RESILIENCE TO NATURE'S CHALLENGES

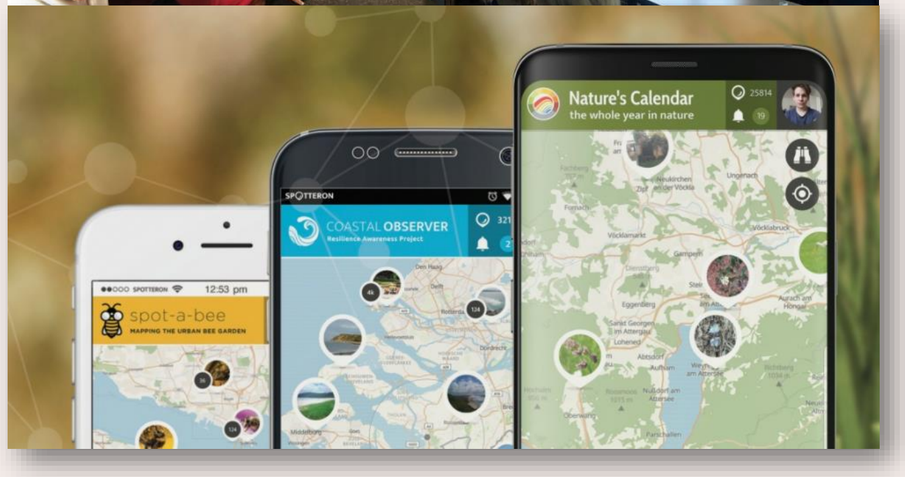
Kia manawaroa – Ngā Ākina o Te Ao Tūroa

# WEBINAR: SMART Resilient Communities

How can emerging technologies help build community resilience?

**MONDAY 8 APRIL**
**11:00AM- 12:00PM**

# How can we best harness technology to develop smart resilient communities?

Understanding the trends and the evolving relationship between:

- people,
- sensors and
- data


Global Community Technology Challenge - NIST

# How do people think and feel about technology in disasters

Dr Marion Lara Tan
Massey University

# Technology shapes society, and society shapes technology

Robert B White

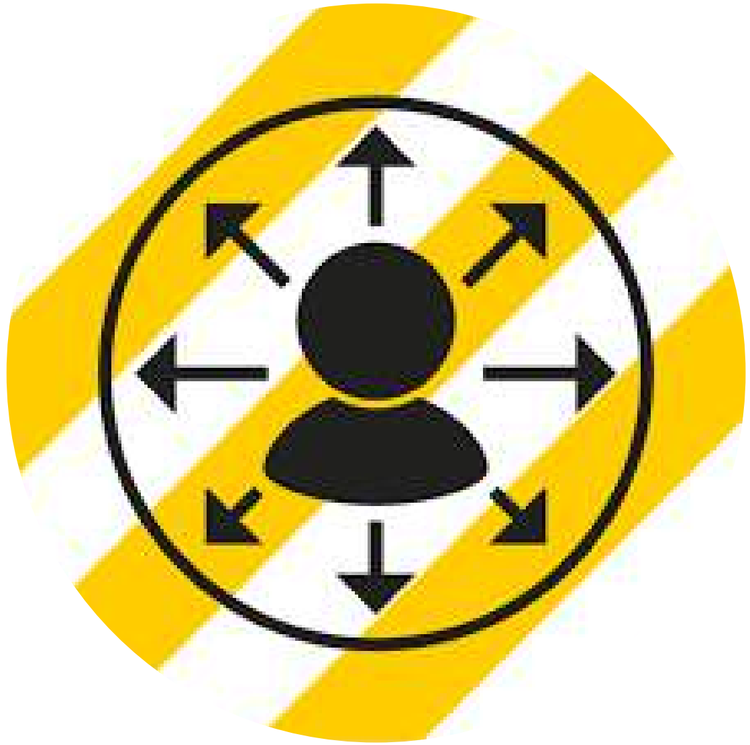

STAHLER.
GOCOMICS.COM
2013
#WHYNEIGHBORSDONTKNOWTHEIRNEIGHBORS

# What do people think about technology and its role in disasters?

**Example 1:**
COVID19 Tracer App

**Example 2**:
Earthquake Early Warning

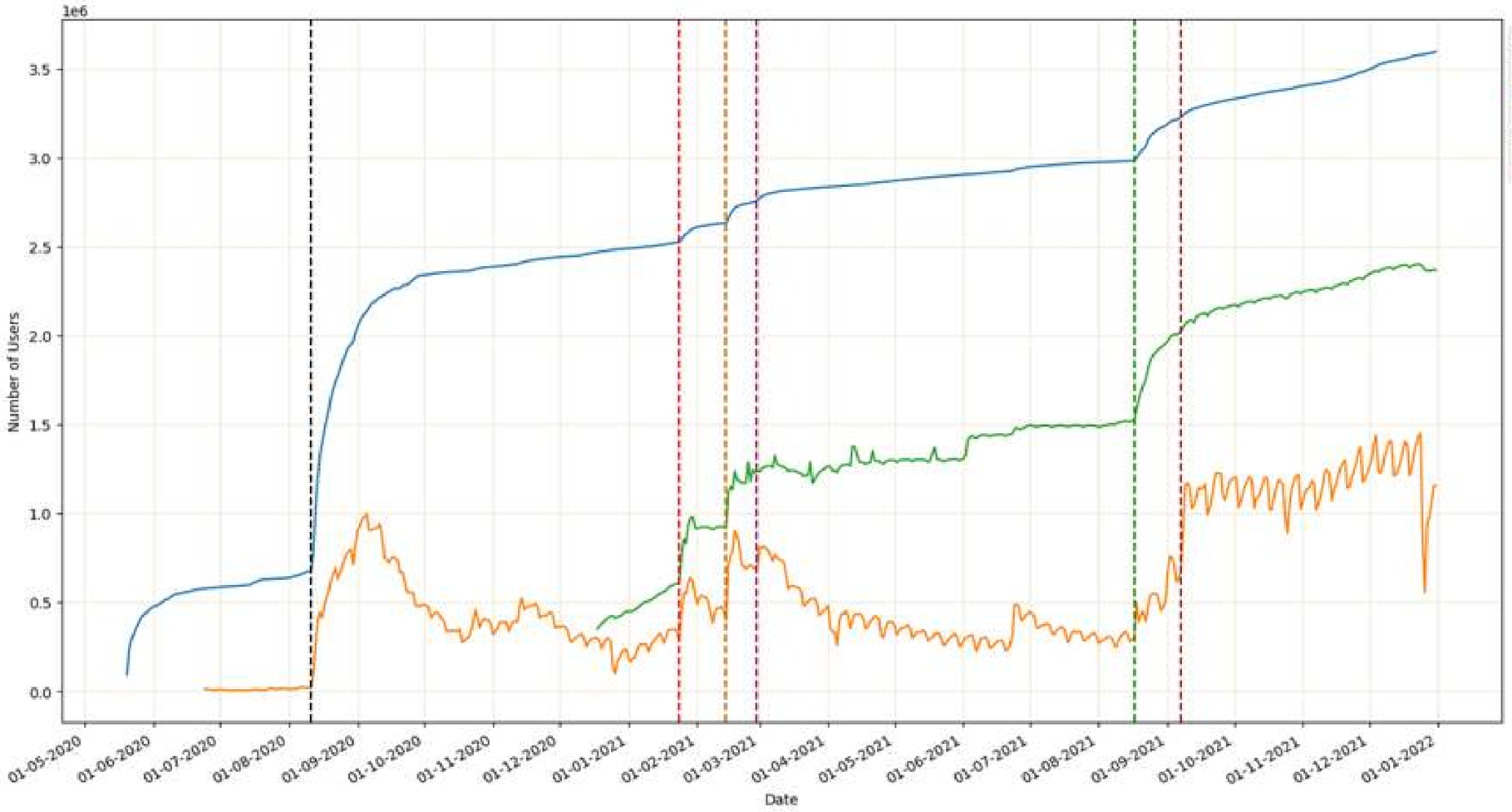

# Example 1: COVID Tracer App



By the end of 31 Dec 2021, there were **3,531,037** cumulative app registrations;

