Measurement Standards Laboratory of New Zealand

Annual Report

FY2025 goals

Top-line Numbers

32.4
FTE MSL staff

33
peer-reviews for papers in 10 scientific journals

6
international measurement comparisons

8
public customer endorsements

82
attendees at MSL training courses

35
assessments of accredited NZ laboratories

106
distinct measurement services

176
calibration reports delivered

3826
resource downloads

>56k
LinkedIn impressions

9
peer-reviewed scientific publications

9.7 million
Total revenue in NZD

Section 1
Performance against organisational goals

In our Strategic Plan 2022 – 2027, MSL identified three critical success criteria (CSCs).

1. Provide and disseminate trustworthy physical standards for NZ
2. Advance metrology through research and development activities
3. Provide measurement science leadership in government, industry and scientific bodies

These CSCs underpin the organisation's overall goal, which is:

To support NZ's economy, wellbeing and innovation by providing measurement standards and expertise that are globally relevant and trusted

The current document reports on progress made towards meeting these criteria – as well as other highlights and challenges – during FY2025.

CSC1: Provide and disseminate trustworthy physical standards for NZ

Maintain world-class suite of measurement services

MSL now has international recognition for **106 distinct measurement services**

MSL has completed **6 international measurement** comparisons within past five years

MSL continues to meet requirements for ISO/IEC 17025. This includes international peer-review of our Mass Standards by Mr Shih Mean Lee, National Metrology Centre, Singapore (April 2025)

Ensure ongoing recognition

Through active participation in international bodies responsible for enacting the Metre Convention and the CIPM MRA*

In FY2025, MSL staff contributed to the following international bodies:

- CIPM Consultative Committees for Photometry and Radiometry, Electricity and Magnetism, Mass and Related Quantities, Thermometry
- BIPM Young Metrologists Vision 2050+ Working Group
- BIPM Forum on Metrology and Digitalization
- Asia Pacific Metrology Programme General Assembly
- Asia Pacific Metrology Program Technical Committees for: Photometry and Radiometry, Electricity and Magnetism, Mass and Related Quantities, Thermometry, Time and Frequency, Length, Quality Systems.

* CIPM MRA = International Committee for Weights and Measures Mutual Recognition Arrangement. Thid is the framework through which National Metrology Institutes demonstrate the international equivalence of their measurement standards and the calibration and measurement certificates they issue.

Disseminate traceable measurement

Number of calibration reports delivered externally: **176**

	Internal**	External	Section Total
Electricity	7	6	**13**
Humidity	12	14	**26**
Length	9	33	**42**
Mass	9	33	**42**
Photometry	5	35	**40**
Pressure	10	11	**21**
Radiometry	5	15	**20**
Temperature	61	26	**87**
Time	1	3	**4**
Total	**119**	**176**	**295**

CSC2: Advance metrology through research and development activities

Collaborate nationally and internationally to solve measurement challenges

- Dr. Johan Grand leads a project, funded by Quantum Technologies Aotearoa (QTA), that aims to advance ocean and seismic monitoring by utilising existing seafloor telecommunication cables as an array of sensors. This work is in collaboration with the UK's National Physical Laboratory (NPL), GNS (now, Earth Sciences New Zealand) and Southern Cross (which own and operate a trans-Pacific network of telecommunications cables).

  In August 2024, MSL successfully installed and tested the laser interferometer at the Takapuna cable landing station. Following fine-tuning of the detection scheme, the system detected its first earthquakes two months later. In November 2024, the NPL and MSL teams met in Takapuna to implement a hardware upgrade, to enhance the setup's reach and sensitivity, for improved earthquake detection. In early 2025, GNS successfully used back-projection of the cable data as a source for tsunami sensing.

- Dr Ellie Molloy is an unfunded partner in a Horizon Europe project, xDDiff, which is investigating multidimensional optical diffusion for the measurement of the appearance of non-isotropic, non-flat and functional surfaces and of translucent materials.

