State of Environmental Monitoring 2022

eagle.io

Contents

Executive Summary

The Environmental Monitoring industry is changing rapidly. We're seeing a proliferation of new technologies, IoT platforms, sensors, telemetry options, gateways, and protocols. Regulators and stakeholders are increasingly demanding more data transparency and access to real-time conditions.

This report provides a snapshot of industry direction and understanding of the current landscape, formed by the expert opinions of over 200 scientists, engineers, and industry specialists.

End-users are moving to real-time with more than a quarter of end-users reporting an upcoming move in 2022 to real-time and three quarters expecting they will be monitoring predominantly remotely by 2025. According to responses, this is largely (41.3%) driven by organisational needs for real-time data in decision-making processes.

Given this real-time drive, almost a third (30%) of end-users are already reporting a shortage of talent as their most pressing challenge. This skills gap could be addressable by connecting organisations with technical sensor deployment skills to these end-users switching to real-time methods.

Respondents also identified multiple limitations in sensing hardware inhibiting broader uptake of remote monitoring, from maintenance costs to lack of suitable sensors for their analytes.

Expect to see monitoring programs expand in 2022 as over thirty per cent (31.5%) of respondents reported an increase in parameters and analytes as their biggest upcoming change for the year.

KEY INSIGHTS

Demand for access

28%

reported increasing demand for real-time data access as the top upcoming challenge

Now the norm

76%

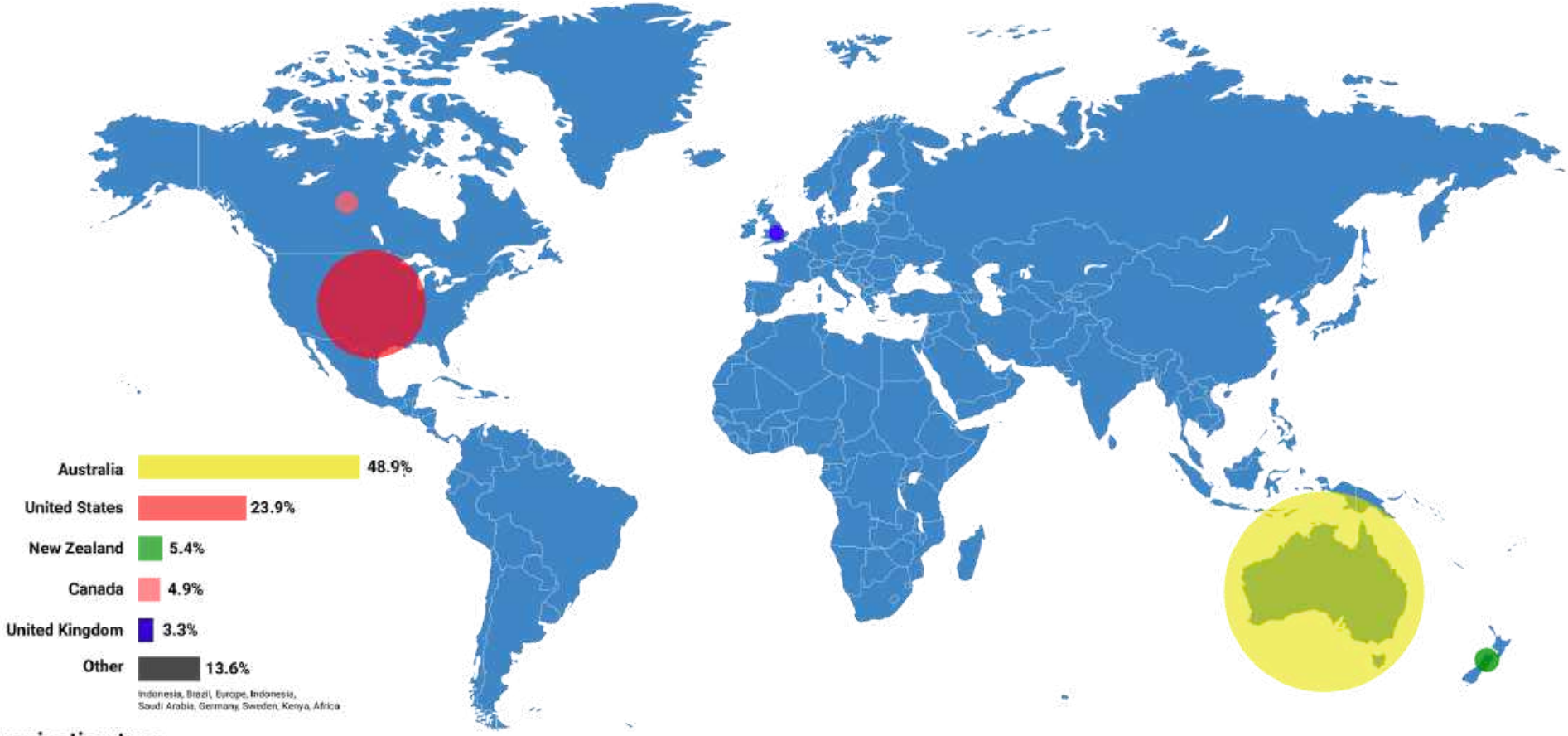
reported using real-time and remote monitoring at their organisations

Broader parameters

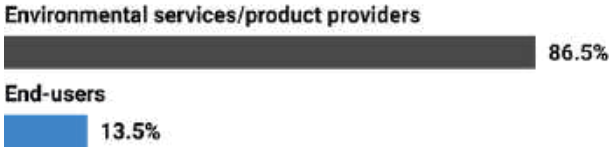
33%

reported their biggest change will be monitoring more parameters in 2022

Survey Demographics



Organisation type



Service providers include: environmental consultants, engineering consultants, hardware integrators
Product providers: Hardware & software vendors
End-users: Construction, Mining, Oil and Gas, Transport (Rail/road/tunnels/ports), government sectors

Of 208 survey responses, almost half the participants (48.9%) were located in Australia, just under a quarter (23.9%) in the United States and the remaining distributed across Canada, the UK, New Zealand with outliers such as Brazil, Indonesia, Germany, Sweden, and Kenya.

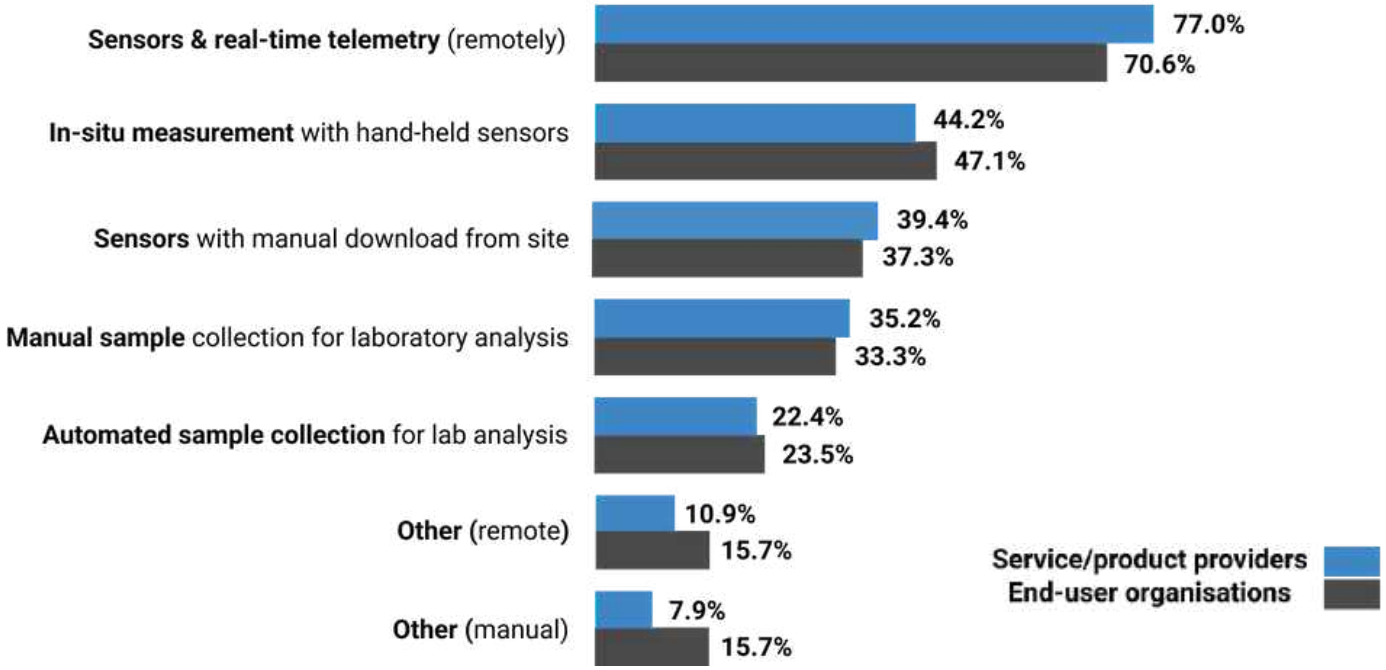
The geographic spread was skewed by eagle.io's operations across Australia, New Zealand and the United States. We believe the resulting findings retain broad multi-national application due to the maturity of these markets.