a seemingly high uptake of approximately 75% of the 5 million population

# App utility over time

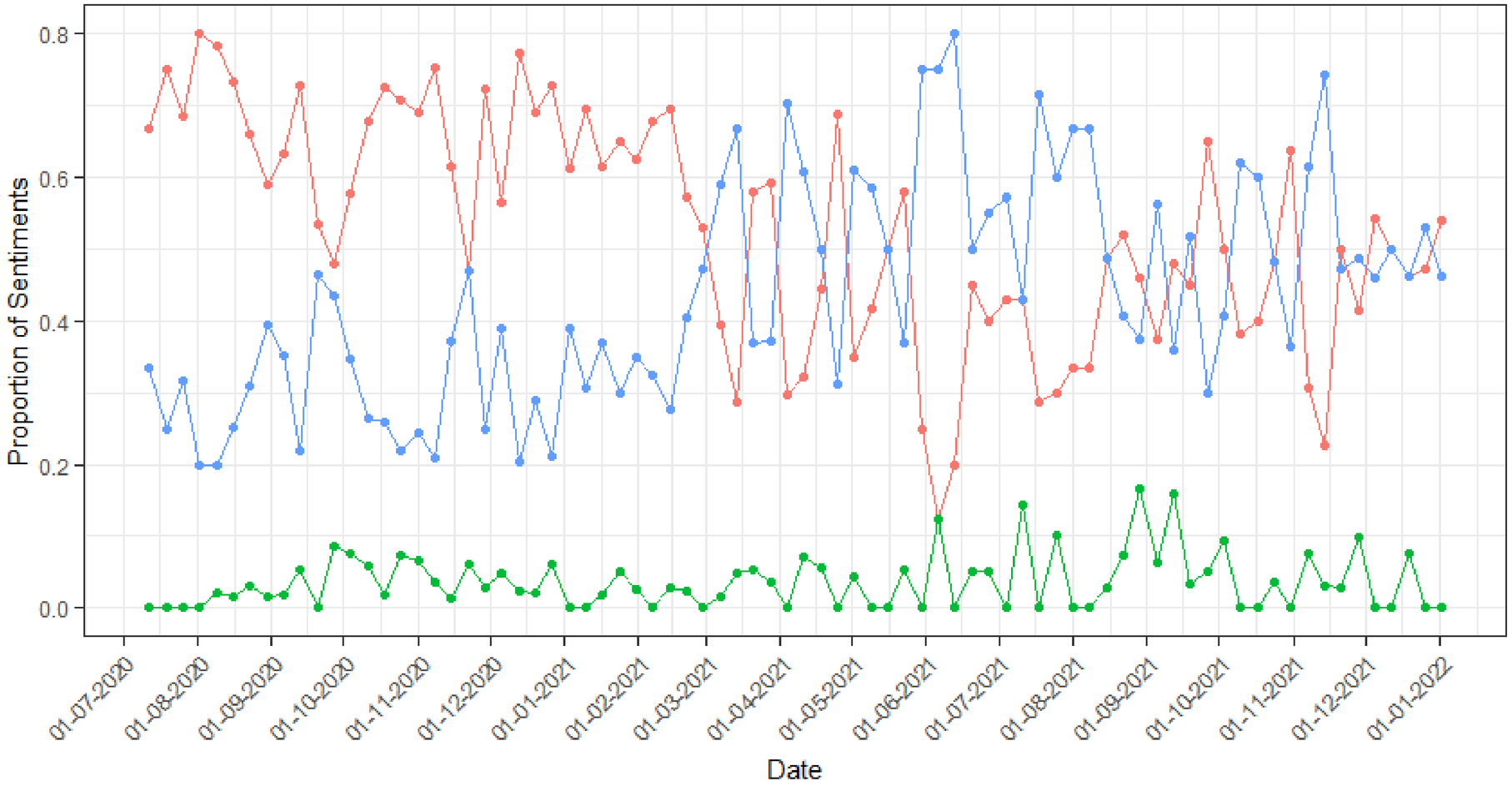



cumulative registrations

Bluetooth active devices

manual scans

# Sentiment over time



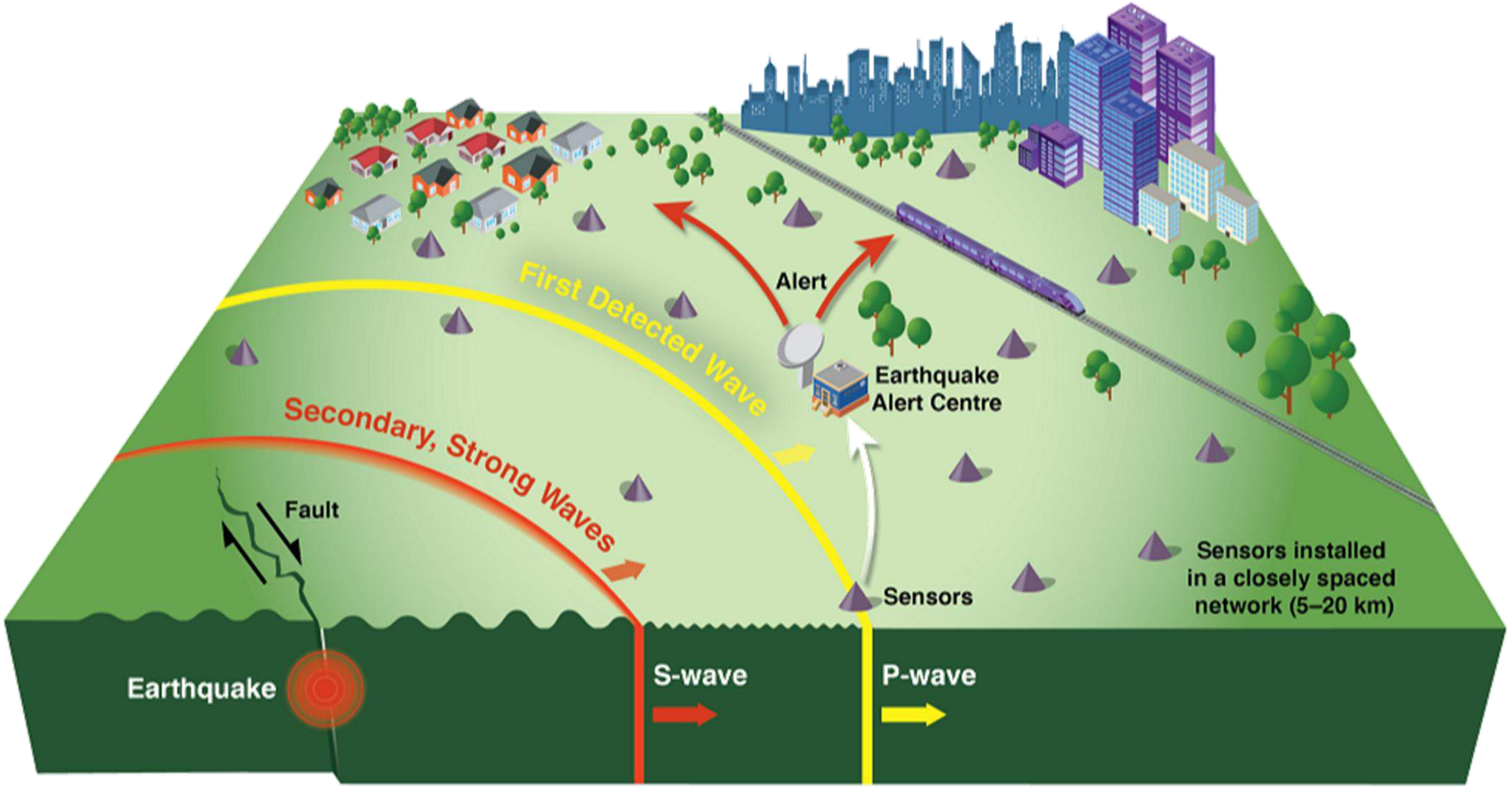

positive sentiments

negative sentiments

neutral sentiments

# What do these imply?

- Context affects usage