- Dr Ana Rakonjac is collaborating with Dr Daniel Barker at the US National Metrology Institute, NIST, on optomechanics-based thermodynamic contact thermometry. She spent 6 months as a guest researcher at NIST, where she optimised an experimental setup, and performed temperature measurements from room temperature down to 20 K (-253.15 °C) The visit was co-funded by NIST and QTA, and ongoing work at MSL is partly supported by Te Whai Ao – Dodd-Walls Centre for Photonic and Quantum Technologies.

- The international metrology community is undertaking an extensive digital transformation of its infrastructure and services. MSL is part of a small group of NMIs collaborating in the CIPM Forum on Digitalisation and Metrology (Forum-MD), which advises the International Committee for Weights and Measures (CIPM) on matters related to global digital transformation in metrology and the international Quality Infrastructure.

- In August, Dr Blair Hall helped to organise a half-day workshop on metrological traceability at the International Measurement Confederation IEMKO 2024 XXIV World Congress, held in Hamburg, Germany. The workshop provided an opportunity for experts to present various approaches to the digitalisation of traceability. Dr Hall also participated in a week-long series of Forum-MD workshops and meetings held in Paris in February 2025.

- Some of the work being done at MSL on digital transformation is of wider interest to the scientific community. In March 2025, Dr Hall was invited to speak at the Units, Symbols, and Terminology in Physical Sciences in and for the Digital Era (DUST) conference, held in London. The aim of the DUST conference was to bring together groups working on a common challenge: how to bring standards for scientific nomenclature and terminology into the digital age.

** Internal Calibration reports are required to maintain NZ's standards.

Prepare for future NZ measurement needs

In the area of quantum metrology, Dr. Vladimir Bubanja has developed theoretical tools to support the experimental development of topologically protected quantum information processing. By employing NeSI supercomputing facilities, he has worked with teams in Vietnam and India on several challenges – quantum capacitance calculations of materials suitable for supercapacitors, the development of novel single-atom-thin materials, and the quantum computational design of new materials.

MSL is building a Kibble balance to realise the kilogram in NZ using a world-first concept based on a twin pressure balance. Led by Dr Yin Hsien Fung, this project has seen the development of few key mechanical, optical and electrical components this year, as well as expertise development in different fields of metrology. This project has opened up international collaboration opportunities, which includes hosting Dr Norbert Rogge for 12 months (funded by DFG, German Research Foundation) to carry out Kibble balance-related research at MSL.

The investment in a Bruker JPK Nanowizard V Atomic Force Microscope (AFM) will expand MSL's expertise into nano-metrology, ultimately supporting types of measurement such as nano-surface roughness and sizing of other nanofeatures such as nanoparticles. Dr Lucy Forde will be characterising this instrument with a view to calibrating it with recognised standards such as single silicon steps, and eventually participating in international collaborations.

Build connections and reputation, and share knowledge

Number of peer-reviewed scientific publications: **9**

Number of peer-reviews by MSL staff: **33 for 10 journals**

- MSL contributed to Science Sector review by submitting a response.
- MSL contributed to an intra-Regional Metrology Organization review of Australia's National Measurement Institute (NMIA)'s calibration and measurement capabilities (CMCs).
- Dr Yin Hsien Fung was invited to be a guest editor for IEEE Transactions on Instrumentation & Measurement on the CPEM 2024 Special Issue.
- Dr Blair Hall was invited to attend the "Units, Symbols, and Terminology in the Physical Sciences in and for the Digital Era", workshop, 13-14 March 2025, Burlington House (Royal Society).
- Dr Annette Koo acted as expert peer reviewer for the Photometry and Radiometry capability of the Centre for Measurement Standards Industrial Technology Research Institute (CMS ITRI) in Chinese Taipei.