Going real-time

Real-time monitoring via remote sensors was the most prevalent monitoring method across the industry. However, a large proportion of both service providers and end-users still feature manual monitoring methods in their practice. This suggests the industry is in a transition period from manual to real-time, with several factors driving and inhibiting remote adoption covered later in this report.

Monitoring method adoption

The distribution was also heavily skewed towards sensor monitored methods vs sample collection.



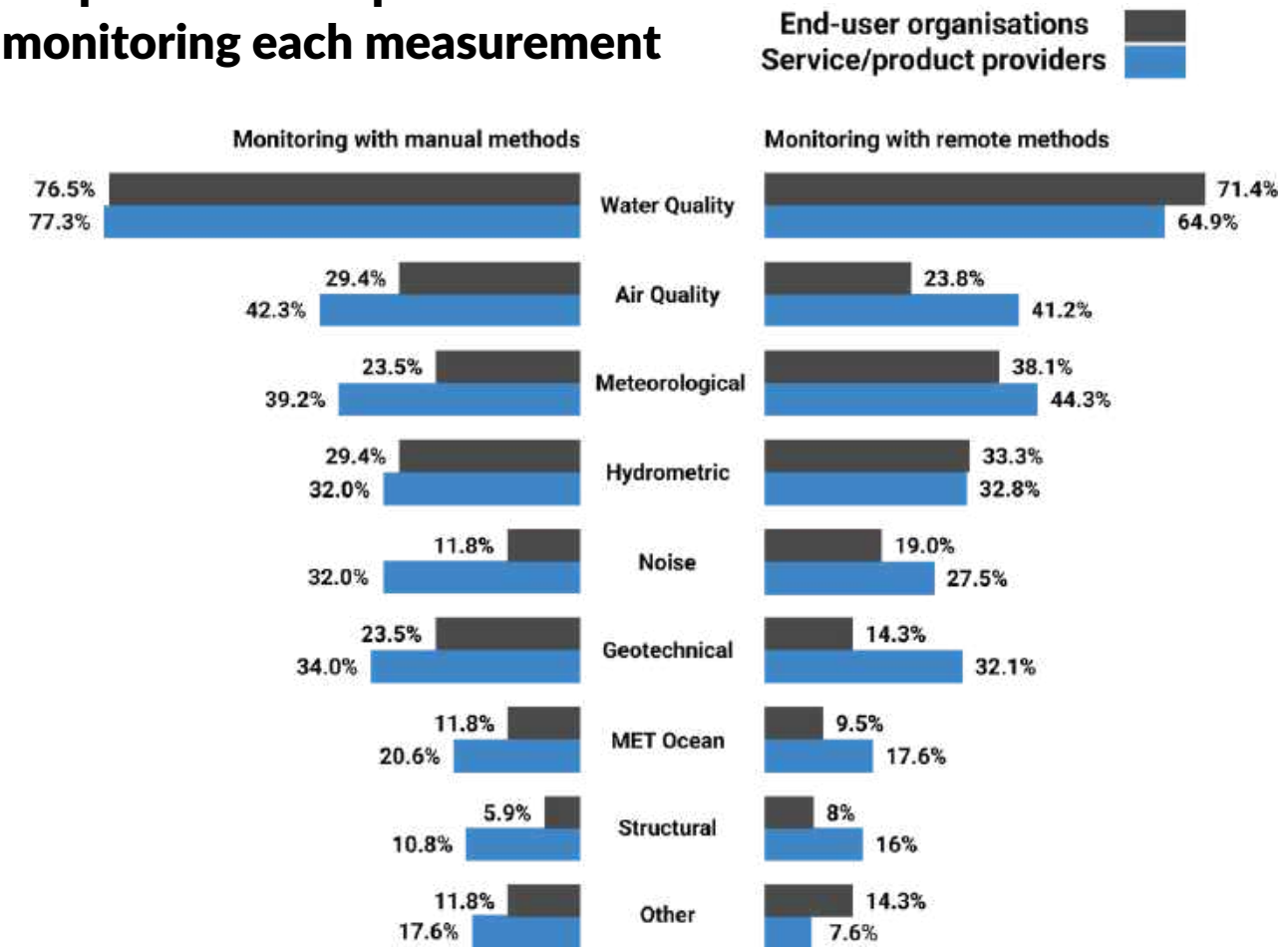
What's measured

Water, Air (quality and meteorological) and Hydrometric (ground and surface water level measurement) were the most commonly monitored analytics across respondents.

With remote sensor talent shortages reported in both Air and Water Quality by end-users, there's a market opportunity for providers who have these capabilities to service end-user demand.

A note of caution on extrapolating market size from this count data, although there are fewer companies and end-users undertaking structural or geotechnical monitoring by count, the number of sensors and scale of these monitoring systems when deployed can be very large.

Proportion of respondents monitoring each measurement



State of Manual Monitoring

Manual remains relevant

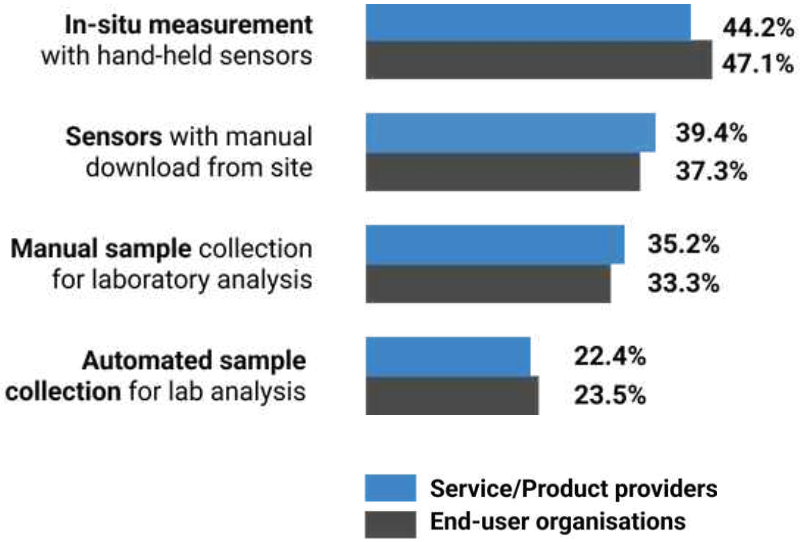
More than half of respondents reported some form of manual monitoring method still in use within their organisation, with Water Quality (22.4%) being the most manually monitored media.

But this seems set to shift as nearly three-quarters of monitoring professionals (71% end-users and 74% of service providers) reported intent to switch some or all of their manual monitoring to real-time in the next 4 years.

