issue for soil moisture probes is their hyperlocal sensing range and issues associated with physical installation across the land. The technology proposed in this project is completely remote and measures the average moisture content across a length of soil – solving both issues.

A novel sensor has been developed and is currently being tested in situ in Camden. Following the formalisation of calibration procedures, the next step will be to seek commercialisation opportunities with Agtech industry players who have expressed interested in this technology.

6. Optical simulation for a novel sensor to detect smoke aerosols

Value: $10,000
Partners: ImRAC
University partners: University of Sydney

This project focuses on computational simulation for next generation sensors to be used in optical particle counters. In particular, the project aimed to solve the problem of current sensors having a difficulty in sizing small particles (<1 micron) accurately. The funding hired an optical scientist to perform Mie-scattering simulations for a dual- wavelength particle sensor. The calculations acted as a proof of concept and green-lit subsequent product design and development.

The project has enabled new ideas for the technology to be applied in areas of black carbon detection for climate change and nanoparticle sensing in the context of COVID-19. With the initial body of work completed, new opportunities are now being explored.

NSSN Grand Challenges

To bring greater focus to the NSSN's R&D program, in 2020 the NSSN launched its Grand Challenges program.

The NSSN Grand Challenges respond to some of the most gripping challenges of our time. Complex challenges that are critical to our environment, health, economy and society and which demand innovative solutions that will impact future generations.

The Grand Challenges have been selected for the important role smart sensing can play in responding to the issue and where technological innovation holds the promise to change the game. They have also been selected for the NSSN's unique ability to mobilise the world-class R&D capability across our member universities in partnership with industry and government for practical, impactful outcomes.

Bushfires – Smart Sensing for bushfire prevention, response & mitigation

The devastating bushfires that ravaged Australia in the summer of 2019-20 galvanised the need for fresh thinking in how we live with and fight bushfires. Climate change will continue to result in more intense, more frequent, more devastating bushfires unless a new approach is taken.

From real-time satellite monitoring to next-generation airborne and ground-based sensor networks, smart sensing holds the key to better bushfire prevention, response and mitigation.

Water – Smart sensing to better understand our water resources and to build a drought resilient NSW & ACT

It is written into Australia's folklore that we are a land of drought and flooding rains. Water is a precious resource critical to agriculture, cities, biodiversity and to life itself. It requires effective management of both quality and quantity to help navigate both flood events and protracted severe droughts.

Smart sensing is central to better understanding our water resources and to building a drought resilient NSW & ACT.

COVID-19 – Smart sensing to emerge from COVID-19 and prepare for future pandemics

Coronavirus swept the world in 2020, killing over a million people, inundating hospitals and crippling economies. Governments, industry and civil society rushed to respond to the crisis, implementing emergency measures with varying levels of success.

From medical responses to social technologies, smart sensing offers a range of solutions that will help Australia flatten the pandemic's growth, emerge from COVID-19 and prepare for future pandemics.
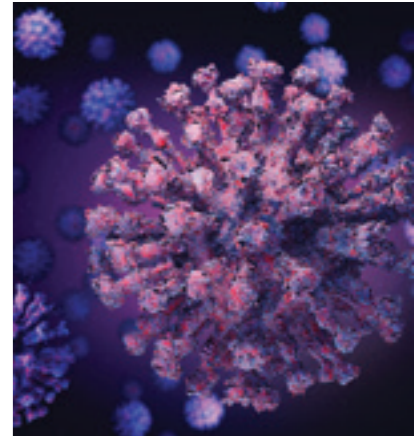
Ageing – Smart sensing for healthier, safer ageing, both at home and in care settings

Australia's population is getting older. An ageing society is placing increased pressure on our healthcare system and demands an age-friendly future in which our seniors can live in their own homes with dignity, independence and access to high quality care.

From real-time, wearable monitoring of vital signs to smart homes equipped with automated appliances, smart sensing is at the heart of technology for healthier, safer ageing both at home and in care settings.

NSSN Living Lab

The NSSN is developing its Living Lab concept in key areas of smart sensing innovation, particularly around air quality and water infrastructure.