- Bluetooth feature is more effective than manual scans.
- BUT does not mean that manual features should be abandoned.
- The danger is that with inactivity, users may uninstall the app entirely.

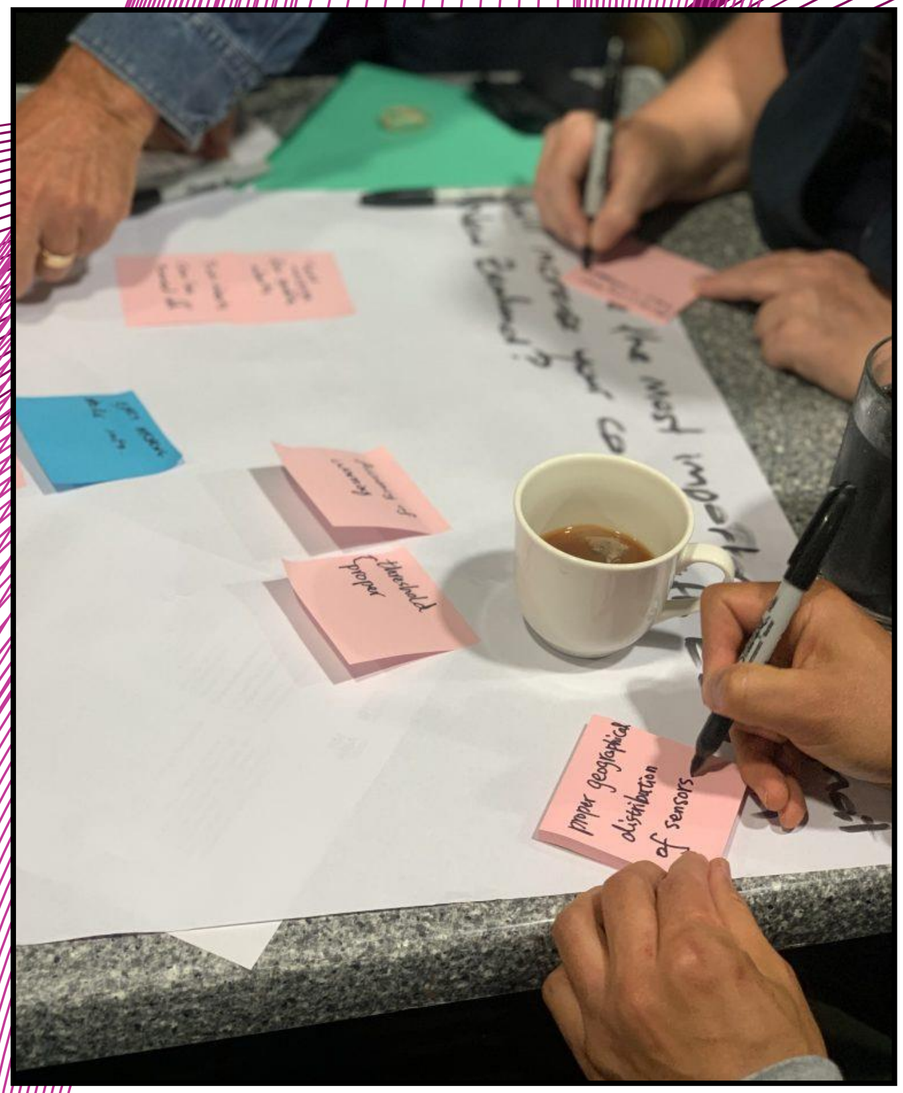



# Example 2: Earthquake Early Warning

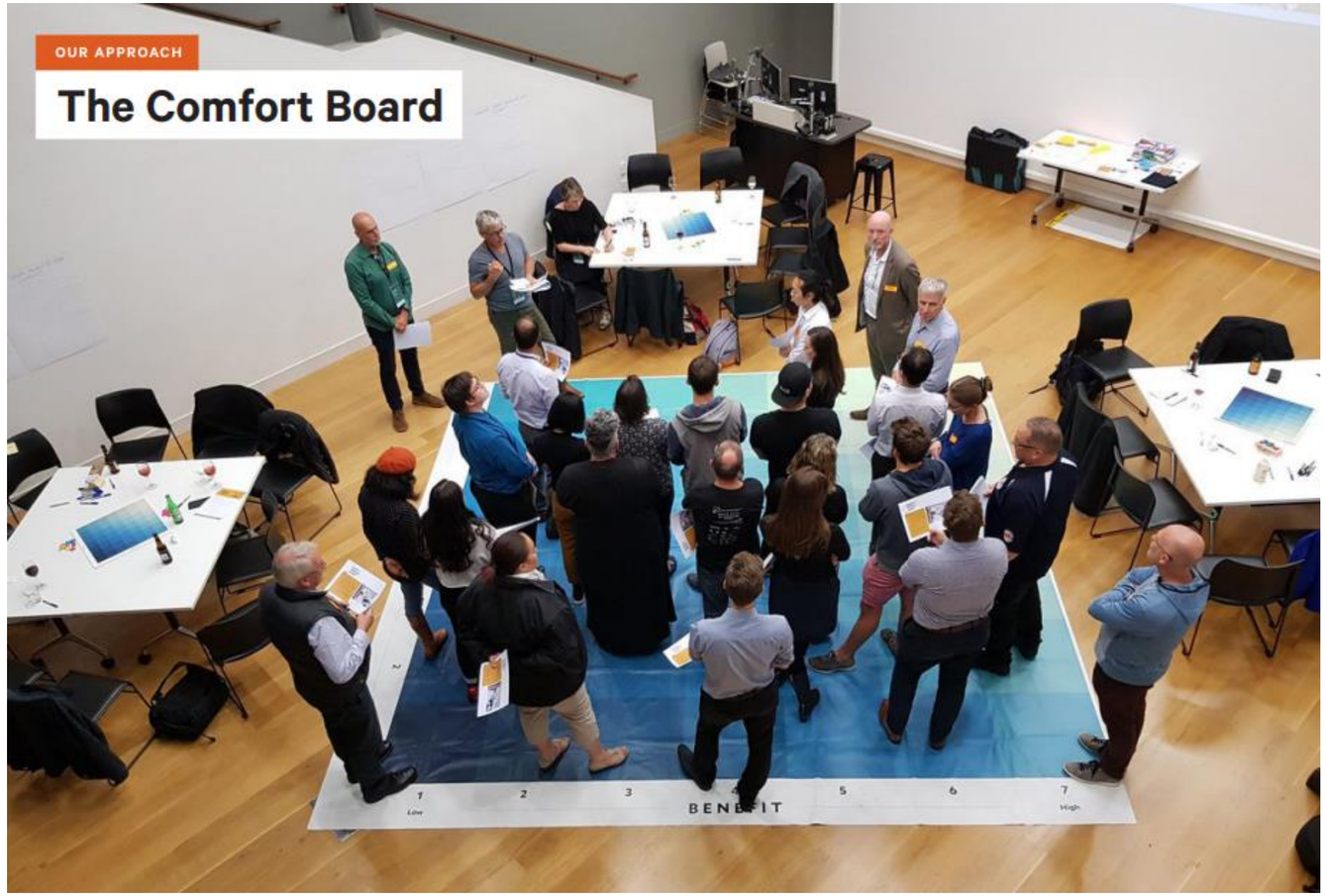
# EEW in Aotearoa New Zealand?