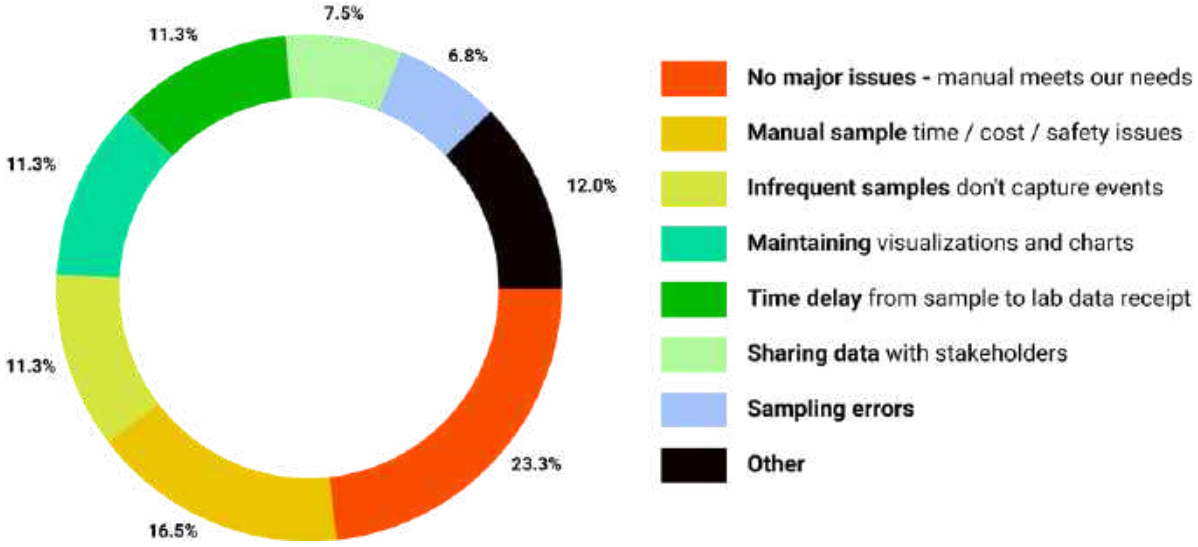
The strongest drivers moving respondents away from manual monitoring were the time/cost/safety issues, poor sampling density (missing events), maintaining data charts and time delays.

Even given these difficulties, a quarter of respondents were completely satisfied with their manual monitoring.

Manual methods by usage



Biggest challenges in manual monitoring



State of Remote Monitoring

Remote, widespread

According to responses, remote monitoring is already widely adopted across environmental monitoring industries and sectors.

Of the 208 respondents, almost three-quarters of end-user organisations (70%) and more than three-quarters of product/service providers (77%) reported using some form of remote environmental monitoring.

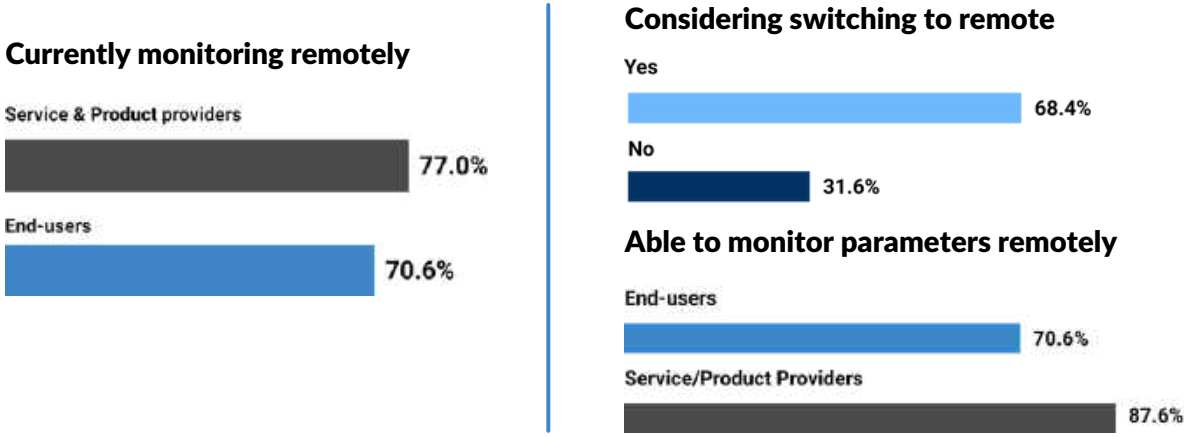
The pull factors driving the adoption of remote monitoring included operational needs (benefits), cost reductions, and legislative requirements.

The survey responses indicate an industry sentiment that we will continue to see a rise in remote monitoring over the next few years.

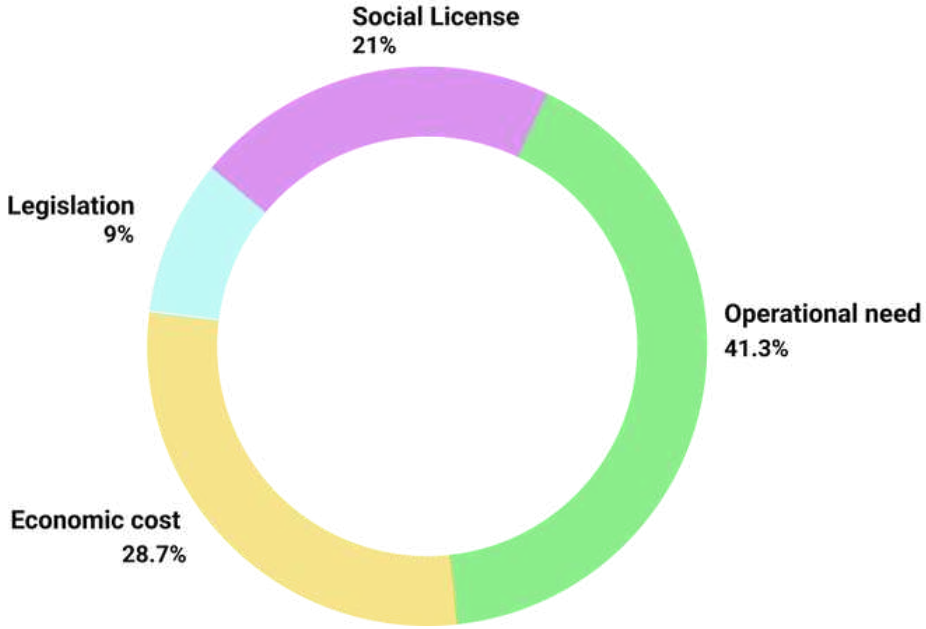
Almost half (48%) of environmental monitoring consultants and technicians who responded said in 5 years time (2026), remote environmental monitoring will be a significant part of their operations.

Operators and professionals who prepare for this shift may position themselves to succeed as remote monitoring proliferates.

Real-time adoption



Factors driving adoption



Addressable challenges to remote adoption

Skills - although a second-tier barrier to hardware limitations, the identified skills gap is solvable today primarily via the connection of those organisations with the technical sensor deployment skills required, and the engineers, scientists and end-users seeking this capacity.

Sensing Hardware - respondents identified a number of hardware-related limitations inhibiting the broader uptake of remote monitoring, including direct and maintenance cost of sensors and telemetry units and lack of commercial availability of sensors for analytes of interest.

There is a clear need for lower cost, more robust sensor and hardware solutions, presenting a large market opportunity for new instrumentation startups to play a role in further adoption.

Water Quality & Hydrometric

The survey revealed a massive demand for real-time Water Quality telemetry services in the next three years, requiring a strong response from engineering and environmental services to build capability and capacity in deploy and maintain real-time systems.