Throughout FY19/20 key stakeholder relationships were developed with **local councils** and with the property developer, Celestino, in relation to their large development in Western Sydney called the Sydney Science Park. These relationships are progressing well and in July 2020 (just outside the scope of this report), an MoU was signed between Celestino **Sydney Science Park** and the NSSN to progress the Living Lab. The NSSN Living Lab concept will advance significantly in FY20/21.

NSSN BUSINESS DEVELOPMENT PROGRAM

NSSN Business Development Program

One of the key ways in which the NSSN delivers financial return on investment to its members is through its business development program.

Drawing upon its large network of government and industry partnerships and contacts, the NSSN matches client smart sensing demand with university research supply. In FY19/20, the NSSN attracted **$1,580,000** in new commissioned projects across 3 projects (for further detail on each project see the R&D Program earlier in this report):

1. Increased Recycling of Plastics by Sensing Label Contamination

Value:	$1,500,000
Funder:	Commonwealth Government CRC-P Program, Visy, Labelmakers, Pegras
Member universities:	UNSW, UTS, Sydney

2. Remote soil moisture sensing using RF technology

Value:	$78,000
Funder:	Sydney Institute of Agriculture
Member universities:	Sydney

3. Optical simulation for a novel sensor to detect smoke aerosols

Value:	$10,000
Funder:	ImRAC
Member universities:	Sydney

The NSSN's Business Development program actively seeks new partnerships and clients and has built a **business development pipeline** of prospective projects valued at over **$16 million across 19 prospective projects**. Relationships are currently being nurtured with a range of government and industry partners like CSIRO, Transport for NSW, NSW DPIE, the Office of National Intelligence, Livingstone International, DataFuel, Skyfii, Ocular Robotics and NSW Health.

NSSN Business Development Pipeline: As of 31 July 2020

New Commercial Opportunities

Stage 1 of 5 281 accounts	Stage 2 of 5 25 accounts	Stage 1 of 5 19 accounts $16,126,000	Stage 4 of 5 5 accounts $7,978,000	Stage 5 of 5 10 accounts $708,764
Prospects	**Leads**	**Opportunities**	**Active Projects**	**Completed Projects**
Contact the Business Development Manager for the full list	• Transport for NSW • NSW Rural Fire Service • ICT International • NSW Fire & Rescue • Sub Mapping • Maxar Technologies • Humense • Drone Shield • CoachAir • ARC ITRH Wearables • Immarsat • Abbott Healthcare • City of Sydney (& other LGAs) • Boeing & Nova Systems (Incl Australian Space Agency) ... and more	• Office of National Intelligence • DPIE (ARC LP) • Transport for NSW • Mezrit (MRFF) • Ocular Robotics • Covidien • Livius/Livingstone • Hitachi & Western Sydney • DataFuel • Ovato • Skyfit • Bronx International • Stormtech • Sydney Water/Thales/Zedelef commercialisation (PSF)	• Sydney Water (& consortium) • RAAF Pian Jericho • Visy • Sydney Institute of Agriculture	• Opus Med • Evisuals • NSW Dep. Of Industry • NSW Dep. Of Industry - Pilot • U of Sydney (Physics) - Pilot • UNSW (Chemsitry) - Pilot • Suncayr (USA) - Pilot • NSW OEH - Pilot • ImRAC • Regional Enviroscience • Office of Environ. & Heritage

Diagram: NSSN Business Development Pipeline indicating R&D Projects completed, active and emerging.

NSSN Digital Capability Map

As part of its business development program, the NSSN actively maintains a comprehensive register of its members' strengths relating to smart sensing. In October 2019, the NSSN Capability Map was made available to the public as a **searchable online database** on the NSSN website.

What expertise are you looking for? Example: sensor, "data analytics"

Image: NSSN Booth at CEBIT 2019

NSSN INDUSTRY ENGAGEMENT PROGRAM

Supporting NSW Manufacturers and Industry

The NSSN is committed to supporting a strong, vibrant and resilient smart sensing industry in NSW.