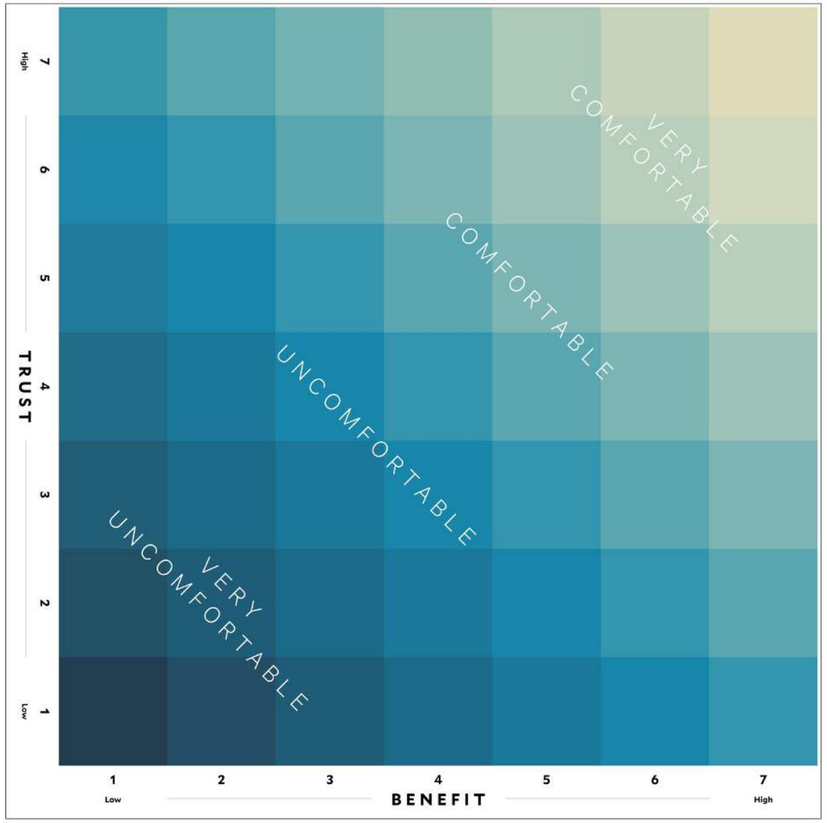
- The NZ public supports EEW
- Various sectors also perceive that there are potential benefits and challenges

What are the **concerns** regarding EEW?



# Workshops with the public



# FINDINGS

## What about tsunami?

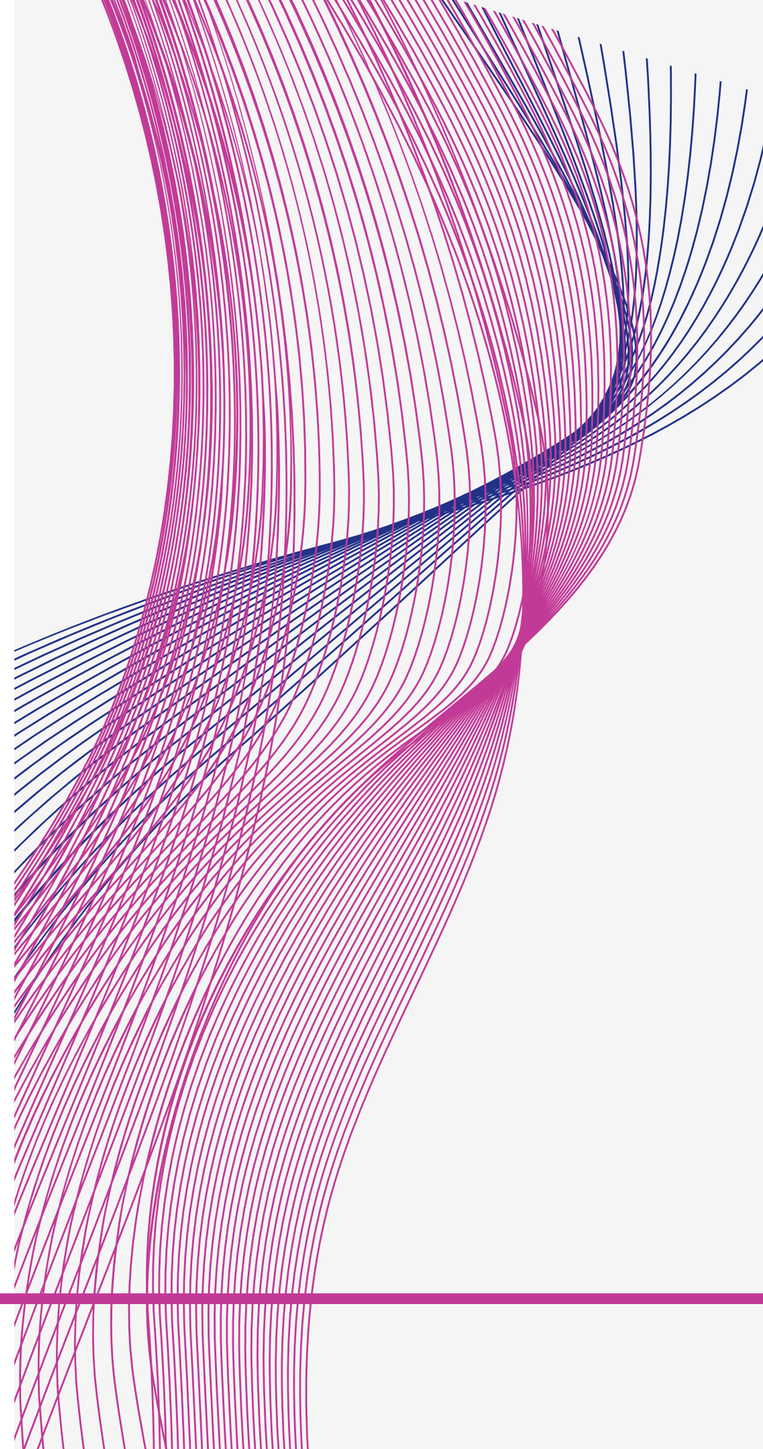
“This [EEW] has to be linked to tsunami for those living at the coast. Tsunami is a bigger fear than earthquakes.”

“Living here, if it isn’t somehow linked to tsunami warning, [then] what use is it?”