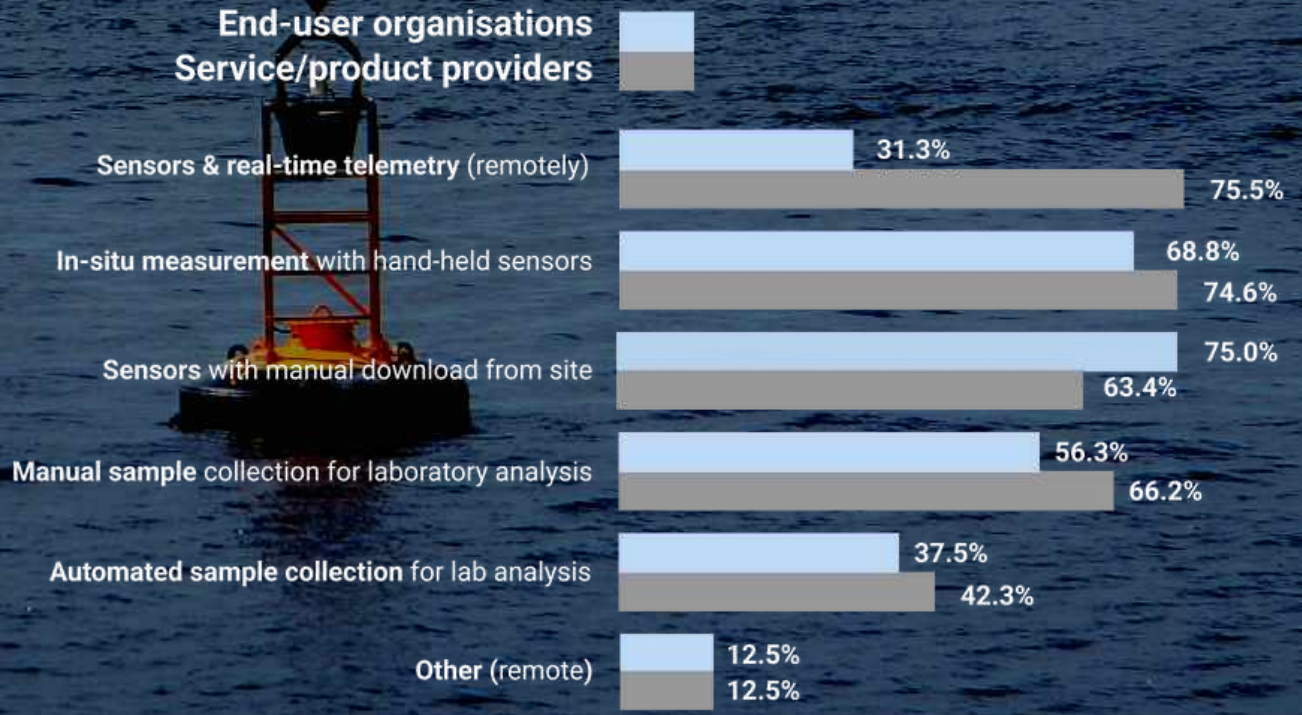
Currently only 25% of end-user companies surveyed use telemetry to collect sensor data in real-time - but this is set to change. By 2025 100% of end-user respondents predicted they would move completely to remote monitoring.

However this is not without challenges.

A shortage of in-house expertise to deploy remote monitoring systems was the primary barrier to further adoption of remote monitoring reported by end-users, along with high perceived costs of real-time operations.

This planned uptake of remote monitoring by end users presents a market opportunity to engineering consultants and environmental service organisations to meet demand.

Monitoring methods in Water Quality & Hydrometric



Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

eagle.io

Envirocoms

ThingsBoard

In-house platforms

CAMPBELL SCIENTIFIC

Hardware vendor supplied

HARDWARE VENDORS

YSI a xylem brand

SonTek a xylem brand

xylem Let's Solve Water

libelium

Eijkelkamp

ELSYS.se

CAMPBELL SCIENTIFIC

YDOC.biz

SIGNALFIRE WIRELESS TELEMETRY

munisense

dataTaker

hi-tech simplicity

VALEPORT

Parameters

Providers

VOC
NAPL
ph
TSS
DO
EC
Flow
Level
Pressure
Particulate
Turbidity
TRC
TN
TP
Chlorine
NTU
Waves
Currents
Depth
Salinity
Temp

End-users

VOC
NAPL
TSS
DO
EC
Flow
Level
Pressure
Particulate
Turbidity
TRC
TN
TP
Chlorine
NTU
Waves
Currents
Depth
Salinity
Temp
OH
pH
Level
Switch
Stormwater
Groundwater
Potable Water
Trade Waste
Dust deposition
Biosecurity
E coli
Conductivity
Microplastics
SO4
Cl
Hardness
Metals (dissolved and total concentrations)

Instruments

Providers

YSI meters
Handheld PID
Waterlevel loggers
pH meters
Convertors
Handheld (electrodes)
Multi-probes sensor
Water level meters
Pressure loggers
ADP's
Turbidity sensors
Salinity sensors
Multi-meters
WQM
SLM
Turbidimeter
Sondes

End-users

YSI meters
Handheld PID
Water level loggers
pH meters
Convertors
Handheld (electrodes)
Turbidity sensors
Salinity sensors
Multi-meters
WQM
IP
SLM
Turbidimeter
Sondes
Piezometer
Ultrasonic flow meters
Multibeam TSS
Submersible pressure sensors
HVAS

Sensors (parameters)

Providers

Xylem multi-probe (Level, Rain, EC, Temp., Turb., DO, pH)
YSI Meters (Temp, EC, pH, DO, Redox, Turb.)
Valeport (Tidal, Weather, Water Quality)
Hydralab MS5 sonde (Temp, DO, pH, Turb., Salinity/EC)
YSI Pro DSS (pH, EC, DO)
Sontek M9/Flow tracker (Turb., Flow)
YSI multiparameter sonde (Turb., EC, pH, DO, Temp),
YSI Multiprobe (pH, ORP, DO, Temp, Conductivity)
SignalFire Ranger (Flow, Level, Pressure)
Sontek ADCPs (Stage, Velocity, Discharge, WQ Big 5)

End-users

YSI water meters (HVAS, Stormwater, Groundwater, Potable Water, Trade Waste)
EXO2/OPUS/OTT (TSS, NOx, N, P, Pesticides, Water Level, Discharge)
Multi-parameter probes with lab analysis: (pH, EC, SO4, Cl, Hardness, Dissolved metals)

Air Quality

Skill shortages in Air Quality

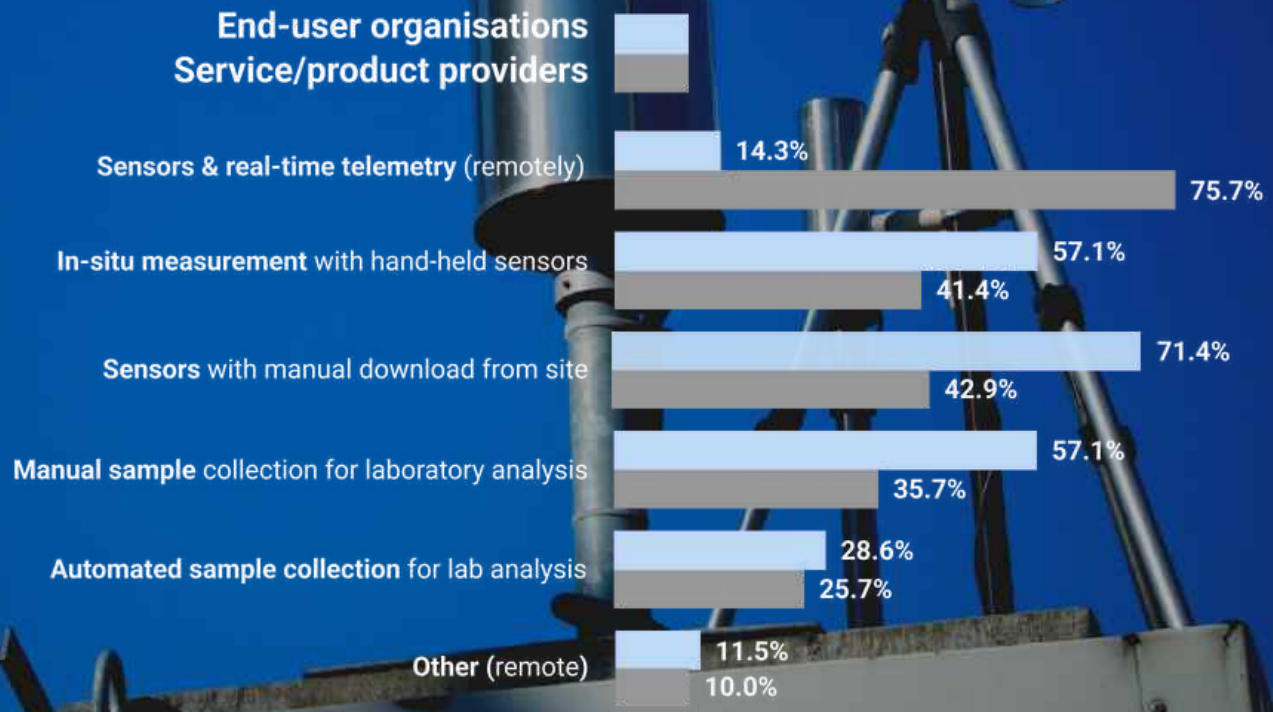
In-house Air Quality monitoring is still largely manual, with just over a quarter (25.8%) of end-users monitoring remotely and most respondents reporting on-site manual downloads from sensors or in-situ measurements.