Between March and May 2020, the NSSN worked closely with NSW-based electronics manufacturer, **Circuitwise, to secure a $350,000 contract to build 2,100 breathing circuits** as part of Australia's response to COVID-19. The NSSN facilitated the introductions and fostered the collaboration required to establish this project.

Our industry engagement program has identified **140 NSW-based companies** engaged in smart sensing and invites their participation in networking, informational and project-building events. These companies include Genesys, Circuitwise, Bosch, Advanced Navigation, Bioscout, Birdi, Carbonix, Contactile, D+I, ICT International, LX Group, Meshed, Ocius, Ocular Robotics, Silanna Semiconductors and Taggle to name just a few.

In FY19/20, the NSSN hosted 15 industry engagement events across 4 event series and 1 standalone event.

NSW Water Industry Innovation Workshop

In October 2019, the NSSN hosted the NSW Water Industry Innovation Workshop, attracting 130 delegates from across the NSW water sector.

Representatives from organisations such as NSW DPIE, NSW Department of Primary Industries, NSW Natural Resources Regulator, NSW Farmers and the NSW Irrigators Council came together with researchers from across the NSSN membership to workshop smart sensing solutions to gripping water challenges facing the state.

Opened by the Minister for Water, Property & Housing, the Hon. Melinda Pavey, the workshop consisted of panel discussions with NSW government agencies and interest groups before breaking out into sandpit sessions to brainstorm smart sensing solutions.

Resulting from the workshop, 7 proposals were presented to NSW DPIE Deputy Secretary and CEO for Water, Jim Bentley, for funding consideration. **4 proposals** have been shortlisted and are being further shaped into collaborative R&D projects with NSW DPIE, including:

- Balancing the water account – measuring interactions between surface & groundwater
- Avoiding fish kills by sensing dissolved oxygen in river systems
- Floodplain harvesting
- Data analytics

Image: NSSN hosted the NSW Water Industry Innovation Workshop in October 2019. Clockwise from top left: Minister for Water, the Hon. Melinda Pavey opens the workshop; NSW Chief Scientist & Engineer, Prof. Hugh Durrant-Whyte speaks at the workshop; panel discussion of industry & government representatives; workshop delegates listen to the Minister for Water's opening address.

Image: Developing Commercially Scalable Smart Devices workshop at UNSW in September 2019.

Successfully Adopting Smart Sensing Technologies

Presented in conjunction with the NSW Department of Industry, these events showcase smart sensing technology that has successfully been commercialised from the host university.

They aim to demonstrate, both to local businesses and to university researchers, the innovation that arises when universities and industry work together. The events also highlight the support government, university and NSSN can provide to such collaborations

1)	July 2019	Western Sydney University
2)	November 2019	UNSW

Developing Commercially Scalable Smart Devices

Presented in conjunction with Genesys Electronic Design and Circuitwise, these workshops deliver tailored information sessions on developing commercially scalable electronic smart devices with a focus on IoT, ICT, built environment and Medtech for researchers at our member universities.

The practical knowledge shared by industry experts has been extremely useful in assisting researchers interested in taking research from benchtop through to commercialisation.

1)	September 2019	UNSW
2)	September 2019	University of Wollongong
3)	April 2020	University of Sydney

Image: Developing Commercially Scalable Smart Devices workshop at UNSW in September 2019.

NSW Sensing Industry Connect

Presented in conjunction with a local accelerator/incubator/industry hub, this event is an opportunity for our sensing industry partners to connect over casual drinks and networking. The NSSN recognises the strength of NSW capability in sensing technology innovation and manufacturing.

Committed to strengthening the competitiveness of NSW industry on a national and international level, the NSSN has created a space where companies can form valuable bonds. The event attracts leaders, innovators and entrepreneurs in the sensing technology industry, ranging from manufacturers to designers and deployers.

1)   March 2020   University of Sydney

Several more events in these series were planned but were placed on pause due to COVID-19. The series has been launched in September 2020.

In addition to events hosted by the NSSN, the Network actively engaged in a range of events throughout the year that enhanced relationships with the smart sensing industry.

