NSW SMART SENSING NETWORK

ANNUAL REPORT **FY21/22**

21/22

NSSN

NSW Smart Sensing Network

FOREWORD BY BOARD CHAIR

I was honoured to be appointed NSSN Board Chair in July 2022 and take forward the excellent work of my predecessor, Dr Susan Pond AM. As inaugural Chair, Susan was a driving force of the NSSN across its first five years and I acknowledge and thank her for her outstanding contribution.

I am no stranger to the NSSN, having served as a Board member for four years prior to assuming the Chair role. Over this time, the network has developed from a thrilling concept in an uncharted landscape to a forerunner in a rich ecosystem dedicated to driving the innovation agenda – both at the NSW state level and nationally.

It is enormously exciting work that was bolstered in FY21/22 with the release of the NSW Government's *20-Year R&D Roadmap*. The roadmap lays out a clear vision of NSW's unique areas of competitive advantage across four technology themes: digital, materials & chemistry, biotechnology and energy. Sensing finds its home in the digital theme but is a key enabling technology across all four themes. Very quickly one begins to realise the integral importance of smart sensing to our state's prosperity, and indeed, the importance of a body like the NSW Smart Sensing Network.

I acknowledge the exceptionally talented and committed NSSN staff, led by Co-Directors, Professors Benjamin Eggleton and Julien Epps, and Chief Operating Officer, Nicholas Haskins. It is through their efforts that the achievements in this annual report are realised.

I step up to chair a Board that is deeply engaged and dedicated to the network's future. The governance model of the Board allows for succession and the introduction of new leaders and talent. In FY21/22 we welcomed two new Board members in Diana Day and Fiona Rankin and recognised the service of retiring Board member, Nick Campbell. I thank and recognise the contribution made by all Board members.

As you read on in this annual report, you will see the breadth and depth of the work of the NSSN. Work that matters and is having real world impact in areas like floods, bushfires, air quality, ageing and sustainability. These are all issues that are highly topical and require *innovative* thinking and *collaborative* spirit to address. These two words – innovation and collaboration – are at the very heart of the NSSN mission. We bring together universities, government and industry to translate world-class research into innovative solutions to economic, environmental and societal challenges.

I thank the NSW Chief Scientist and Engineer, Professor Hugh-Durrant-Whyte and his team, for their continued strong support and advocacy of the NSSN, and for our shared vision of NSW being recognised as a global leader in the smart sensing ecosystem.

Jo White
Chair of NSSN Board

CO-DIRECTOR'S MESSAGE

In June 2022, the wider NSSN community gathered overlooking Sydney Harbour to celebrate the 6th Birthday of the network. It was a fitting celebration of six years of achievement and a chance to reflect on how far we have come together – universities, industry and government working in partnership.

Thinking back to 2016 and the establishment of the Network, perhaps no one expected this wild experiment to work so well. Prompted by then NSW Chief Scientist & Engineer, Professor Mary O'Kane's vision, the founding Co-Directors shaped the NSSN on the basis that great things happen when universities, government and industry work together to translate the world-class research taking place in our universities into innovative solutions to some of our biggest challenges. Smart sensing was chosen as the focus for its ability to cut across industry sectors and academic disciplines and the key enabling role it plays in so many critical technologies.

Six years later and the NSSN has successfully delivered 19 R&D projects to a value of over $5.5 million, is mentoring 17 active R&D projects to a value of $22 million and has generated a strong pipeline of future projects. We are delivering value to our member universities in the form of new commissioned research and to our industry and government partners in the form of new insights, products and competitive advantage.

Our co-created R&D programs are contributing to innovative solutions to a wide range of current economic, environmental and social challenges including droughts, floods, bushfires, ageing, water and air quality, national safeguarding, and manufacturing sovereignty. In some, the impact is already being seen and in others, the true impact will be seen over the course of many years.

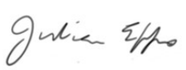
We are motivated by achieving the kind of outcomes that no single university, company or government agency can achieve working alone. We know that transformation happens through collaboration and vehicles like the NSSN are important activators of such collaboration.

We were encouraged in FY21/22 by the commitment by the NSW Government to continue funding the NSSN for a further four years through to June 2026. A recognition of all that we have achieved and an expression of confidence in what we will achieve in the future.

We take this opportunity to thank the NSSN's myriad stakeholders – our member universities, brilliant researchers, innovative partners, dedicated team, accomplished Board and the unwavering support of the NSW Government through the Office of the Chief Scientist & Engineer, Professor Hugh Durrant Whyte.

We invite you to read on for a more detailed report on the NSSN's achievements in FY21/22.

Professor Benjamin Eggleton
Co-Director, NSSN



Professor Julien Epps
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 & 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 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 VISION

NSW is a recognised global leader in smart sensing.

OUR MISSION

To translate world-class research in smart sensing into compelling solutions that create value for the economy, environment and society of NSW and beyond.

OUR OBJECTIVES

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

1. Enhance the NSSN's role as an Activator of innovation
2. Develop signature projects
3. Deliver valuable services to our members
4. Quantify and validate the NSSN's impact
5. Strengthen research capacity & profile

OUR VALUES

SOLUTIONS-ORIENTED

We seek out and solve challenging problems faced by our partners.

INNOVATIVE

We translate outstanding research strengths into opportunities, products and services that add.

TRUSTED

We are the go-to source for quality solutions. People rely on us as suppliers of knowledge. We offer value for money and the best solution for our partners.