End-user organisations who reported using manual measurement methods for monitoring Air Quality parameters also reported their biggest challenges as a shortage of talent and increased reporting requirements around real-time data obligations.

The survey suggests end-users lack ability to monitor and report on Air Quality remotely, and there may be an opportunity for service providers who are able to assist here.

Interestingly, 31% of service/product providers who monitor Air Quality for their clients indicated that a technical gap in skillsets was the key factor prohibiting expansion of real-time Air Quality monitoring.

Monitoring methods in Air Quality



Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE/VENDORS

eagle.io
ThingsBoard
CAMPBELL SCIENTIFIC
Envirocoms
Airodis™

In-house platforms

Hardware vendor supplied

HARDWARE VENDORS

ELSYS.se
CAMPBELL SCIENTIFIC
libelium
aeroqual
hi-tech simplicity
South Coast
munisense
dataTaker
PurpleAir
ICT INTERNATIONAL

Parameters

Particulate	NH3
VOC	No2
Asbestos fibres	COD
Micromet gas	Atmospheric dust
LEL	Gravimetric dust
O2	Particle release
CO	Nitrogens
CO2	Sulfides
H2S	Natural Gas
PM10	BOD Landfill gas
PM2.5	AFM

Instruments

LPWAN	Convertors
Dust/gas sensor	LFG Meters
Electrochemical Sensors	
Optical Particle Counters	
Light scatter	
NDIR	
PID Analyzers	
Probes	
Detectors	

Sensors (parameters)

Purple Air (PM10)
CEMS with fence line units (PM O2 CO2 NOx SOx CO THC VOC H2S HCL ETO)
Electrochemical Sensors and Optical Particle Counters (PM1, PM2.5, PM10, O3, NO, NO2, SO2, H2S, CO, CO2, TVOC, Temp, Pressure, Relative Humidity)
Light scatter, NDIR, PID (Particulates, Gases)

Structural & Geotechnical

Ahead of the curve

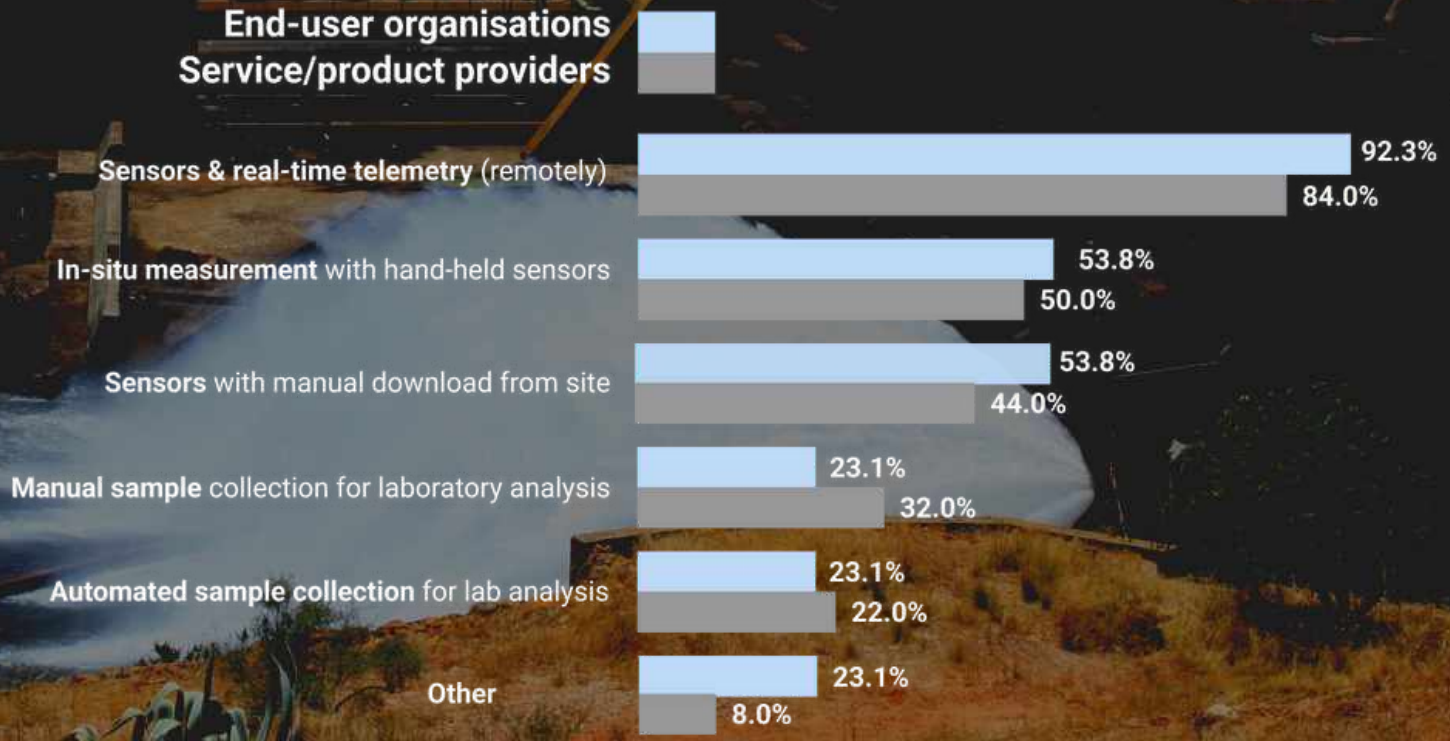
Both organisation types monitoring Structural & Geotechnical parameters reported higher levels of sensor & real-time telemetry (84% and 92.3%) than the industry average (73%).

Service and Product providers also reported the top upcoming challenge to expanding remote monitoring services (34%) as a shortage of talent. Even with the advanced stage of this industry, talent remains scarce.

End-user organisations reported increased reporting requirements (50%) and monitoring a broader array of parameters and analytes (50%) as two upcoming challenges and changes in their practices.