Image: Delegates from across the NSW sensing ecosystem network at the inaugural NSW Sensing Industry Connect event at the University of Sydney in March 2020.

CEBIT 2019

A flagship event of the NSSN in FY19/20 involved a significant presence at the largest biztech conference in the Asia Pacific region in October 2019.

Invited by the NSW Department of Industry and provided with complimentary booth space, the NSSN hosted a three day presence at CEBIT that provided excellent exposure to a broad array of prospective clients and generated a considerable number of business development leads for the Network.

As part of the conference, the NSSN also hosted a 3-day Hackathon in which student teams from NSSN member universities competed to solve a real-world sensing data challenge related to transport. Teams were mentored by industry sponsors including Microsoft, GoGet, Here Technologies and the NSW Data Analytics Centre.

Image: NSSN hosted a booth and hackathon at CEBIT 2019. Clockwise from top left. The eye-catching NSSN booth at CEBIT 2019; student teams from across the NSSN battling it out in a hackathon; Minister for Better Regulation & Innovation, the Hon. Kevin Anderson tours the NSSN booth with NSSN Chair Susan Pond & COO Nick Haskins.

Image: Hackathon winners, Western Sydney University, surrounded by other student teams from across the NSSN.

AMGC NSW Regional Tour

The NSSN participated in a tour of regional centres of NSW to better understand smart sensing capability across the state and connect with industry partners. Hosted by the Australian Manufacturing Growth Centre, the tour visited Albury, Dubbo, Wollongong and Nowra across late 2019 and early 2020.

Sydney Water Science Week

The NSSN showcased its *Advanced Pipe Sensing to Reduce Leaks & Breaks* project along with other relevant smart sensing capability at the 2019 Sydney Water Science Week Fair in August 2019.

TasWater Hackathon

Resulting from the NSSN's Water Industry Innovation Workshop in October 2019, Dr Tomonori Hu, NSSN Environment & AgTech Theme Leader was invited to judge a TasWater hackathon in Hobart.

IoT Alliance Impact Conference

The NSSN sent a delegation to the 2019 IoT Alliance Impact Conference in October 2019. The annual conference has quickly become the largest gathering of the IoT and sensing industry in Australia and provides an excellent opportunity for the NSSN to build profile and make valuable industry connections.

National Plastics Summit

Dr Don McCallum represented the NSSN at the National Plastics Summit in Canberra in March 2020. Hosted by the Federal Minister for the Environment, the Hon. Sussan Ley, the summit was an opportunity to profile the NSSN's work in HDPE recycling innovation and make further connections in Australia's growing recycling industry.

NSW Business Innovation Spotlight

Dr Ram Vaidyanathan represented the NSSN at this industry engagement event hosted by the NSW Government in July 2019.

Image: NSSN Theme Leader Dr Ram Vaidyanathan and Michael Sharpe, National Director, Industry, AMGC during a site visit in regional NSW.

Image: NSSN Frontiers in Sensing 2019. Keynote speaker: Prof Kai Bongs, Director, UK Quantum Technology Hub for Sensors & Metrology.

NSSN PUBLIC OUTREACH PROGRAM

NSSN Public Outreach Program

Beyond its core stakeholder groups of member universities and industry and government partners, the NSSN is committed to engaging the wider public in the important role smart sensing plays in delivering solutions to environmental, economic and societal challenges.

Image: Screen grab from the NSSN COVID-19 Q&A Virtual Forum hosted in March 2020.

COVID-19 Fora and Workshops

In March 2020, as COVID-19 began to spread rapidly throughout the globe, the NSSN responded swiftly to highlight **smart sensing solutions** to the pandemic. On 31 March, shortly after NSW went into lockdown, the NSSN hosted a COVID-19 Q&A Virtual Forum that attracted an audience of **350.**

The panel discussion, moderated by ABC Science journalist, Robyn Williams, included experts from NSSN member universities, hospitals and the World Health Organisation.