COLLABORATIVE

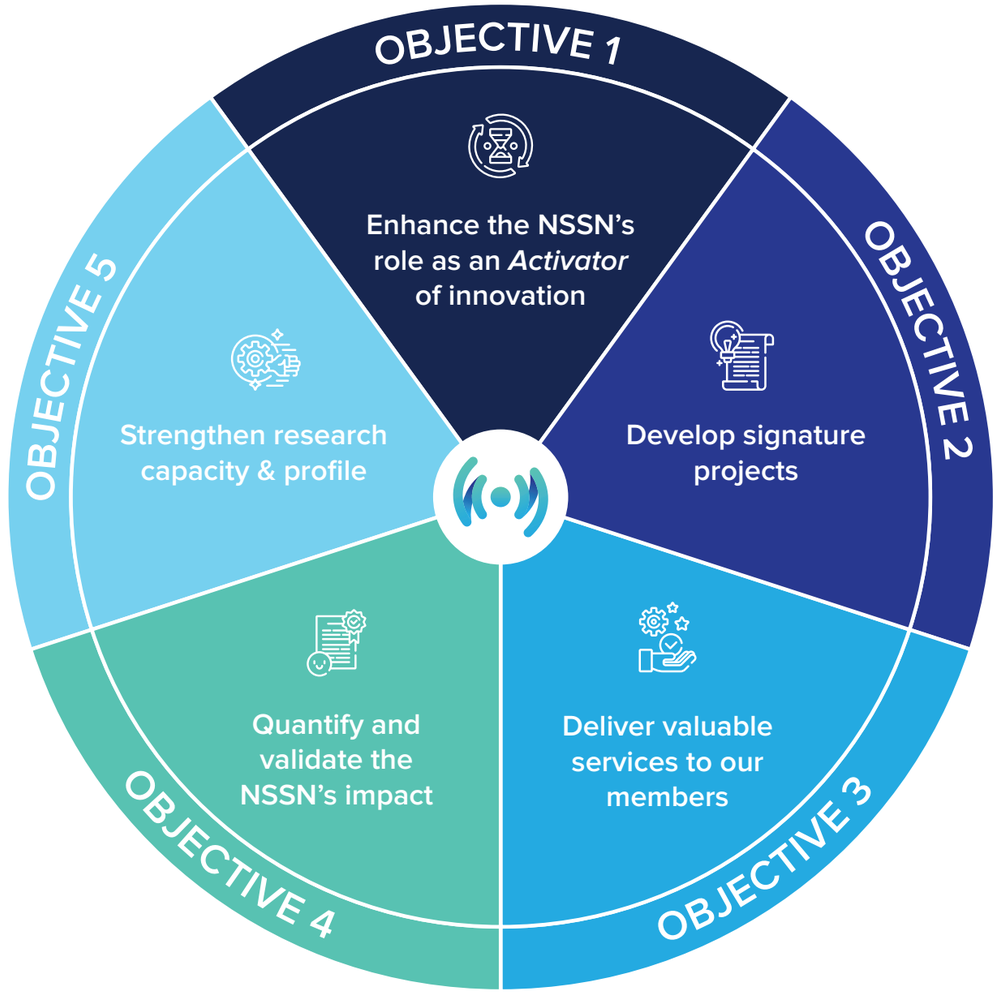
We offer a single point of entry to expertise across multiple institutions and disciplines, from our core in science and engineering to diverse disciplines that can contribute to successful solutions.

CELEBRATE SUCCESS

We create value and build prosperity. The success of our partners is our success. We are thrilled when research is converted to real-world impact, and we celebrate this success.

DIVERSITY

People are at the heart of all that we do and our people represent rich diversity in all its forms. Diversity breeds innovation and we cultivate a culture of inclusion.



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

Charles Sturt University

Macquarie University
SYDNEY·AUSTRALIA

The University of Newcastle
Australia

UNSW Sydney

The University of Sydney

UTS

University of Wollongong
Australia

Western Sydney University

PEOPLE

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

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

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 universities and government imperatives guide the strategy and activities of the network.

A lean central team of talented staff lead the research programs and coordinate the operations of the network.

CO-DIRECTORS

Professor Benjamin Eggleton
Co-Director, NSSN

Professor Julien Epps
Co-Director, NSSN

BOARD

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

Jo White
Chair

Dr Diana Day
Board Member

Dr Jill Freyne
Board Member

Dr Ian Opperman
Board Member

Fiona Rankin
Board Member

Sally-Ann Williams
Board Member

Frank Zeichner
Board Member

Caroline Residovic
NSW Government Representative

MEMBER'S COMMITTEE

The NSSN Members' Committee consists of the Deputy Vice-Chancellors (Research & Innovation) or equivalent and represents the members' interests in the strategic direction of the Network.

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

Dr Paul Di Pietro
Dean of Research Knowledge Exchange and Translation, University of Wollongong

Professor Michael Friend
Pro-Vice-Chancellor (Research & Innovation), Charles Sturt University

Professor Brian Kelly
Pro Vice-Chancellor (Research), University of Newcastle

Dane McCamey
Pro Vice-Chancellor (Research), UNSW

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

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

Ute Roessner
Director, Research Initiatives & Infrastructure, ANU

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

STAFF

The NSSN consists of a lean central team of talented staff who lead the research programs and co-ordinate the operations of the network.

Nicholas Haskins
Chief Operating Officer

Ivan Chua
Business Development Manager

Dr Tomonori Hu
Environment & AgTech Theme Leader

Kimi Izzo
Electronics Engineer

Catherine Oates Smith
MedTech Theme Leader

Peter Runcie
Smart Cities Theme Leader

Dr Ayu Saraswati
Engineer

Danielle Seagrave
Project Administrator

EXECUTIVE SUMMARY

FY21/22 marked solid growth in our R&D program, with 17 projects under active management. A strategic focus on larger, signature projects is reflected in the R&D program, with projects such as the ARC Research Hub for Connected Sensors for Health (led by UNSW with partners at Macquarie University, the University of Newcastle and the University of Wollongong) and the OPENAIR project (led by UTS with partners at ANU, UNSW, University of Sydney and WSU) both launching in FY21/22. Not only are these projects high in dollar value, but they will have a significant and lasting impact on their sectors: MedTech and Smart Cities, respectively.

The *Where is all The Water?* project was completed, and the final report was delivered to the NSW Department of Planning & Environment for implementation into policy. As NSW oscillates between periods of extreme drought and extreme flood, this project has improved our understanding of natural water systems and enhanced the state's water monitoring network. The next steps and follow-on projects continue to be actively explored.

The second round of the NSSN Grand Challenge Fund directly invested $360,000 of NSSN funds to seed innovative R&D projects that brought together universities with industry/government partners to address challenges across the six defined NSSN Grand Challenges.