Monitoring methods in Structural & Geotechnical

36% of Structural & Geotechnical providers reported their biggest change in operations for 2022 is monitoring more parameters



Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

In-house platforms

Hardware vendor supplied

HARDWARE VENDORS

Parameters

Providers

Vibration
Displacement
Crack
Noise
Strain
Deflection
Load
Ground Displacement
Structure Displacement
Geomatics
Pore Pressure
Pressure

End-user

Vibration
Displacement
Crack
Noise
Slope monitoring
Strain
Deflection
Load
Ground Displacement
Structure Displacement

Instruments

Providers

Optical
Instantel
Crack gauge
Vibrating Wire devices
Shape arrays
RADAR
Manual inclinometer
Probes
Pressure depth sensors
Piezometer
Accelerometer
Geophone

End-users

Piezometer
Tilt sensors
Inclinometers
Handheld probes
RADAR
Scanner
Submersible pressure sensors
HVAS

Sensors (parameters)

VW Piezometers and 4-20m Amp sensors
(Pore pressure)
Instantel vibration
(Vibration)
Manual inclinometer probes
(Horizontal displacement)
RADARScanner
(Slope monitoring)

Meteorological

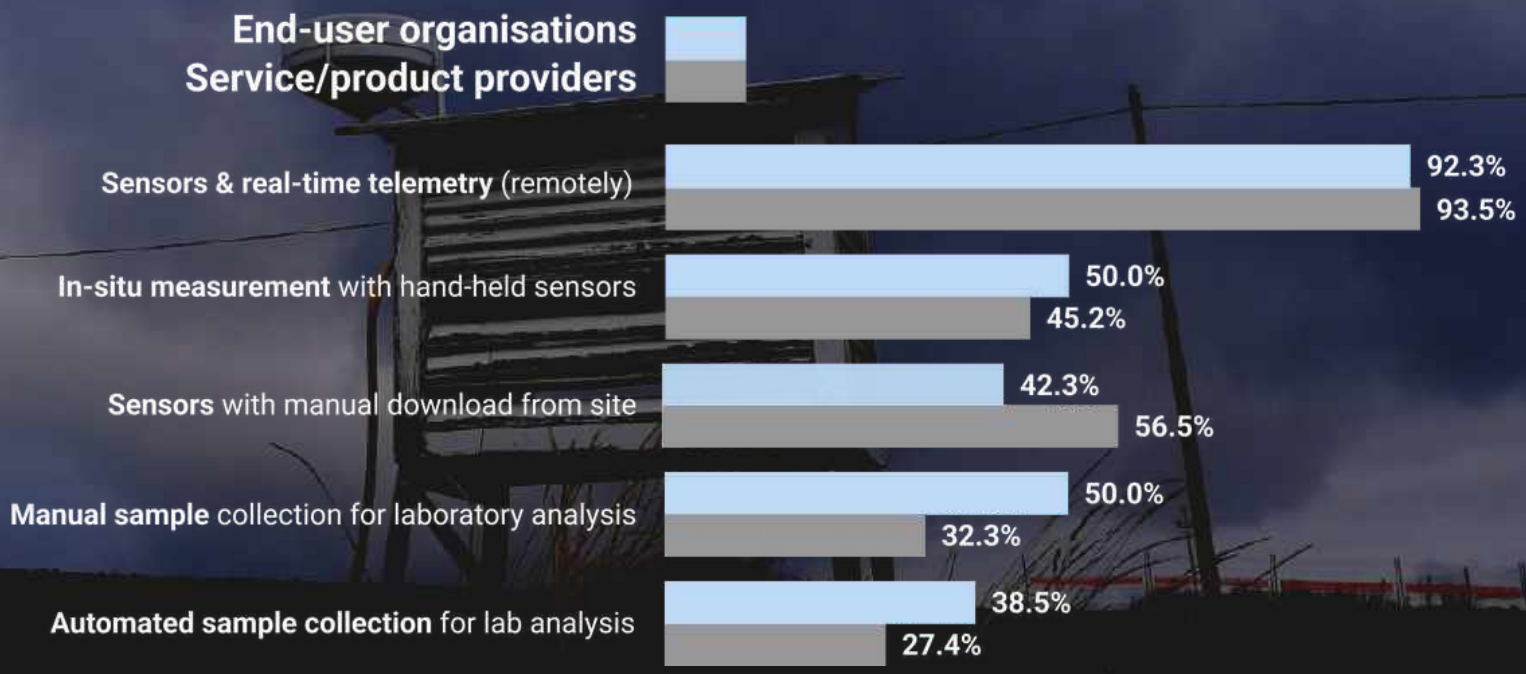
More real-time coverage

With 84% of respondents reporting they will be monitoring 'mostly remotely' by 2025, a surge in demand for remote Meteorological hardware and monitoring services by integrators is expected.

Others reported the lacking availability of broad-array Weather stations and their cost as challenges, with few listing a lag between standards and technology as possible upcoming issues for their operations.

36% of all respondents who monitor Meteorological reported regulators, community liaisons and internal stakeholders demanding access to real-time data as their top upcoming challenge.

Monitoring methods in Meteorological



Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

Tinytag, eagle.io, Airodis, SIGNALFIRE WIRELESS TELEMETRY, ThingsBoard, CAMPBELL SCIENTIFIC WHEN MEASUREMENTS MATTER

In-house platforms

Hardware vendor supplied

HARDWARE VENDORS

aeroqual, PurpleAir, CAMPBELL SCIENTIFIC WHEN MEASUREMENTS MATTER, eState Automation, BARANI DESIGN, Tinytag, MAIT Industries, SIGNALFIRE WIRELESS TELEMETRY, metasphere, METER ENVIRONMENT, hi-tech simplicity, YDOC.biz

Parameters

Providers

Conductivity
Wind speed
Wind direction
BP
Rainfall
Air Temperature
RH
Snow depth
Snow Water Equivalency
Precipitation
Humidity
Cloud height
Visibility
Global radiation
Barometric pressure

End-user

Conductivity
Wind speed
Wind direction
BP Current speed
Current direction
Rainfall
Air Temperature
RH
Snow depth
Snow temperature
Snow Water Equivalency
Precipitation

Instruments

Providers

Multi-parameter weather station with data logger
CEMS and fence line units
Light scatter
NDIR
Electrochemical
PID
IR radiometers
Ultrasonic snow depth sensors
4-way net radiometers
Snow Pillows
GNSS Storage Cans
Pressure Transducers
Load Cells
Thermistors

Sensors (parameters)

Providers

MeteoHelix (Weather)
atmos 41 (Weather)
Vaisala and Lufft sensors (Wind speed & direction, Pressure, Temp, Humidity)
Kipp & Zonen sun trackers and solar radiation sensors (Solar energy parameters)
Tiny Tag (Temperature, Humidity)
ICT International Devices (Full SPAC)
ClimaVUE (Weather)

Noise

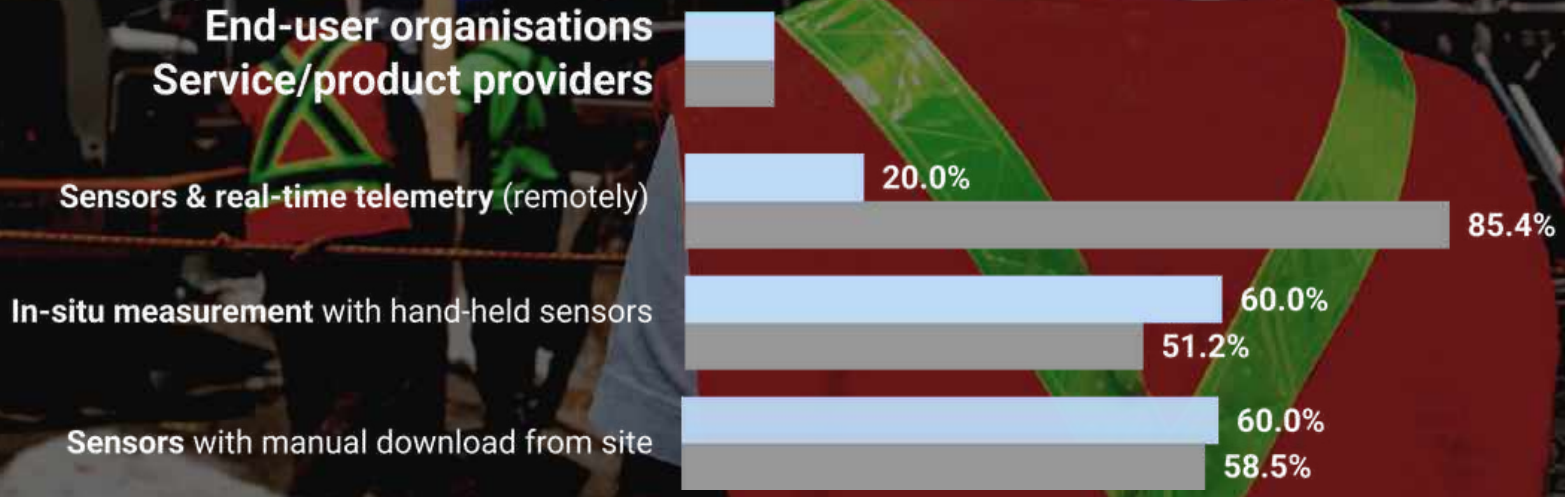
With only 25% of integrators monitoring noise, and even fewer end-user organisations, noise was a smaller sub-sector of survey respondents.