# FINDINGS

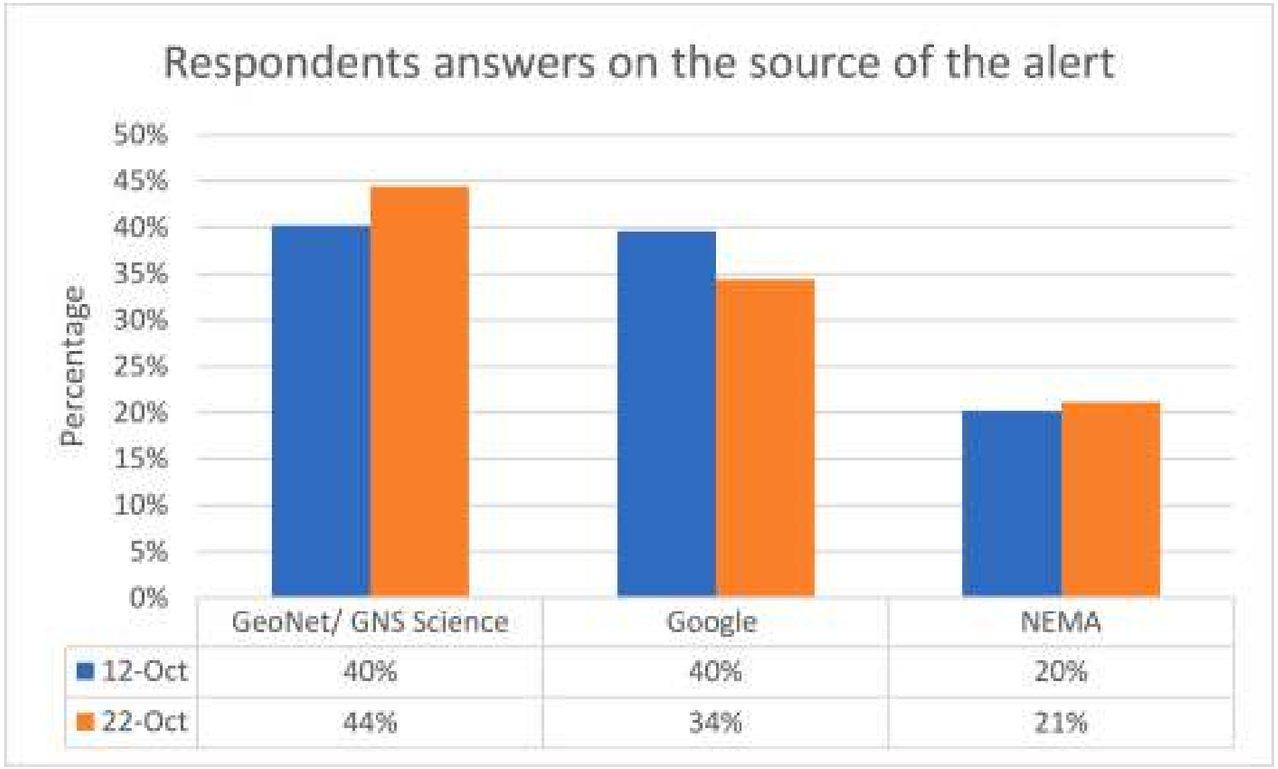
## Public education and communication

“There is another really important thing - you can give people warning and you can have infrastructure and you can have sensors and all the rest of it, but people aren’t used to these things and if there’s no drills or no practice involved the end result is going to be the same blind panic”



# On Android Earthquake Alerts

- Survey after 12 and 22 Oct 2021 alerts
  - Most respondents thought the alert would be useful or somewhat useful
  - People did not necessarily know the proper action upon receiving the alert
  - Confusion to who is responsible for the alert (GeoNet , Google, NEMA)



# Final thoughts

- Technologies are embedded in our social fibre.
- People’s uptake of new technologies can be more challenging than perceived.
- More frequent use relates to positive sentiments.
- The usefulness of technologies depends on social and environmental contexts.
- People are generally open to new technologies.
- But can have misconceptions about technology, and it can affect trust.
- Education and clear communication are needed for new disaster technologies.

# How Disruptive Technology Can Provide Solutions for Disaster Risk Management

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

JOINT CENTRE FOR DISASTER RESEARCH

CRISiSLab

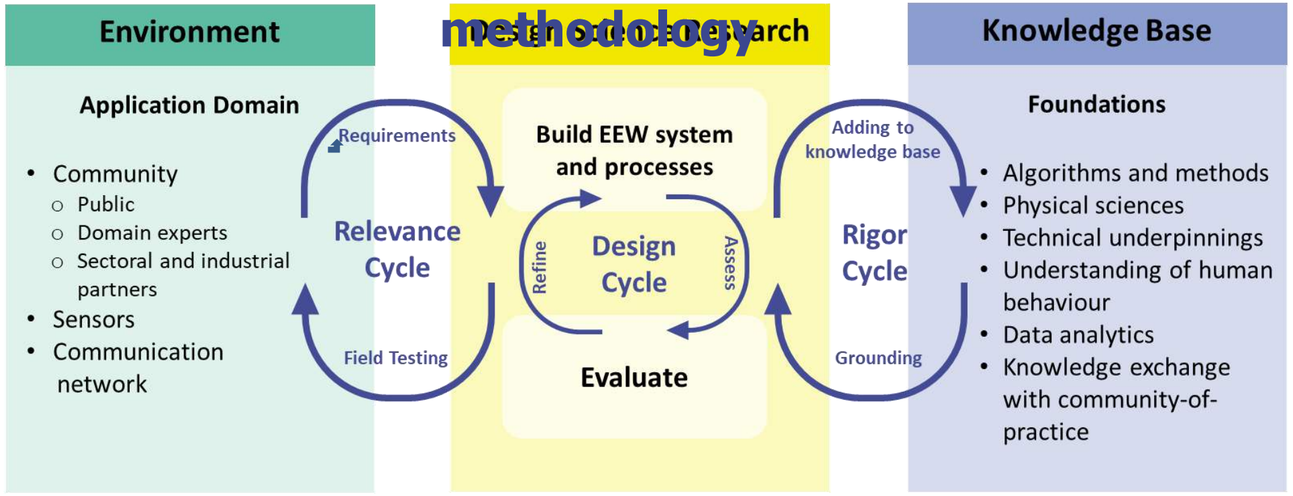
https://www.crisislab.org.nz/

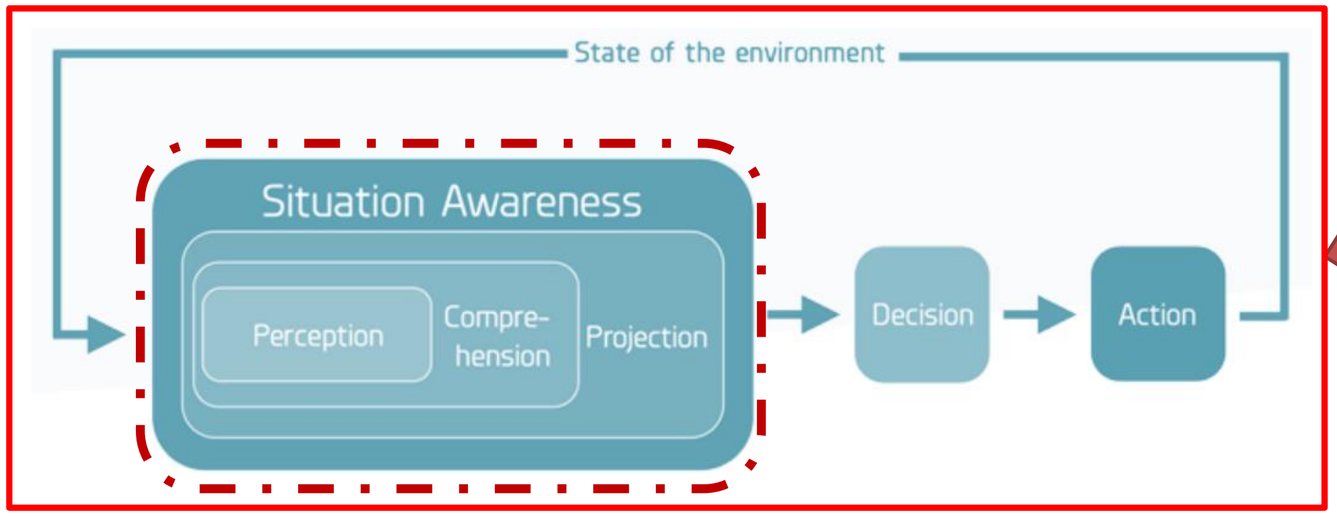
Human behaviour, interaction, and interface