16 applications were received to the 2022 fund, a three-fold increase on the inaugural round. Four proposals were funded, representing a 25% success rate. Importantly, this NSSN investment leverages significant industry co-investment of $769,637 – a 2:1 return on investment in the GCF alone.

Our Business Development program continues to build a strong pipeline of commissioned research leads and opportunities for our member universities. In FY21/22, the NSSN attracted an impressive $15.7 million in commissioned research across 13 projects. This represents a significant increase from previous years and is a testament to the NSSN's new strategic focus on pursuing larger, signature projects; and the compound efforts of the Network's first six years.

We continue delivering value to our members beyond our R&D and business development activities. We take a proactive approach to strengthen the research capacity of our member universities through activities such as supporting significant funding bids. We played a pivotal contribution to securing two ARC LIEF Grants in the 2022 Round:

- BioSHeM – High-Resolution Imaging and Spectroscopic Helium Atom Microscope (LE220100168), led by the University of Newcastle.
- Secure Smart Sensing & Industry Analytics Facility for Industry 4.0 (LE220100078), led by UTS.

These activities are not officially captured in our metrics but are an increasingly important value-add to our members.

Our Industry Engagement program enjoyed renewed vigour as the nation slowly emerged from COVID-19 lockdowns. The NSSN hosted 10 events engaging the NSW sensing ecosystem. In March, we hosted the 2nd NSSN Ageing Grand Challenge Forum at NSW Parliament House, which included in-person addresses from the Minister for Science, Innovation and Technology, the Hon. Alister Henskens; and Minister for Seniors, the Hon. Mark Coure. In June, we celebrated our 6th Birthday with a glittering reception at the Museum of Contemporary Art in Sydney, drawing together a host of NSSN stakeholders, past and present.

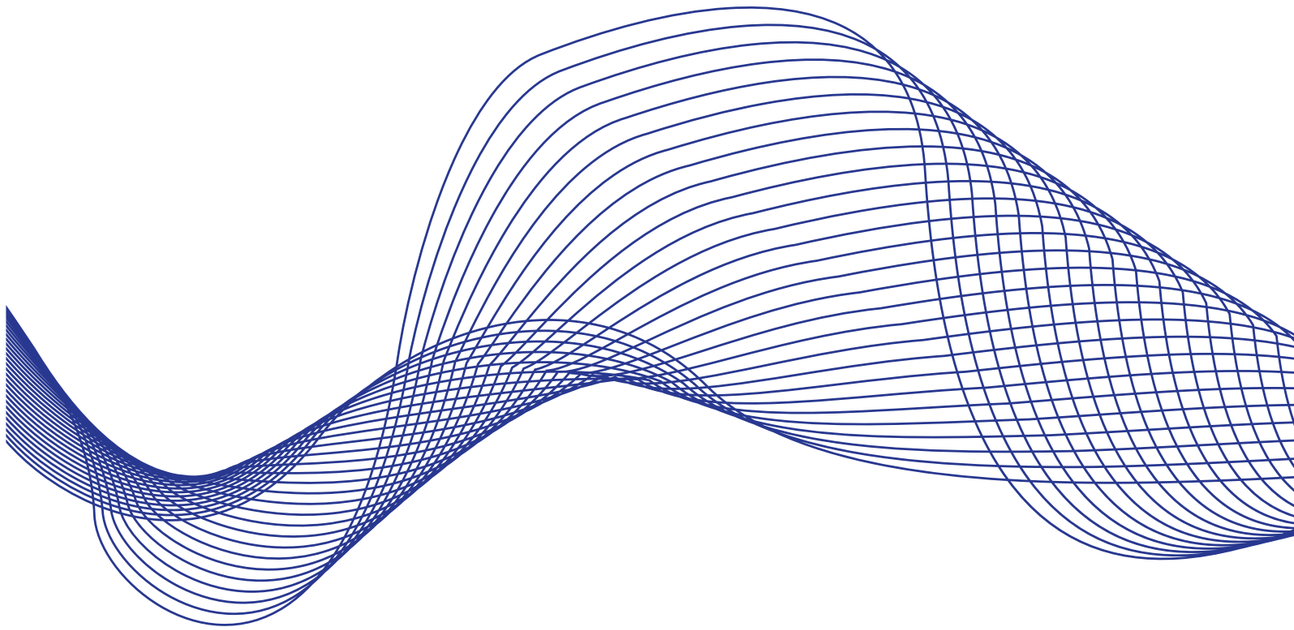
We take our role as the first of the NSW Innovation Networks seriously. Having established the model, we were pleased to see the establishment in FY21/22 of new networks in space, decarbonisation and connectivity. We provided advice and support to these networks in both the bid and establishment phases and continue collaborating with them as they develop. We were equally proud to partner with the Defence Innovation Network and NSW Circular on joint initiatives and workshops throughout the year.

The NSSN was also proud to play a crucial role in the scoping phase of the NSW Semiconductor Sector Service Bureau (S3B), participating in the early-stage consultations and advising on the development of the initiative.

We continued to broaden our audience through our Public Outreach program. Across our events and digital, social and traditional media, we seek to engage, educate and inform the scientific and general community on issues relating to smart sensing innovation. Our Twitter reach grew by 20% to 3,100 followers, and our LinkedIn community grew by 35% to 2,090 followers. We achieved 85 mentions across print, online and broadcast media, representing a 40% increase from the previous year.

We are proud of the contribution we continue to make to the NSW innovation ecosystem and are excited by the evolving opportunities driven by the NSW Government's bold vision.

We invite you to read on for a more detailed report on the NSSN's achievements in FY21/22.



FY21/22 BY THE NUMBERS

17
ACTIVE R&D MULTI-PARTNER PROJECTS UNDER NSSN MANAGEMENT

$15.7 MILLION
NEW MULTI-PARTNER CONTRACT RESEARCH FUNDING

$360,000
GRAND CHALLENGE FUNDING AWARDED

10
INDUSTRY ENGAGEMENT EVENTS HOSTED BY NSSN

3,100
TWITTER FOLLOWERS

2,090
LINKEDIN FOLLOWERS

“The NSSN has elevated the conversation on how industry can work with research organisations by investing the time to build a robust smart sensing community. They have taken a true partnership approach, which has helped amplify the University of Sydney’s smart sensing initiatives.