CSC3: Provide measurement science leadership in government, industry, and scientific bodies

Share MSL expertise with commercial calibration laboratories

- Number of expert assessments of accredited NZ laboratories: **35**
- Number of attendees at MSL training courses: **82**
- Resource downloads: **3826**

Contribute to national oversight bodies

- The chief metrologist of NZ chaired the annual Metrology and Calibration Professional Advisory Committee, which provides independent oversight to IANZ of the operation of the accreditation programme.
- MSL has a seat on the Quantum Technology Aotearoa Steering Committee, managing the 5-year Catalyst funding to grow NZ international connections, research activity, and commercial sector growth in quantum technologies.
- Dr Annette Koo is the treasurer for the NZ institute of physics.
- The MSL director is a member of the Standards, Accreditation and Metrology Group (SAM) which is a forum for information sharing, collaboration and coordination of actions between standards and conformance agencies.
- Together with colleagues from Defence Science and Technology, Dr Vladimir Bubanja contributes to Five Eyes intelligence alliance team working on applications of quantum technologies of interest to national security.

Contribute to international committees

MSL staff contribute to a variety of committees:

- International Commission on Illumination (CIE)
- International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC)
- Various Consultative Committee Task groups, e.g. for Photometry and Radiometry (CCPR)
- Asia Pacific Metrology Programme (APMP) Developing Economies Committee (e.g. Mass Mentor for National Measurement Centre, Cambodia)
- Pacific Quality Infrastructure (PQI)
- Technical Committee on Quantum Measurement and Quantum Information of the International Measurement Confederation (IMEKO).

Raise awareness of the value of metrology

- MSL collaborated with the Metrology Society of Australasia, and Trading Standards, the legal metrology team in MBIE, to host a day of events celebrating World Metrology Day on 20 May 2025. This year marked 150 years since the signing of the Metre Convention in 1875. The events brought together industry, NZ science representatives, metrologists and interested members of the public.
- In FY2025, MSL made a concerted effort to increase the lab's profile in NZ media, in order to demonstrate the contribution of metrology to modern society. Highlights include: a live interview on TVNZ Breakfast, an article in The Dominion Post, and two interviews on RNZ – one related to World Metrology Day.
- Four MSL staff attended the bi-annual New Zealand Institute of Physics conference, highlighting progress in metrology to the wider NZ physics community and delivering a workshop on the history of measurement in NZ to physics high school teachers.
- Starting in March 2025, MSL prioritised producing content specifically for its LinkedIn page. LinkedIn is the online channel of choice for many of the lab's staff, customers and collaborators, and MSL's page had previously been underutilised. This content included a series called 'Did You Know' which shares interesting facts about metrology, and a series called 'Who We Serve', which highlights the breadth and depths of MSL's influence on wider NZ society. This content is proving popular. As an indicator, between September 2024 and February 2025, MSL content made 596 impressions, i.e. it was shown to members 596 times, and we gained 22 new followers. Between March and September 2025 – during this social campaign – MSL content made more than 56,000 impressions, and we gained 298 new followers.
- Four MSL staff attended the Metrology Society of Australasia conference in Sydney. As part of the programme, they delivered short, public-friendly presentations on each of the SI units, collaborating with NMIA staff. Attendees included Australian science sector representatives, metrologists, government representatives, industry, and interested members of the public.
- In 2020, MSL collaborated with House of Science to develop a Measurement Matters education kit that is now available to schools across the Wellington region. In July, MSL staff visited the Hutt City branch of House of Science to speak with the team, and to replenish and prepare the kits for Term 3.

Section 2
Hot Topics & Opportunities

International Arrangements

In 2024/25, MSL signed an Arrangement with the National Measurement Institute, Australia, renewing joint commitment to working together in common areas:

- Technical and scientific exchange through virtual teams, joint projects, and facility access arrangements.
- Cooperation to engage with the Pacific and Indo-Pacific regions.
- Collaboration to support the indigenous interests in our respective countries.

MSL also signed an Arrangement for the first time with the National Institute of Metrology, China, during Prime Minister Christopher Luxon's visit to China. This paves the way for deeper collaboration in our preparation for meeting the future measurement needs of New Zealand.