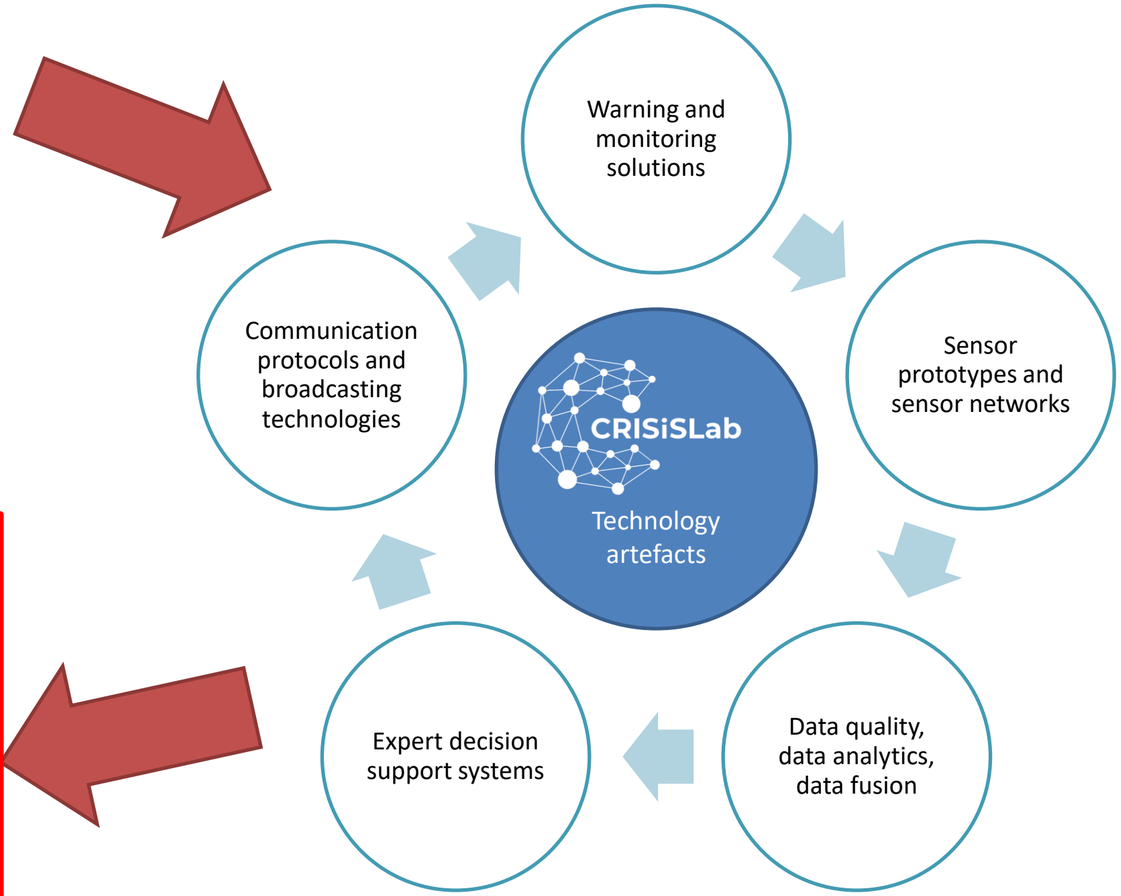
Technology adoption, management and transfer

Technology design, development, implementation and validation

# Design-science-led methodology



CRISiSLab

# Promotes Disruptive Technologies

Disruptive technologies are innovations that significantly alter the existing technology landscape and their approaches to minimise or eliminate limitations of the current state of the art.

These technologies can generate novel approaches, rendering previous solutions obsolete or less competitive.

Disruptive technologies offer advantages such as improved performance, lower costs, increased accessibility, or enhanced user experiences, which can support solving wicked and complex unanswered questions and challenges existing in our societies.

Can support enhancing Situation Awareness during a Crisis.

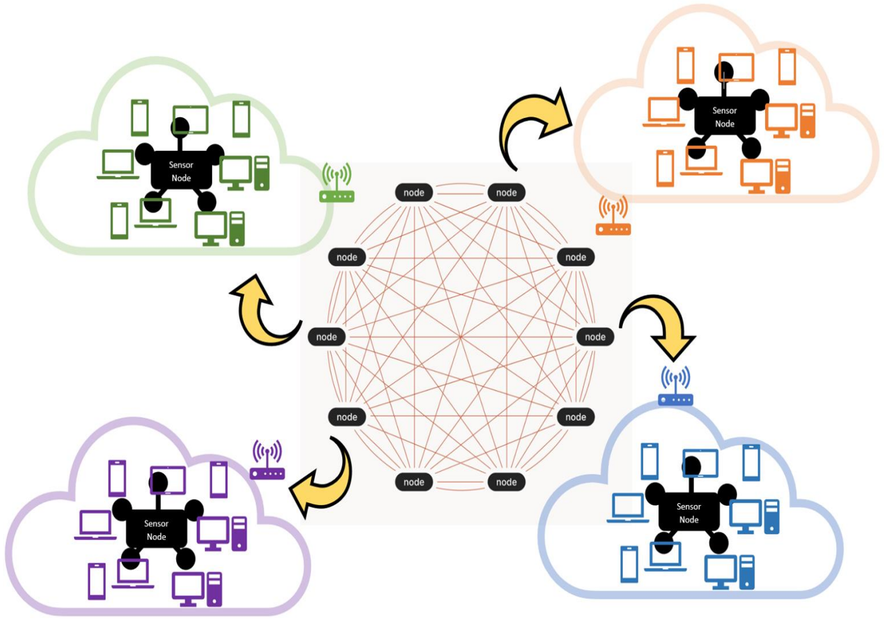
# A Novel Approach to Implementing a Low-Cost Earthquake Early Warning with Node-Level Detection and Alert Generation