RUPAL ISMIN
DIRECTOR, SYDNEY KNOWLEDGE HUB

NSSN R&D PROGRAM

THE NSSN RUNS AN ACTIVE RESEARCH AND DEVELOPMENT PROGRAM, WITH 17 ACTIVE R&D PROJECTS UNDER MANAGEMENT IN FY21/22:

OPENAIR: OPERATIONAL NETWORK OF AIR QUALITY IMPACT RESOURCES	19
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OPENAIR: OPERATIONAL NETWORK OF AIR QUALITY IMPACT RESOURCES

CASH FUNDING $1.78 Million

PARTNERS NSW Department of Planning & Environment (NSW DPE), 9 Local Government Councils across NSW

UNIVERSITY MEMBERS

UTS · UNSW SYDNEY · Australian National University · THE UNIVERSITY OF SYDNEY · WESTERN SYDNEY UNIVERSITY

Poor air quality caused by bushfires, woodfired heaters, agriculture, transportation, industry and urban heat is a significant cause of health problems and premature death in Australian communities.

Currently, official ambient air quality monitoring in NSW is conducted by NSW DPE using high-precision (and high-cost) regulatory equipment. Some local councils collect air quality data using low-performance, affordable equipment but, with no existing consensus relating to the design, sale or application of such technology, the data captured tends to fall short of creating meaningful impact.

Led by the NSSN, in collaboration with NSW DPE, this project will arm local governments with the latest know-how in the use of low-cost, air quality sensors and will, for the first time in Australia, establish a best practice methodology for all aspects of council-led air quality monitoring and localised air quality forecasting.

OPENAIR

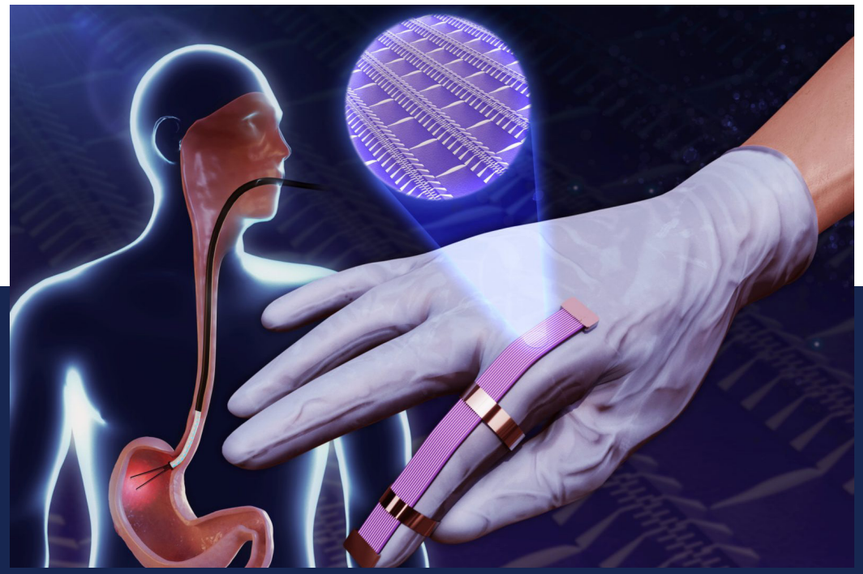
ARC INDUSTRIAL TRAINING RESEARCH HUB FOR CONNECTED SENSORS FOR HEALTH

CASH FUNDING $9.6 Million

PARTNERS Sante Innovation, Nutromics, Genesys, Vlepis, Tiger Pharm and other industry partners across the MedTech sector

UNIVERSITY MEMBERS

UNSW SYDNEY · MACQUARIE University SYDNEY·AUSTRALIA · THE UNIVERSITY OF NEWCASTLE AUSTRALIA · UNIVERSITY OF WOLLONGONG AUSTRALIA



This Industrial Transformation Research Hub, funded by the Australian Research Council, will position Australia at the forefront of connected sensors for health by developing next-generation biophysical and biochemical sensors.

By bringing together world-class research institutions with industry partners, the Hub will co-design, verify and certify new sensor technology to transform health care in Australia. Led by industry need, the work of the Hub will enable new approaches to diagnosis, monitoring, predictive treatment and prevention of disease.

ARC RESEARCH HUB FOR CONNECTED SENSORS FOR HEALTH

SMART TRIAGING AND WELLBEING IN AGED CARE

CASH FUNDING $1.48 Million

PARTNERS Vlepis, Allambie Heights Village, Careteq

UNIVERSITY MEMBERS

UTS

The NSSN worked with industry partners on this project to secure funding from the Commonwealth Government Co-operative Research Centres Projects (CRC-P) scheme. The project aims to build an integrated smart triaging platform that leverages data science and new Australian-manufactured sensing technologies to automatically identify health and wellbeing events that notify the relevant care staff.

The project develops and then leverages low-cost, unobtrusive wearable sensors that will actively monitor the users' wellbeing biomarkers such as heart rate, blood oxygenation and temperature. The technology will use real-life data for optimal detection and triage. It has a clear target of improving the well-being of at-risk Australians and reducing hospital admissions, saving lives and improving access to care in remote communities. Meanwhile, the collaboration will grow Australia's sovereign manufacturing capability and directly addresses care providers' compliance risk through ongoing health and wellbeing monitoring.

WHERE IS ALL THE WATER?

CASH FUNDING $450,000

PARTNERS NSW Department of Planning & Environment

UNIVERSITY MEMBERS

Australian National University, Macquarie University, UNSW Sydney, The University of Sydney

This project developed a technology framework and roadmap that enables evidence-based, integrated management of water resources across NSW. The project combined existing data sets with the latest developments in low-cost sensing, quantum gravity sensing, gravity data sets and data fusion techniques to address gaps in current knowledge of water location and movement in NSW.