Considering this relatively smaller footprint in the monitoring ecosystem, organisations monitoring noise almost always used remote/real-time methods (93%).

The challenge for this measurement service seems to be communicating this data to stakeholders.

The top challenge (34%) was reported as increasing demand by stakeholders (regulators, community groups, internal departments) for access to real-time data from monitoring programs. We anticipate more demand for noise level alerts and public-facing communication assets.

Monitoring methods in Noise



Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

eagle.io
Sigicom
mooven
eRUIDO
Cirrus Research plc

Hardware vendor supplied

HARDWARE VENDORS

Airodis
Sigicom
eRUIDO
aeroqual
Cirrus Research plc
AVA MONITORING

Parameters

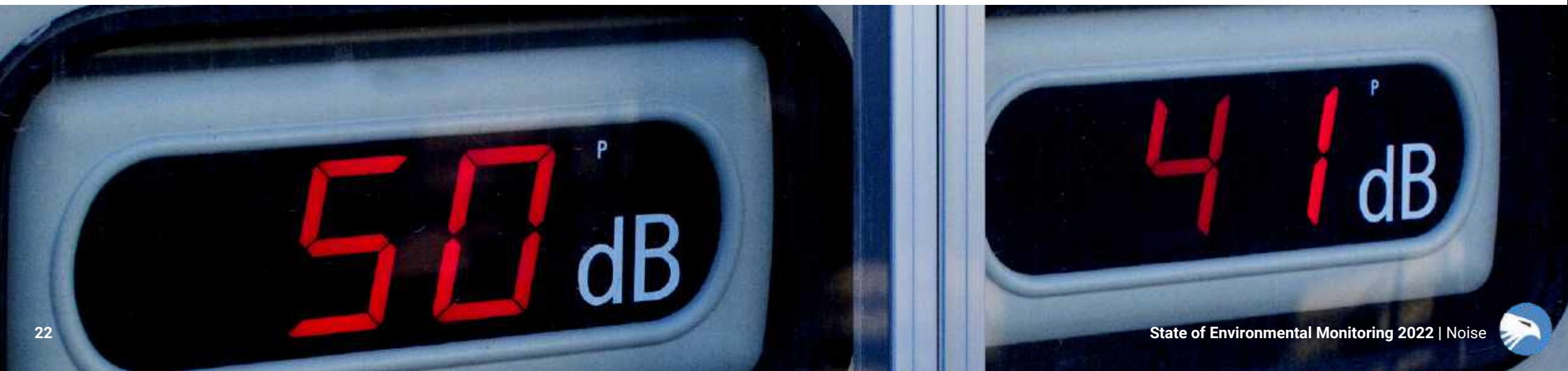
DB peak noise
Cumulative noise
dBA levels
Vibration in mm/s
Velocity/Frequency
Equivalent Noise Pressure Level
LAeq
LA90

Instruments

Environmental Noise Monitors
Class 1 Condenser Microphones
Sound level meters
Noise dosimetry
Vibrating wire sensors
Sound Level meters

Sensors (parameters)

eRuido Monitor Model U20 (Equivalent Noise Pressure Level)
Sigicom (Vibrations**)**
Aeroqual (All parameters)
01dB fusion (dB**)**



METocean

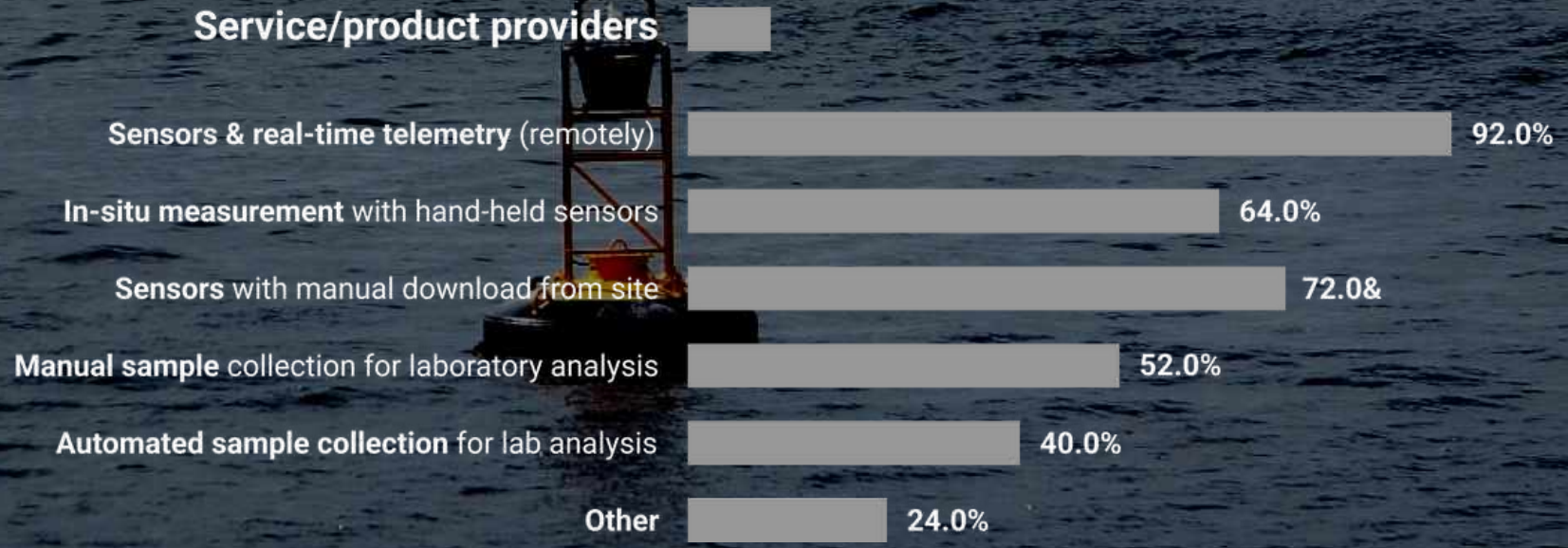
More parameters

METocean respondents represented a smaller segment of the survey responses (13%). Of this smaller subset, 85% reported monitoring via sensors & real-time telemetry.

32% of respondents reported that expanding the range of parameters measured by sensors and monitored in real-time to meet client demands is the biggest change currently occurring in their organisation.

36% responded that their biggest challenge is increasing demand for access to real-time data and visualisations (charts, dashboards) from regulators, community groups, internal departments and partner organisations.

Monitoring methods in METocean



Reported Parameters, Vendors & Instrumentation

SOFTWARE VENDORS

eagle.io

ThingsBoard

CAMPBELL SCIENTIFIC

Envirocoms

HARDWARE VENDORS

xylem Let's Solve Water

SonTek a xylem brand

CAMPBELL SCIENTIFIC

libelium

YSI a xylem brand

Parameters

pH
EC
DO
NTU
PAR
Depth
Temperature
Salinity
Benthic cover
Waves
Currents
Tides
Turbidity
Seabed chemistry
Flow