## Our Approach

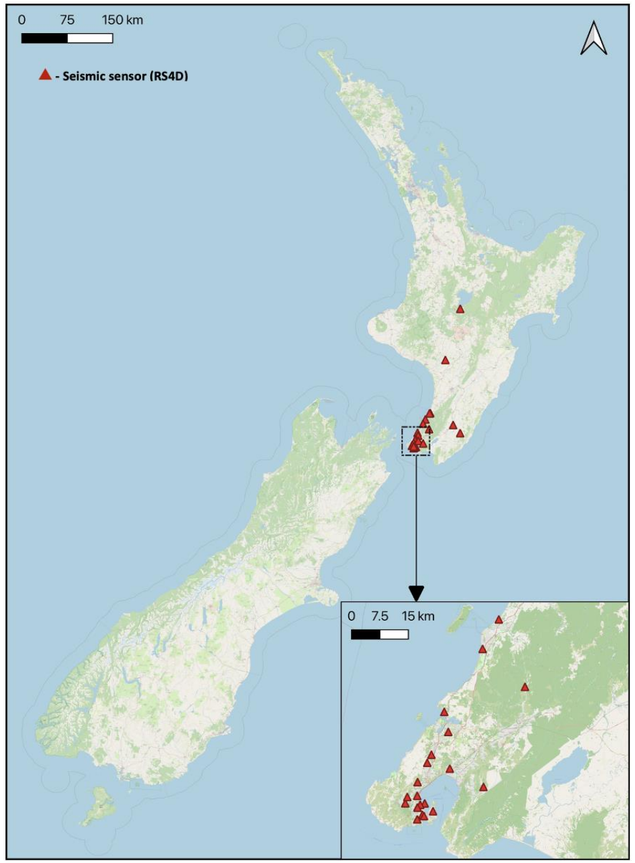
I. **Low-Cost MEMS Seismographs:** Establishing an EEW network using affordable MEMS-based seismographs for ground motion detection.

II. **Community-Hosted Network:** Implementing the EEW network entirely maintained and hosted by the community, ensuring wide accessibility and engagement.

III. **Node-Level Processing:** Designing the EEW system to detect and process earthquake data locally at each node, eliminating the need for centralised processing units for real-time responsiveness.



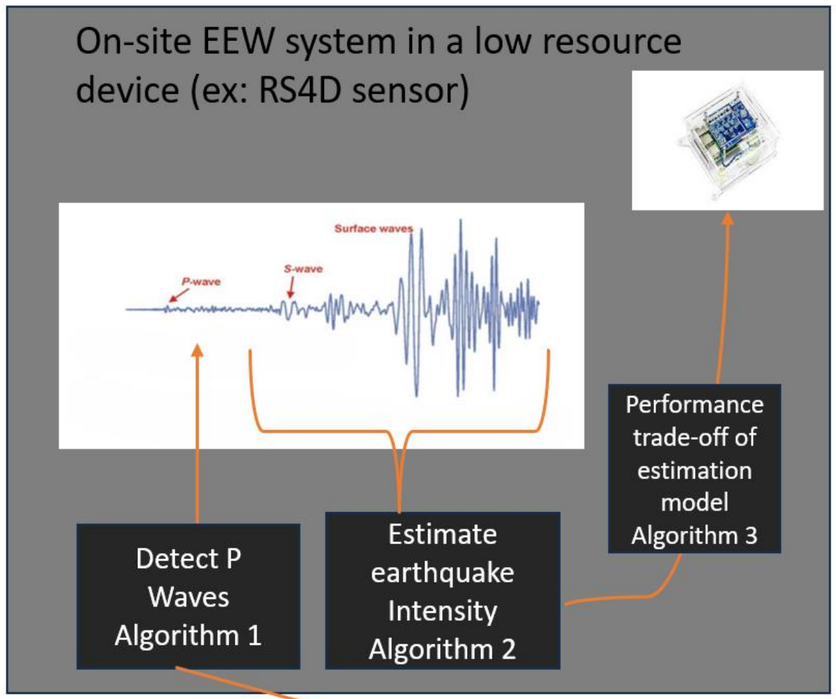


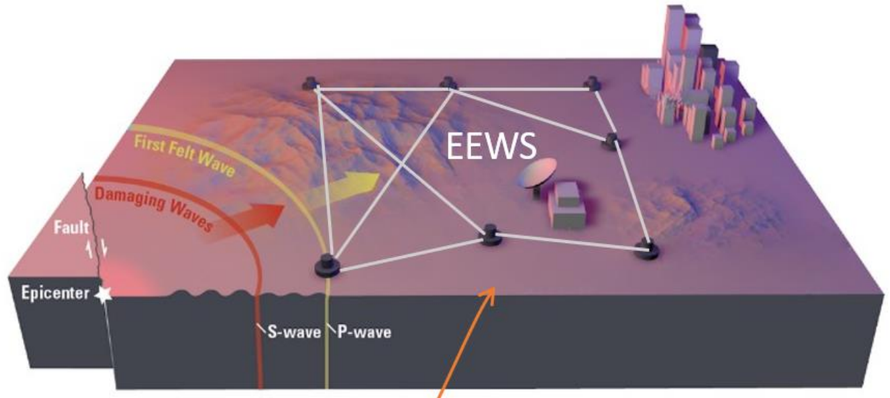


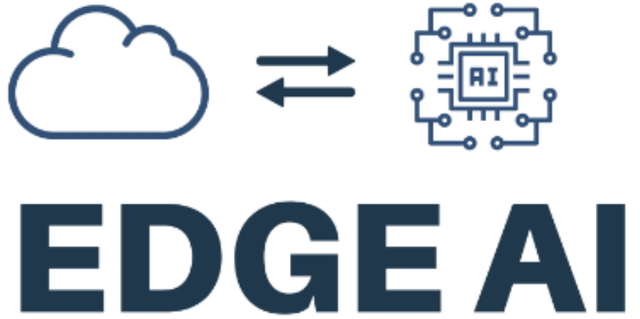
# Design and Optimisation of Machine Learning Models for Resource Constrained Edge Devices of On-site EEWS