This project has improved understanding of natural water systems and enhanced the state's water monitoring network through:

- using NASA satellites to show the gravitational pull of water at both a catchment and a continent level, revealing new information on how water moves through the landscape;
- demonstrating the use of low-cost sensors for high spatial resolution sensing;
- investigating the recharge mechanisms of aquifers, while providing a wealth of knowledge on hydrology;
- using Bayesian inference to complete probabilistic modelling, giving insights into how uncertainty around water measurements can be addressed.

Next steps and follow-on projects are being actively explored.

USING ADVANCED IOT-BASED MACHINE LEARNING FOR IN-HOME QUALITY AGEING

CASH FUNDING $252,898

PARTNERS Intelicare

UNIVERSITY MEMBERS

The University of Sydney, Macquarie University

With funding from the NSSN Grand Challenge Fund, researchers are working with industry to build machine learning (ML) algorithms to predict and prevent health events that are likely to impact the elderly's quality of life. ML is a subset of AI that allows machines to learn from big data without being programmed explicitly. It is a powerful method to structure data and identify patterns.

The solution will extend InteliCare's artificial intelligence (AI) accuracy at predicting risks of chronic disease and mental health deterioration that can lead to loss of independence, and in some cases, injury. The project will accelerate ML capability of sensors to predict events within InteliCare, which to date has focussed on detecting events, rather than predicting and hence preventing adverse events.

INSTANTANEOUS DETECTION OF HIGH-RISK LIGHTNING WITH PINPOINT ACCURACY

CASH FUNDING $250,000

PARTNERS Fire Neutral Network, NSW Rural Fire Service, ACT Government, ACT Fire & Rescue

UNIVERSITY MEMBERS

Australian National University

WESTERN SYDNEY UNIVERSITY

With funding from the NSSN Grand Challenge Fund, this project utilises novel lightning detectors capable of measuring the attributes of High Risk Lightning (HRL), including long continuing currents and charge transfer, that lead to heating. Fire agencies can then efficiently target this small proportion of HRL strikes. In addition, the smart detectors are able to map lightning in 3D, leading to superior detection efficiency and location accuracy, thereby facilitating both a quicker and more efficient inspection of high risk ground strikes.

This outcome is accomplished using a machine learning algorithm to analyse electric field waveforms from the lightning detector, to identify the presence of long-continuing current. This unique characterisation of lightning strikes is combined with information about weather and fuel attributes derived from satellite and airborne sensors, to enable a more thorough characterisation of the conditions under which lightning ignitions occur. An historical analysis of lightning-initiated bushfires, conducted in tandem with the HRL project, will facilitate rapid parameterisation of the risk factors for lightning ignition, without waiting many years to achieve results.

SMART ENERGY ASSET MANAGEMENT INTELLIGENCE

CASH FUNDING $200,000

PARTNERS Global Sustainable Energy Solutions, APVI, Lake Macquarie City Council, 5 Local Government Councils across NSW

UNIVERSITY MEMBERS

UNSW SYDNEY

UTS

With funding from the NSSN Grand Challenge Fund, this project enables automatic performance monitoring of distributed energy systems by leveraging in-built sensors in system inverters, power electronics and control systems. The knowledge, methods and algorithms developed as part of this project will provide smart energy asset owners with the actionable intelligence required to maintain their portfolio of systems. This will reduce operational administration for the asset owner, allow for financial and performance transparency, and ensure that maintenance regimes are optimised and tracked for asset owners.

AUTONOMOUS DRONES ON RESERVOIRS FOR SMOKE DETECTION

CASH FUNDING $199,985

PARTNERS Sydney Water, NSW Rural Fire Service, NSW Fire & Rescue, Southern Cross Drones

UNIVERSITY MEMBERS

With funding from the NSSN Grand Challenge Fund, this project is developing an autonomous air vehicle that will be housed in enclosures atop Sydney Water's elevated reservoirs. Once commissioned, the vehicles will periodically ascend to preset altitudes and capture 360degree video of the surroundings, providing the RFS with high-frequency visual information from multiple remote locations. Such data will not only assist in identifying and tracking fires, but also alleviate the need for RFS personnel to risk their safety in climbing these reservoirs in extreme conditions.

PAIMCOS QUARANTINE MONITORING SYSTEM

CASH FUNDING $184,076

PARTNERS Visicase Pty Ltd

UNIVERSITY MEMBERS

This project aims to strengthen the Pandemic Impact Control System (PAIMCOS) by using Machine Learning (ML) and Artificial Intelligence (AI) to optimise the sequence for fraud prevention, high scalability and protection against cyber-attacks.

Researchers from the UTS Data Science Institute are using advanced AI algorithms to optimise the timing of compliance checks based on the circumstances of each individual user, which minimises the risk of non-compliance and ensures interruption for the users is minimal.

Researchers from the University of Sydney's School of Computer Science have brought their expertise in cybersecurity and data privacy to the project, ensuring the data is collected securely and it's permanently destroyed after sometime.