Feedback and interest in the NSSN COVID-19 Q&A Virtual Forum was so positive that the NSSN hosted a second Forum in the same format on 21 May, attracting an audience of **115**.

Both fora attracted significant media attention with both events re-broadcast in their entirety on SkyNews Australia and ABC Radio National and interviews on Radio 2GB.

Accompanying the public fora, a series of **5 industry workshops** were held around key areas in which smart sensing could play a key role in addressing the pandemic. These targeted virtual workshops brought together relevant NSSN researchers with representatives from NSW Health and industry partners such as Medtronic, 3M, Circuitwise, Ocular Robotics, Skyfii and Mezrit among others.

Three collaborative projects were established arising from the workshops and are being developed with key industry partners.

"We must learn from the last fire season, and we must do better for the next."

NSW Minister for Energy & Environment
The Hon. Matt Kean MP

NSSN Frontiers in Sensing Forum: bushfire prevention, mitigation and response

NSSN's flagship event, the Frontiers in Sensing Forum, took place online on 7 May 2020.

Following the devastating impact of 2019-20 *Black Summer* bushfires in Australia, the forum explored the critical role that smart sensing technology can play in delivering solutions to the complex challenge of bushfire prevention, mitigation and response. The online event attracted an audience of 258.

The Forum was opened by Minister for Energy & Environment, the Hon. Matt Kean MP and featured a keynote address by NSW Rural Fire Service Commissioner, Mr Rob Rogers, and a panel of speakers including Chair of the Bushfire & Natural Hazards CRC, Dr Katherine Woodthorpe AO; Lead at the Minderoo Foundation's Wildlife & Disaster Resilience Program, Mr Adrian Turner; Director of Climate & Atmospheric Science at NSW DPIE, Mr Matt Riley; Director of Risk Frontiers, Mr Andrew Gissing and Senior Lecturer in Environment & Engineering at ANU, Dr Marta Yebra.

Social Media

Across FY19/20, the NSSN increased its social media engagement significantly.

1,938
TWITTER
FOLLOWERS

94%
INCREASE ON
JUNE 2019

269
AVG. LIKES
PER MONTH

71
AVG. RETWEETS
PER MONTH

84,405
AVERAGE
IMPRESSIONS
PER MONTH

in 1,125
LINKEDIN
FOLLOWERS

256%
INCREASE ON JUNE 2019

The NSSN website is maintained as a comprehensive resource on the remit, structure and activities of the network.

1,890
AVG. VISITS
PER MONTH

78
NEWS STORIES
POSTED FY19/20

Traditional Media

The NSSN also experienced considerable growth in its traditional media engagement in FY19/20, securing 38 mentions across print, online and broadcast media outlets including:

Television

| Channel Seven | Sky News |

Radio

| ABC Radio National | 2GB Radio |

Industry Publications

Pace today	Australian Printer	Trenchless Australia
AIP Publishing	Utility Magazine	SA Water Newsroom
Government Tech Review	Education Diary	Inside Waste
Australian Printer Magazine	IoT Alliance Australia	Australian Manufacturing

University Media

| UTS News | UC News | University of Sydney News |
| UNSW Newsroom | ANU Newsletter | Macquarie News |

Newsletter

The monthly NSSN Newsletter, *The Sensor*, was delivered 11 times across FY19/20, taking a scheduled hiatus in the month of January. At 30 June 2020, *The Sensor* has a subscription list of 1,665 readers.

Academic Publications

A total of **7 academic publications** acknowledging the NSSN were published in FY19/20:

1. Suwannakot, P., Lisi, F., Ahmed, E., Liang, K., Babarao, R., Gooding, J., Donald, W. Metal–Organic Framework-Enhanced Solid-Phase Microextraction Mass Spectrometry for the Direct and Rapid Detection of Perfluorooctanoic Acid in Environmental Water Samples. Analytical Chemistry. 2020; 92, 6900-6908.

2. Nikoloska, R., Bykerk, L., Vitanage, D., Valls Miro, J., Chen, F., Wang, Y., Liang, B., Verma, S. Enhancing Sydney Water's Leak Prevention Through Acoustic Monitoring: New Approaches to the Application of Sensing for Leaks. Water e-Journal. 2020; Vol 5 (2).