Review of MSL services

Following a decrease in MSL FTE over several years due to cost pressure issues in Callaghan Innovation (down 20% to 32 from 40 in 2020), MSL reviewed the scope of its activities to:

- Ensure that MSL delivers outstanding measurement services within a clearly defined but limited scope.
- Ensure that MSL's mix of activities is sustainable both from a personnel and resources point of view.
- Ensure that staff can see a balanced career path ahead of them with a reasonable workload.

A process of gathering status reports from each section and then workshopping principles and criteria for decision-making led to identification of several proposals for change. MSL will shortly be consulting with stakeholders and potentially affected customers to solicit feedback and minimise disruption during a period of transition.

Science sector reform

Callaghan Innovation was instructed by the Minister to prepare MSL for transfer into Earth Sciences New Zealand, one of the new Public Research Organisations.

Benefits

There are potential synergies with scientists across Earth Sciences New Zealand. MSL can provide expertise and calibrations to improve reliability of measurements made by other parts of the organisation. And closer connection with end users of measurement will allow MSL to identify future challenges and broaden expertise.

As a larger scientific organisation, the PRO will give better access for MSL to scientific services (e.g., library, mechanical workshop, scientific computing and networking, specialist software).

Risks

MMSL laboratories remain on the Gracefield Innovation Quarter site, which requires significant investment to support MSL's ongoing operation.

As NZ's National Metrology Institute, MSL's operations and business model differ greatly from those used in other parts of the science sector. As such, it requires a degree of operational independence in order to thrive. There is a risk that any operational independence will be lost upon on moving into Earth Sciences New Zealand.

Future opportunities and challenges

Quantum technology and advanced materials

NZ has played a key role in quantum science since the field's inception. However, if we are to advance towards the development of commercial Kiwi-made quantum technologies, an expansion of our quality infrastructure is needed. For example, with support, MSL could develop the capability to traceably measure materials at cryogenic temperature, and to develop random number generators for cryptology. Such services would help New Zealand's quantum sector to grow.

Chemical and biological metrology

Despite the reliance of our economy on production and export of primary produce, the scientific metrology to support laboratories testing for food quality and safety is exclusively sourced overseas.

Should there be any constraint on access to reference materials, or a challenge to the quality of testing carried out in NZ, we have no expertise to resolve such issues or produce reference materials specifically required by NZ.

Time dissemination

The risk of loss of GNSS services is raising concerns across the communications, power, and defence sectors in NZ. Like most other developed nations, NZ has been looking for alternative options to retain access to time services.

For NZ, the most likely solution is to distribute an accurate time signal via terrestrial optical fibres. This would include increasing resilience of UTC(MSL) through improving the clocks, and installing clocks at two locations in addition to those held at MSL in Lower Hutt.

Discussions with various actors are underway to explore commercial or public options for investment.

MSL Customer Stories

As part of MSL's efforts to demonstrate the value of metrology to the NZ economy, a series of interviews were carried out with selected customers. This produced eight short 'customer stories', which have since been added to the calibration pages of the MSL website. The stories are also being shared via scheduled LinkedIn posts. Three of the eight stories have been included below. All demonstrate the vital roles that MSL plays here in New Zealand.

Teltherm

Teltherm is a uniquely New Zealand success story. Since 1946, the company has been manufacturing and importing high-quality instruments – pressure gauges, temperature gaugues and probes, gas detectors, flow meters – for use across industry. Teltherm is also a second-tier calibration laboratory, accredited by IANZ, which serves customers in sectors as diverse as timber treatment and medical devices.

The relationship between Teltherm and MSL is an abiding one. Today it is focused mainly on temperature, with MSL providing calibrations for Teltherm's reference thermocouples and thermometers, and acting as technical assessors for IANZ audits.

Jennie Dingley, Teltherm Laboratory Manager says:

"MSL is special because it doesn't just focus on pure science. It also offers an unbroken measurement chain right here in New Zealand – we don't need to go overseas to access it. We have a big range of customers, and working with MSL helps us deliver them the best quality service we possibly can. MSL offers a combination of technical expertise, friendliness and openness and a willingness to help and spread the knowledge. It is just amazing."