NOVEL SENSOR FUSION AND ELECTRONICS DESIGN FOR HEALTHY AGEING

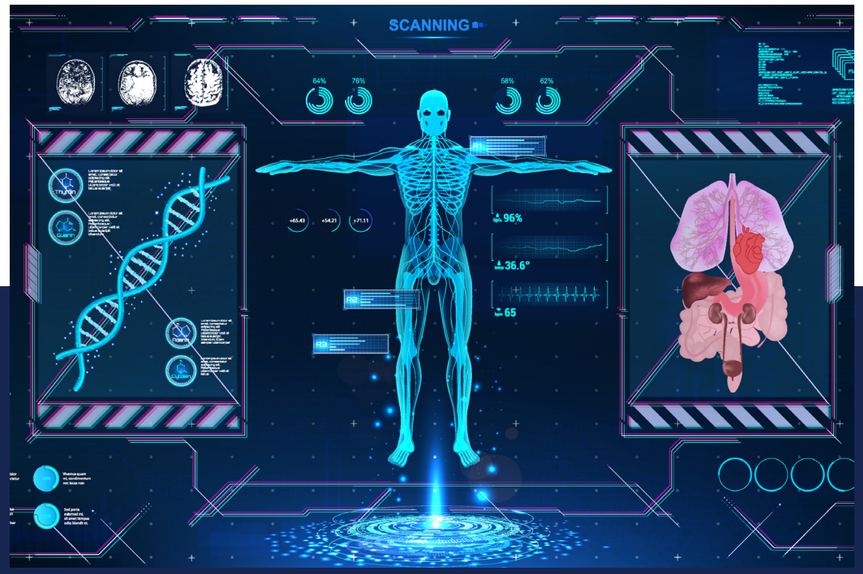
CASH FUNDING $160,000

PARTNERS 3 Aim Solutions Pty Ltd

UNIVERSITY MEMBERS

UTS

WESTERN SYDNEY UNIVERSITY



Working together with 3Aim Solutions, researchers from Western Sydney University and the University of Technology Sydney (UTS) are developing novel fused sensors and miniaturised electronics designs, overcoming the issues affecting wearable devices for healthy ageing.

With funding from the NSSN Grand Challenge Fund, the research team has developed stretchable sensors that are non-invasive, low-power and low-cost. The sensors are designed to work with people's lives and are specifically designed to simultaneously measure the users' cardiac, vascular and lung function seamlessly and unobtrusively.

NEW GENERATION OF ADVANCED FIBRE OPTICS FOR INTELLIGENT STRUCTURAL HEALTH MONITORING OF BRIDGES

CASH FUNDING $119,652

PARTNERS Transport for NSW

UNIVERSITY MEMBERS

THE UNIVERSITY OF SYDNEY

UNSW SYDNEY

This project will produce high performance, low-cost fibre optics and advance their use in health monitoring of civil infrastructure by carrying out an integrated experimental and field analysis, machine learning modelling and digital twin solution. Outcomes of this novel approach provide a holistic, end-to-end fibre optic structural health monitoring strategy that effectively integrates embedded optical sensors, artificial intelligence and computational modelling for realtime remote monitoring of critical infrastructures. This provides significant benefits by digital transformation and expanding application of advanced technologies in a built environment, enhancing resilience and sustainability of infrastructure.

SENSING MICROPLASTICS IN WATER

CASH FUNDING $100,000

PARTNERS Pegras

UNIVERSITY MEMBERS

THE UNIVERSITY OF SYDNEY

The NSSN worked with the industry partner to secure funding through Phase I of the inaugural round of the NSW Small Business Innovation & Research Program (SBIR). The program aims to foster R&D collaborations between NSW universities and SMEs towards resolving technological challenges identified by NSW Government agencies. Phase I of the program supports feasibility studies, with successful projects graduating to Phase II of the program which develops proof-of-concept. The ultimate aim of the program is to create a pathway to government procurement for NSW-based SMEs.

This project uses novel smart sensing technologies to identify and remove harmful plastics from medical waste from entering the wastewater stream. Phase I of the project was successful and has graduated to Phase II.

AIR-TO-GROUND DELIVERY VEHICLE WITH COMMUNICATIONS

CASH FUNDING $99,685

PARTNERS Dandelions

UNIVERSITY MEMBERS

MACQUARIE University SYDNEY·AUSTRALIA

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

With funding from Phase I of the NSW SBIR, this project undertook a feasibility study to develop an unpowered air-to-ground vehicle integrated with a communications payload to provide on-demand communication networks in emergency situations.

The NSSN connected Dandelions with researchers at Macquarie University and the University of Newcastle to assess radio behaviour in varied terrain and to size down the P25 radio to be able to be airborne.

NEUROMORPHIC ACOUSTICS FOR KOALA MONITORING

CASH FUNDING $99,373

PARTNERS Biodiversity Monitoring Services

UNIVERSITY MEMBERS

WESTERN SYDNEY UNIVERSITY

With funding from Phase I of the NSW SBIR, this project set out to test the feasibility of changing from traditional acoustic recording systems to a bio-inspired device, the Silicon Cohlea, that has been developed by the University of Western Sydney for enhanced monitoring of NSW's endangered koala population.

These neuromorphic systems are specially built to react to changes in the environment, like our sensory systems, and only detect and record data when calls are made. Such a system would overcome the issue of data overload, and at the same time bring additional benefits like higher dynamic range (longer range detection), and lower power of operation.

Such a system has been demonstrated to detect dingo calls in a previous study at the University of Western Sydney, and this project repurposed this technology to koala populations. In order to do this, a new artificial intelligence model was trained using koala call data and implemented in the hardware of this novel sensing device.

The project has secured Phase II funding through the NSW SBIR to build a proof-concept.

OPTICAL REMOTE SENSING IN THE WATER COLUMN

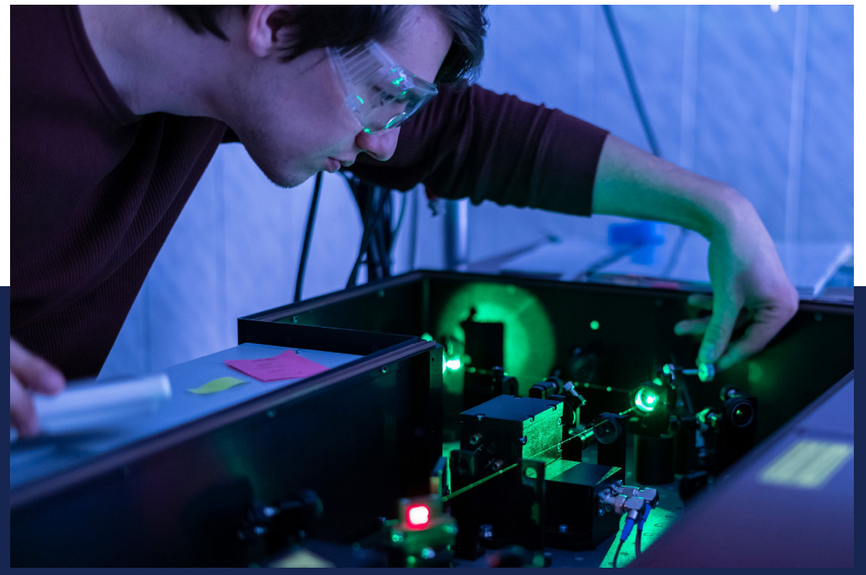
CASH FUNDING $80,000

PARTNERS NSW Department of Planning & Environment (DPE)

UNIVERSITY MEMBERS

MACQUARIE University SYDNEY·AUSTRALIA

UTS



Working with NSW Department DPE, researchers from Macquarie University and UTS evaluated optical sensing methods for systematic mapping of a range of parameters in natural waterways.