Instruments

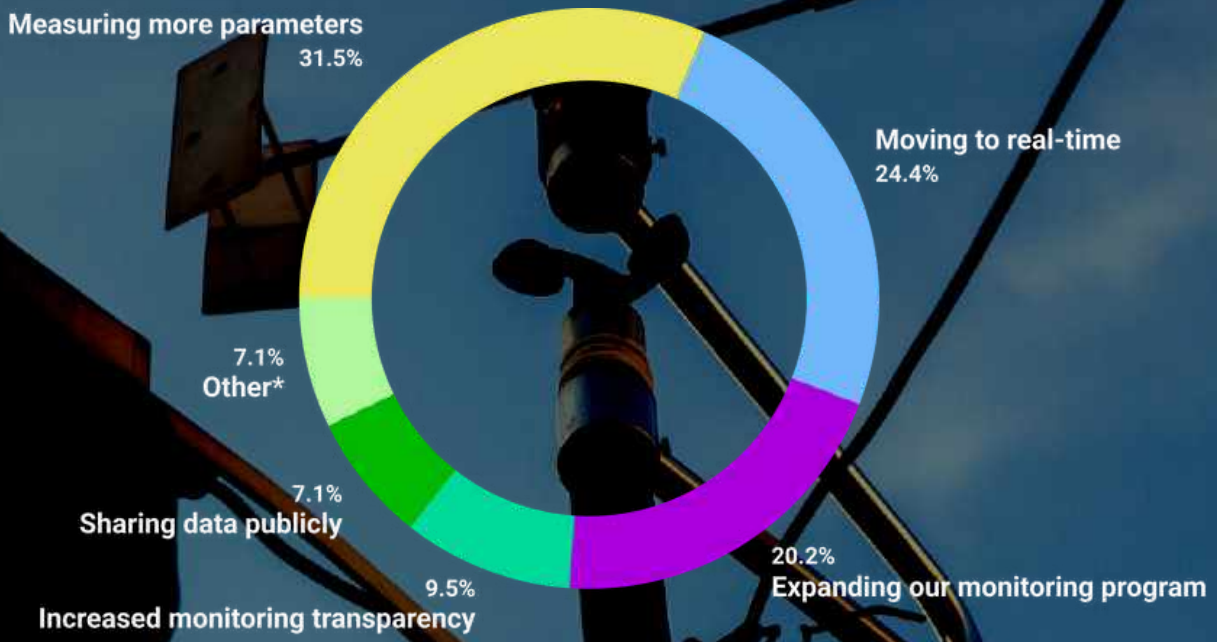
YSI meters
Water level loggers
pH meters
Convertors
Multi-probes
Flow sensors
Water level meters
Pressure loggers
ADP's
Turbidity sensors
Salinity sensors
Multi-meters
WQM
IP
SLM
Turbidimeter
Sondes

Sensors (parameters)

Valeport (Tidal, Water Quality)
YSI Pro DSS (pH, EC, DO, Turb)
Sontek M9 Flow Tracker (Flow)
YSI multiparameter sonde (Turb, EC, pH, DO, Temp)
SignalFire Ranger (Flow, Level, Pre)

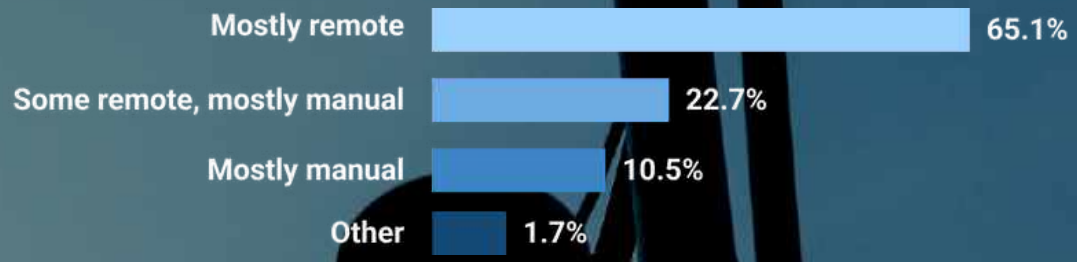
Industry Trends

Reported organisational changes in 2021



*Citizen science and crowd-sourcing, Cloud based web access for clients, Using DNA and development of chemically derived standards that remove the need for bioassay testing, Finer accuracy measuring lower targets, Investigating new technologies, Regulation, Generation of well documented and defensible data, Artificial Intelligence, Retrieving information from sensor data

Expected monitoring operation by 2025



Breaking down trends

Across a series of questions regarding changes in organisations, trends, upcoming challenges and adoption practices, respondents identified these four major industry trends in environmental monitoring:

1. Remote monitoring
Over 50% of all end-user organisations and service/product provider respondents reported remote/real-time via IoT and telemetry to be the top upcoming industry trend, with 65% of the industry expecting to be mostly remote by 2025, and 24.4 % of all respondents moving to real-time in 2022.

2. More parameters and data points
31.5% of all respondents reported that monitoring more parameters is their biggest change in their organisation for 2021.

3. Increasing stakeholder demand for real-time
Pressure from communities, regulators and internal stakeholders around data-transparency and access is increasing, with over 1 in 4 of respondents reporting delivering on these demands as the biggest upcoming challenge in the industry.

4. Automation
Respondents reported data-automation and fully-automated monitoring systems as one of the biggest upcoming trends.

Challenges in industry

Just over 1 in 4 respondents indicated a shortage of talent across the environmental monitoring industry.

This skills shortage was worse in those companies focused on real-time/remote monitoring programs with 30.2% of these respondents reporting a shortage of talent as their biggest upcoming challenge.

For End-user organisations, an increased requirement for reporting from regulators and stakeholders came in as the top challenge. Together with the skill shortage, and appetite for end-user organisations to move to 100% real-time by 2025, this presents an interesting opportunity for service/product providers to meet this supply and demand gap.

Several respondents also list cost factors of hardware (particularly relating to sensors in the water sector) and flagged potential supply issues as challenges on the horizon.

From an industry standpoint, the push to digital data management and increasing demand from stakeholders for data transparency could be set to put pressure on sourcing talent across the industry, with several measurement verticals (Air Quality, Water Quality and Noise Quality) already reporting talent shortages (over 30% of respondents reported this as their biggest challenge).

Other reported upcoming challenges reported in free-text responses.

- Managing costs coming from rising wages (talent) and upskilling staff
- Automating IoT operations with low-cost solutions
- Supply chain issues with hardware due to a global component shortage driving costs up
- Challenges with the ability of instruments to meet Data Quality objectives and regulatory requirements
- A lag between government standards and technology preventing acceptance of new methods
- A lack of shared best practices applicable

Client demands in 2022

The automation of reporting and data management was the most reported client demand in responses.

Service and product providers also reported the following key demands from clients for 2022: multi-parameter sensors, sensor data and visualisation software integrations with B.I. tools, real-time data transmission from sensors and more advanced sensor data analysis.

Across responses, service and product providers also reported end clients demanding more real-time data access, alarms and alerts, with end clients requesting to integrate their remote-sensor data software into other data tools (BI platforms like Power BI, YellowFin etc) for more advanced modelling and data transformation.

From a service perspective, providers reported rising demand for automated data interpretation (such as automated PDF reports) services.

End clients seem to be seeking more assistance with editing, coding, transforming and reporting on their data. Service/product providers should consider tailoring solution offerings to match demand for this type of done-for-you data service.

Upcoming trends

According to respondents, we're going to see a rise in data volumes, wider uptake of data analytics and data management over the coming years. This presents opportunities for employees skilled in these specialities, and service/product providers who cater to these needs for organisations. There is also an expectation of improvements in IoT sensor technology - smaller sizes, cheaper costs and higher quality data.

Progress in remote/telemetry technology:
Respondents expect better remote access and setup and low orbit satellites from new companies taking market share from historically strong companies that are over-reliant on past technologies and not able to adapt to remote monitoring.

A move to automated systems:
More organisations transitioning to fully automated IoT systems with data centralisation and self-serve system automation. Respondents also noted the push to 'set & forget' technologies with automated alerts and reporting.

Improved IoT sensor technology:
Respondents anticipate smaller, cheaper devices that use small data packets with wireless sensors to become more affordable and miniaturised with longer battery life.

Service Opportunities

Reporting and data management

Done-for-you data coding and editing

Multiparameter sensor instalment

Sensor data integration with BI tools

Advanced data analysis/visualisations

Real-time alarms and alerts set-up

Product Opportunities

Automated reporting (e.g. PDF) tools

User-friendly multi-parameter sensors

Sensor data integration with BI tools

Advanced sensor data analysis tools

Low-cost, low-maintenance IoT sensors

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