3. Nikoloska, R., Bykerk, L., Arbon, N., Vitanage, D., Valls Miro, J., Stephens, M. Enhancing acoustic monitoring in Sydney Water's CBD networks. Water e-Journal. 2020; Vol 5 (3).

4. McCallum, D., Vitanage, D. 2020. 'NSSN Working with Water Industries to Reduce Leaks and Breaks during Drought'. OzWater 20.

5. Valls Miro, J. Review of Acoustic Sensing for the Prediction of Leaks & Breaks in Water Mains: A Technical Report for the Sydney Water led collaborative research project on "Enhancing Predictive Management of Water Networks", under the umbrella of the NSW Smart Sensing Network. November 2019.

6. Bretreger, D., Yeo, I.Y., Melchers, R. LiDAR derived terrain wetness indices to infer soil moisture above underground pipelines. International Journal on Smart Sensing and Intelligent Systems. 2020; Vol 13 (1), p1-7.

7. Cheema, F., Hu, T., Eggleton, B., 'Pushing low-cost particle sensor limits - performance in clear indoor environments'. CASANZ19 - Air Quality & The Built Environment, Queenstown, NZ, 2019.

Conference Presentations

The NSSN delivered a total of **4 presentations** to academic conferences.

1. Presentation to the Centre for Air Quality & Health Research & Evaluation (CAR) workshop on *Exposure Assessment, Data Fusion & Measurement Error.* Dr Tomonori Hu, NSSN Environment & AgTech Theme Leader. 23 March 2020.

2. Presentation to the 13th International Conference on Sensing Technology (ICST) hosted by Macquarie University. Prof. Ben Eggleton, NSSN Co-Director. 2 December 2019.

3. Presentation to CASANZ19 – the 24th International Clean Air & Environment Conference in Queenstown, New Zealand. Dr Tomonori Hu, NSSN Environment & AgTech Theme Leader. 18 September 2019.

4. Presentation to Centre for Air Quality & Health Research & Evaluation (CAR) workshop on *Photonic Sensors for Air Quality & Beyond.* Dr Tomonori Hu, NSSN Environment & AgTech Theme Leader. 30 July 2019.

Thought leadership

The NSSN's expert team of theme leaders and engineers retain a scholarly remit and, as such, are continuously abreast of research trends in smart sensing.

This expertise is shared regularly with NSSN members, stakeholders and the wider public. Through the dissemination of thought pieces via NSSN's communication platforms and various other outlets, the NSSN is contributing to a national discourse on smart sensing.

Across FY 19/20, **8 thought pieces** from the NSSN were published:

1. *Futureproofing Australian printing with industry 4.0* – Australian Printer Magazine. July 2020. Dr Don McCallum, NSSN Development Manager.

2. *Smart sensing solutions to COVID-19* – Radio 2GB. May 2020. Prof. Ben Eggleton & Prof. Justin Gooding, NSSN Co-Directors.

3. *Tailoring smart sensing solutions for Australian printers* – Australian Printer Magazine. May 2020. Dr Don McCallum, NSSN Development Manager.

4. *From smart sensors to AI: a data flow journey* – NSSN website and other channels. April 2020. Dr Ayu Saruswati, NSSN AI/ML Engineer & Jimmy Tran, NSSN Engineer.

5. *Cutting energy costs for Australian printers* – Australian Printer Magazine. March 2020. Dr Don McCallum, NSSN Development Manager.

6. *Air quality sensing to serve all citizens* – NSSN website and other channels. January 2020. Dr Tomonori Hu, NSSN Environment & AgTech Theme Leader.

7. A*natomy of a smart sensor: a non-technical perspective* – NSSN website and other channels. November 2019. Jimmy Tran, NSSN Electronics Engineer.

8. *Creating opportunities for Australia in Microfluidics* – NSSN website and other channels. August 2019. Dr Ram Vaidyanathan, NSSN Advanced Manufacturing Leader.