The laser-based technology developed by the team is non-contact and generates data in near-real time, overcoming some disadvantages of existing technologies such as probe biofouling and delays in retrieval and analysis times.

NSSN GRAND CHALLENGES

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.

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CLEAN TECH
Smart sensing for a low-carbon economy

As NSW – and Australia – strive towards a low-carbon economy, the development of clean technologies is critical. Clean Tech refers to innovative technologies that improve environmental sustainability but also offer compelling opportunities for economic growth. From renewable energy to circular supply chains, Clean Tech innovation will lead to lower emissions, a cleaner environment and power efficiencies.

SMART PLACES & BUILDINGS
Using technology to create vibrant, safe and sustainable spaces

Despite having a large geographical area and modest population Australia is a highly urbanised country with over 86% of the population residing in cities and towns.

Australia's population is expected to increase from approximately 26 million to almost 36 million by 2050. The majority of this growth will be accommodated by existing urban places or by new large-scale urban development initiatives such as in Western Sydney and South East Queensland.

WATER
Smart sensing to better understand our water resources and to build a drought resilient NSW and ACT

Water is a shared, limited, resource that is used by many across the land. In order to best manage our water we first need to sense both its quality and quantity. Smart sensing of water aims to fill the gaps in our understanding of the complex water cycle, so it can be rightfully allocated and treated to protect our environment, safeguard our key industries, and supply for residential use.

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.

BUSHFIRES
Smart sensing for better bushfire prevention, response and 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.

NSSN GRAND CHALLENGE FUND

Since 2021, the NSSN has offered its annual NSSN Grand Challenge Fund in order to foster collaboration and build a cadre of research programs around the NSSN Grand Challenges.

Grants of up to $100,000 per project are offered to support innovative, collaborative research projects that partner with industry and government. Grants must be matched or exceeded by concomitant industry/government investment.

Applications to the fund are assessed on the following five criteria:

- Significance – how the proposal represents a significant and novel approach to addressing the defined Grand Challenge (30%).
- Collaboration – how the proposal integrates and fosters genuine collaboration between NSSN member universities (15%).
- Partnership – how the proposal integrates genuine partnership with industry and government partners and responds to a defined industry or government need (15%).
- Governance – how the proposal defines a realistic research plan and the measures that will ensure delivery on milestones (15%).
- Impact – how the proposal defines a pathway to subsequent funding, commercialisation and/or operationalisation (15%).
- Diversity – how the proposal champions diversity in the team or addresses diversity as an issue (10%).

The fund enables researchers to team up with industry and government partners to develop innovative solutions to NSSN Grand Challenges, including bushfires and smart places.

The Fund is offered in November each year, with applications closing in February of the following year.

“Dandelions has benefited enormously from NSSN’s support, and we are very grateful. With their assistance, we were able to source the right academic support, which in turn helped us win a spot in the inaugural SBIR program! Cannot thank the NSSN team enough, they moved mountains for us!

BRIAN LIM
FOUNDER & CEO, DANDELIONS

NSW 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 serves as a broker matching client smart sensing demand with member university research expertise to activate collaborative R&D projects.

In FY21/22, the NSSN attracted **$15,716,072** in cash across 13 commissioned research projects.

PROJECT	CLIENT	CASH FUNDING $
ARC Industrial Training Research Hub for Connected Sensors for Health	Multiple across the MedTech sector	$9,600,000
OPENAIR	NSW Department of Planning & Environment	$1,780,000
Neonatal Resuscitation Monitoring System	Resusright	$1,600,000
Sensor and Data Innovation for Smart Triaging and Wellbeing in Aged Care	Vlepis Pty Ltd	$1,480,000
Instantaneous Detection of High-risk Lightning with Pinpoint Accuracy	Fire Neural Network	$250,000
Smart Energy Asset Management Intelligence	Global Sustainable Energy Solutions Pty Ltd	$200,000
Autonomous Drones on Reservoirs for Smoke Detection	Sydney Water	$199,985
PAIMCOS Quarantine Monitoring System	Visicase Pty Ltd	$184,076
Intelligent Structural Health Monitoring of Bridges	Transport for NSW	$119,652
Sensing Microplastics in Water	Pegras	$100,000
Air-to-Ground Communication Connectivity	Dandelions	$99,685
Neuromorphic Acoustics for Koala Monitoring	Biodiversity Monitoring Services	$99,374
Food Sensing - Ethylene sensors	Boost Design	$3,300

More information on each of the above-listed projects can be found on the projects page of the NSSN website.

The NSSN's Business Development program actively seeks new partnerships and clients and has built a business development pipeline valued at over $53 million. Relationships are being nurtured with a range of industry and government partners.

NSSN BUSINESS DEVELOPMENT PIPELINE

The NSSN tracks its business development activities through its business development pipeline, which maps partnerships from lead stage through to active stage and on to completion. The figure below shows the NSSN Business Development Pipeline as at 30 June 2022.