MSL Customer Stories

Air New Zealand

MSL has worked with Air New Zealand for more than 20 years. The relationship that started via a calibration service agreement, has expanded and evolved ever since. It now includes training provision across a range of areas, such as temperature and length, and technical assessment for the accreditation of Air New Zealand's calibration labs.
And in 2020, MSL apprentice Nina spent a month at Air New Zealand's facility in Christchurch.

When asked about the experience of working with NZ's national metrology lab, Paul Biddick, Calibration Coordinator at Air New Zealand, said:

"We have an excellent, productive relationship with MSL. We try to do as much calibration in-house as we can, but that's only been possible because of MSL's input over the years. Aviation is a highly-regulated sector, so procedures need to be followed exactly, and there's always a lot to learn. We put all of our calibration engineers through MSL training courses, and we draw on your expertise around uncertainty budgets. And as technical assessors, MSL plays a key role in helping us gain IANZ accreditation for our services. Without that input, we wouldn't have the knowledge or understanding to move forward and grow our calibration labs."

Wedderburn

Wedderburn is a technology company with deep roots in this part of the world. They have been manufacturing weighing scales in Australia since 1896, and have continued growing ever since. Today, they supply a vast range of weighing, processing, packaging, and labelling equipment for use across the food and retail sector. MSL has worked with Wedderburn ever since the company expanded into the New Zealand market in 1990.

Now the country's largest supplier of weighing scales, their team of 48 engineers work all around the motu, making sure that NZ industry – and their customers – can trust in their measurements.

Brent Taylor, Wedderburn's National Service Manager, has been with the company since 1993, and leads their IANZ programme. He describes the importance of the close working relationship he has with NZ's national metrology lab:

"The culture at Wedderburn is that we always do the best job possible, and I see the same thing at MSL. In the many years I've worked with the mass team, they've continued to provide a very professional service, delivering to the highest possible standards. The people there are always happy to hear from us, and will make time for us, no matter what."

Finance, staff, and facilities update

Account	2024 ($000s)	2025 ($000s)
Commercial	583	681
Crown Revenue – excl. Grants	8,986	8,986
Other Revenue	181	48
Total Revenue	**9,750**	**9,715**
Personnel	4,369	4,427
Project Expenses	545	345
Property and Assets	98	79
Travel	131	96
Contractors and Consultants	12	0
Digital Expenses	17	22
Other	111	79
Total Expenditure	**5,283**	**5,048**
Facilities and Corporate Services	5,129	5,832
EBITDA	**-660**	**-1,163**
Depreciation and Amortisation	4,369	4,427
Surplus	**-1,953**	**-2,631**

Capex Investment

MSL capex investment for FY25 was $719,367 in total and was predominantly dedicated to replace ageing equipment.

Section	Item	Value	Business reason
Temperature	Standard Radiation Thermometer	$33,120	replacement
	Zinc fixed point cell, Isotech Model 17671QCO	$40,000	replacement
Electricity	Digital Multimeter (DMM), Fluke 8588A	$34,739	replacement
	Digital Multimeter (DMM), Keysight 3458A	$34,739	replacement
	National Instruments PXI-5922 Oscilloscope and PXIe-1090 Chassis	$75,808	expansion
	Lock-in Amplifier	$20,603	replacement
	CT Analyzer Advanced Package	$57,000	replacement
	Dual Voltage sources	$81,270	replacement
	Dual Voltage sources	$37,606	replacement
Time	Pendulum FTR-210R	$35,431	expansion
	Rakon HSO14 - Ultra Stable Oscillator	$66,015	expansion
	Stabilized Laser	$89,000	expansion
Mass	Bruel and Kjaer Power Amplifier 2719	$15,980	expansion
	20 kg Reference masses x 2	$19,460	replacement
Length	Mitutoyo Long Gauge Blocks	$34,128	replacement
Light	Stepper controller	$9,540	replacement
Pressure	Piston Cylinder Unit FLUKE-PC-7100-50	$37,984	replacement

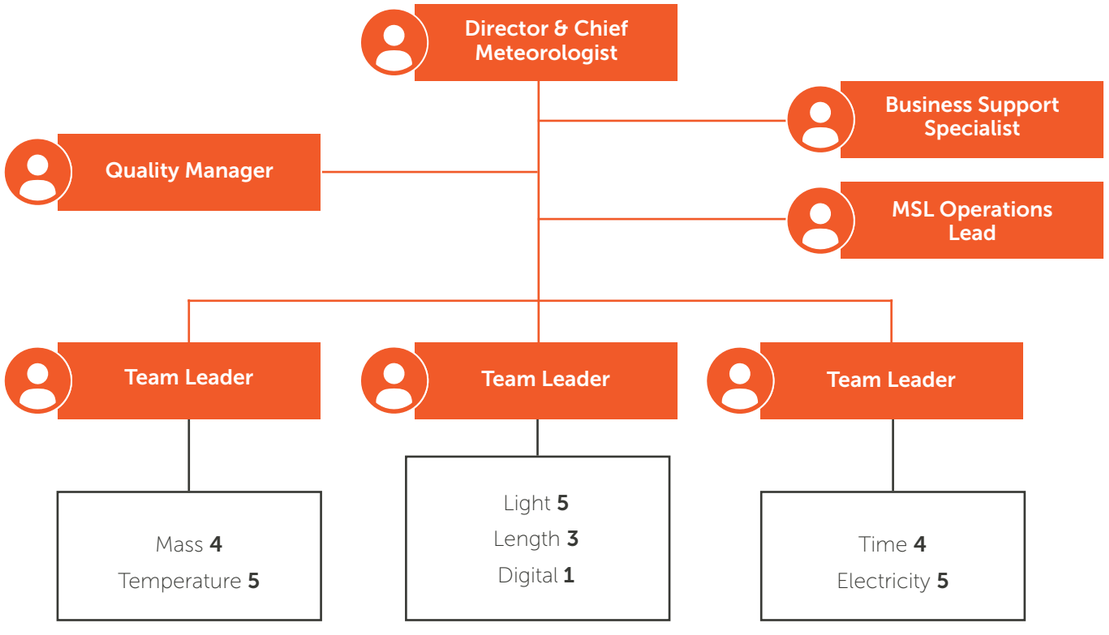
Staff

MSL has 32.4 FTE structured across three teams: Mass, Pressure & Temperature, Time & Electricity, Length, Light & Digital.

In December 2024, MSL restructured its leadership team and appointed 3 part-time team leads in place of two full-time managers. We also appointed a fixed-term operations lead to support MSL during the transition associated with the science reform. One principal scientist, Jeremy Lovell-Smith, also retired in December 2024.

In September 2025, our then-Director and Chief Metrologist, Dr Annette Koo, left Aotearoa and move to the Bureau International des Poids et Mesures (BIPM) in Paris. There she will initially act as Director Designate, and will move into the top job when the current Director, Dr Martin Milton, retires. She'll become the first woman and the first New Zealander to hold the Director role in BIPM's 150-year history.

Dr Peter McDowall (previously Team Leader for the Mass and Pressure, and Temperature and Humidity teams) became the new MSL Director and Chief Metrologist on 1st September 2025.



Facilities

MSL's specialist laboratories are distributed across two buildings in the Gracefield Innovation Quarter (GIQ). Overall, an area of about 1800 m2 is occupied. Many of the laboratory spaces for MSL equipment are highly-specified for temperature, humidity, vibration, and light control to allow for high accuracy measurements. Half of MSL's labs moved (in 2022) to a new, purpose-built building, and the remainder are in a 1980s building. This latter building has an immediate need for some investment to maintain its function (e.g. HVAC, roof, floor surfaces) and a plan for replacement within approximately 15 years.