NEW COMMERCIAL OPPORTUNITIES

Stage 1 of 5 c. 300 Accounts	Stage 2 of 5 60 Accounts	Stage 3 of 5 22 Accounts $40,837,944	Stage 4 of 5 8 Accounts $7,737,552	Stage 5 of 5 13 Accounts $4,186,000
PROSPECTS	**LEADS**	**OPPORTUNITIES**	**ACTIVE PROJECTS**	**COMPLETED PROJECTS**
Contact the Business Development Manager for the full list.	• Transport for NSW • Hitachi • ICT International • Aquamonix • Spectur • Maxar Technologies • Humense • Drone Shield • CoachAir • Abbott Healthcare • Northparkes Mine • City of Sydney • Bluescope Steel • SkyFii	• Waratah Seed Consortium • Leidos Australia (CADRE) • Trility • Department of Defence (CASG) • Dandelions (NSW SBIR 2021 Phase II) • Biodiversity Monitoring Services (NSW SBIR 2021 Phase II) • Pegras (NSW SBIR 2021 Phase II) • Leidos Australia • Exci • Dandelions (NISDRG Round 2) • Forcite (CRC-P Round 13) • Vlepis (Accelerating Commercialisation Grant) • Airbus Defence and Space (JP9102) • Sydney Water (SmartSat CRC Demonstrator Program)	• RAAF Plan Jericho • Where is all the Water? (DPIE) • Intellicare Holdings (GCF 2021) • 3 Aim Solutions (GCF 2021) • DPIE (GCF 2021) • ARC Research Hub for Connected Sensors for Health • ResusRight • Visicase Pty Ltd • DPIE (NSW Digital Restart Fund) • Vlepis (CRC-P Round 12) • Fire Neural Networks (GCF 2022) • Global Sustainable Energy Solutions Pty Ltd (GCF 2022) • Sydney Water (GCF 2022) • Transport for NSW GCF 2022)	• Sydney Water (& consortium) • OpusMed • Evisuals • NSW Dep. of Industry – Pilot • U of Sydney (Physics) – Pilot • UNSW (Chemistry) – Pilot • Suncayr (USA) – Pilot • NSW OEH – Air Quality • ImRAC • Regional Enviroscience • OEH • Dandelions (NSW SBIR 2021 Ph 1) • Biodiversity Monitoring Services (NSW SBIR 2021 Ph 1) • Pegras (NSW SBIR 2021 Ph 1)

NSW INDUSTRY ENGAGEMENT PROGRAM

The NSSN hosted 10 industry engagement events **across FY21/22. These events are important in engaging with industry and government partners, showcasing the work of the NSSN and building-high-value partnerships towards funded R&D projects.**

EVENT	DATE	LOCATION
NSSN Bushfire Smart Sensing Workshop	October 2021	Virtual
NSSN Smart Sensing & Climate Change Roundtable	October 2021	Virtual
Sensing, Mining & Water Workshop	November 2021	Virtual
NSW Agrifood Pitch Qualifying Final - *co-hosted with Investment NSW and NSW DPI*	December 2021	Sydney Start-Up Hub
NSSN Ageing Grand Challenge Forum	March 2022	NSW Parliament House
NSSN Data Working Group	April 2022	UTS
NSSN Successfully Adopting Smart Sensing Technologies Breakfast Series • UTS • UNSW	June 2022	UTS UNSW
OPENAIR Launch	June 2022	WSU Parramatta
NSSN 6th Birthday Reception	June 2022	Sydney

Highlights of the year include the Ageing Grand Challenge Forum hosted at NSW Parliament House in March 2022. Over 100 stakeholders from across the aged care sector, universities and government came together to workshop smart sensing solutions for improved aged care outcomes. Minister for Science, Innovation and Technology, the Hon. Alister Henskens; and Minister for Seniors, the Hon. Mark Coure both spoke at the event to outline the government's support for aged care innovation.

Images from the NSSN Ageing Grand Challenge Forum, NSW Parliament House, March 2022.

The NSSN celebrated its 6th birthday in fine style at the Museum of Contemporary Art in Sydney in June 2022. The event welcomed NSSN partners from across its six-year history in a celebration of the network's achievements and a vision for future success. NSW Chief Scientist Prof. Hugh Durrant-Whyte addressed at the event alongside the Network's Chair and Co-Directors and a video message from Minister for Science, Innovation and Technology, the Hon. Alister Henskens.

Images from the NSSN 6th Birthday Reception, Museum of Contemporary Art Sydney, June 2022.

The NSSN also revived the *Successfully Adopting Smart Sensing Technologies* breakfast series following a COVID-19 hiatus. This series showcases to researchers at NSSN member universities successful examples of triple helix collaboration and the role the NSSN can play in activating such partnerships. Events were held at UTS and UNSW in June and are continuing to roll out across the Network throughout 2022.

Throughout the year, members of the NSSN team participate in a vibrant calendar of events across the NSW and Australian innovation ecosystem, attending and contributing to dozens of conferences, workshops and seminars.

NSSN PUBLIC OUTREACH PROGRAM

3,100
TWITTER FOLLOWERS

20%
INCREASE ON JUNE 2021

100
AVG. LIKES PER MONTH

30
AVG. RE-TWEETS PER MONTH

250,000
IMPRESSIONS ACROSS THE YEAR

2,090
LINKEDIN FOLLOWERS

35%
INCREASE ON JUNE 2021

2,500
AVG. WEBSITE VISITS PER MONTH

78
NEWS STORIES POSTED TO WEBSITE

85
MENTIONS ACROSS PRINT, ONLINE AND BROADCAST MEDIA

40%
INCREASE ON JUNE 2021

2,300
NSSN NEWSLETTER READERS

11
EDITIONS OF *THE SENSOR* NEWSLETTER DELIVERED

"Across the work we do, the NSSN team has been absolutely brilliant. From reaching out to various academics, helping us reach stakeholders by leveraging their credibility, we cannot thank you enough for the ongoing support. You guys have been the biggest difference in our journey, thank you for that!

TATHAGAT BANNERJEE
FOUNDER & CEO, VIDEOTRANSLATOR.AI

NSW GOVERNMENT

Australian National University

Charles Sturt University

MACQUARIE University
SYDNEY·AUSTRALIA

THE UNIVERSITY OF NEWCASTLE
AUSTRALIA

UNSW SYDNEY

THE UNIVERSITY OF SYDNEY

UTS

UNIVERSITY OF WOLLONGONG AUSTRALIA

WESTERN SYDNEY UNIVERSITY

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NSW Smart Sensing Network

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