Develop reliable ML algorithms for

1. P Wave-based earthquake detection
2. Earthquake intensity predictions



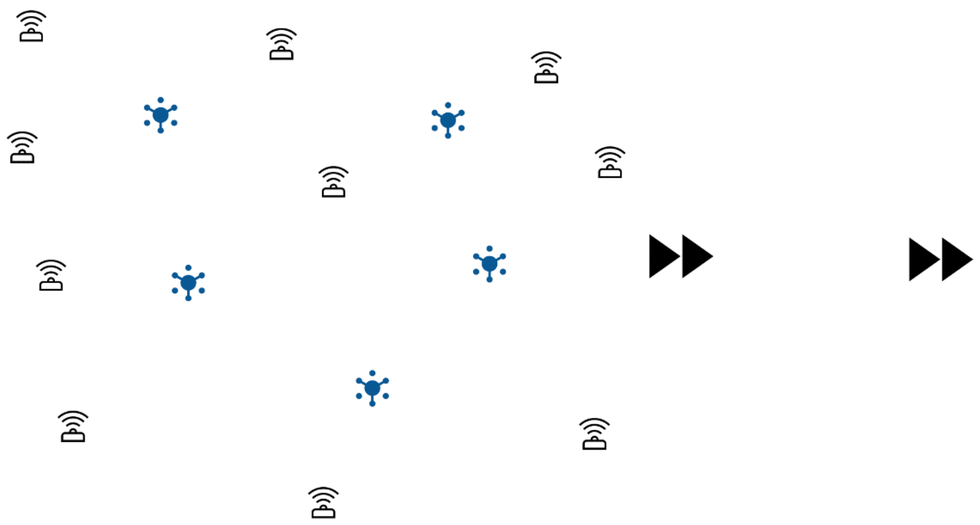



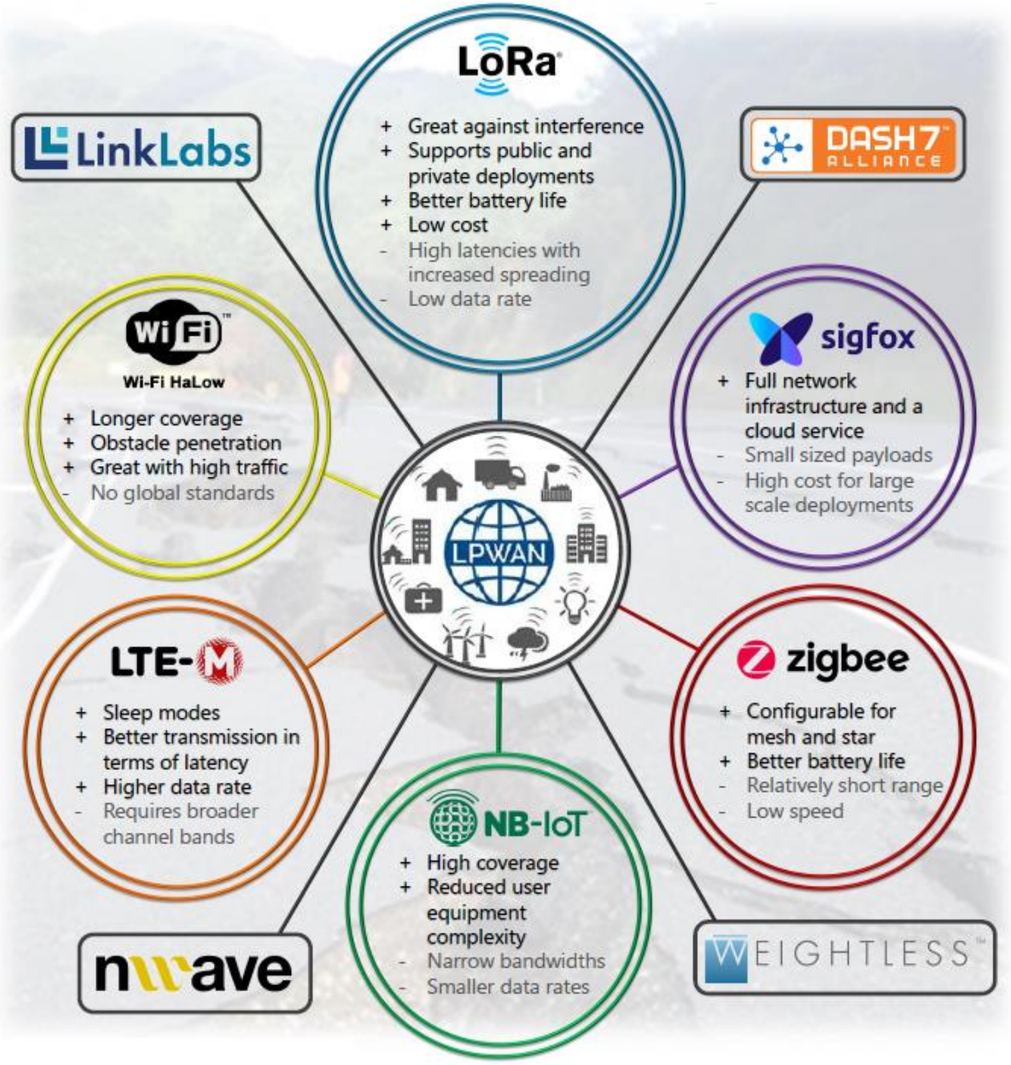



# Alternative Long-Range Data Communication Solutions When Limited or No-access to Internet

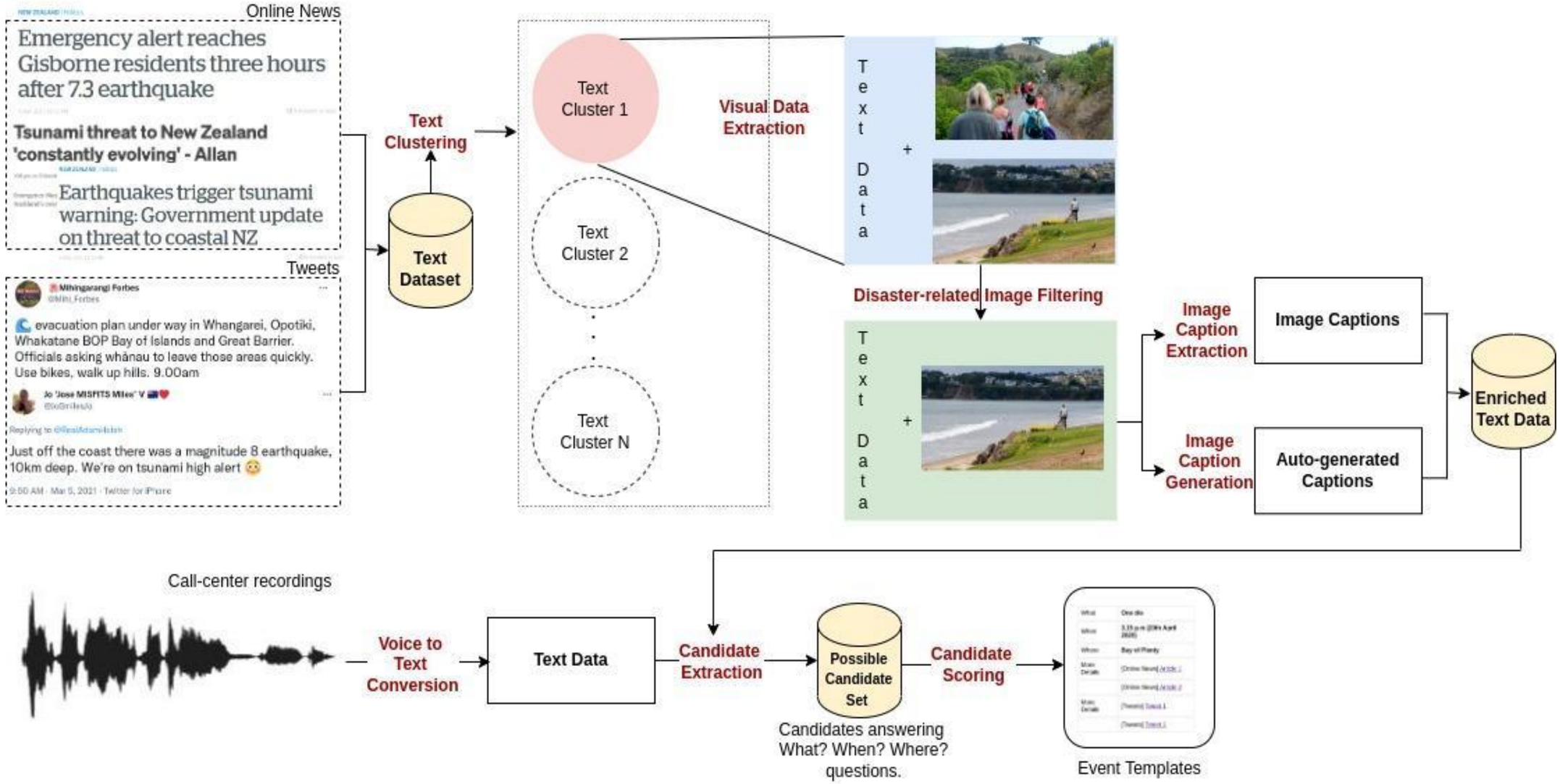
LPWAN-based solution for:

1. Real-time monitoring of building health
2. Earthquake Early Warning

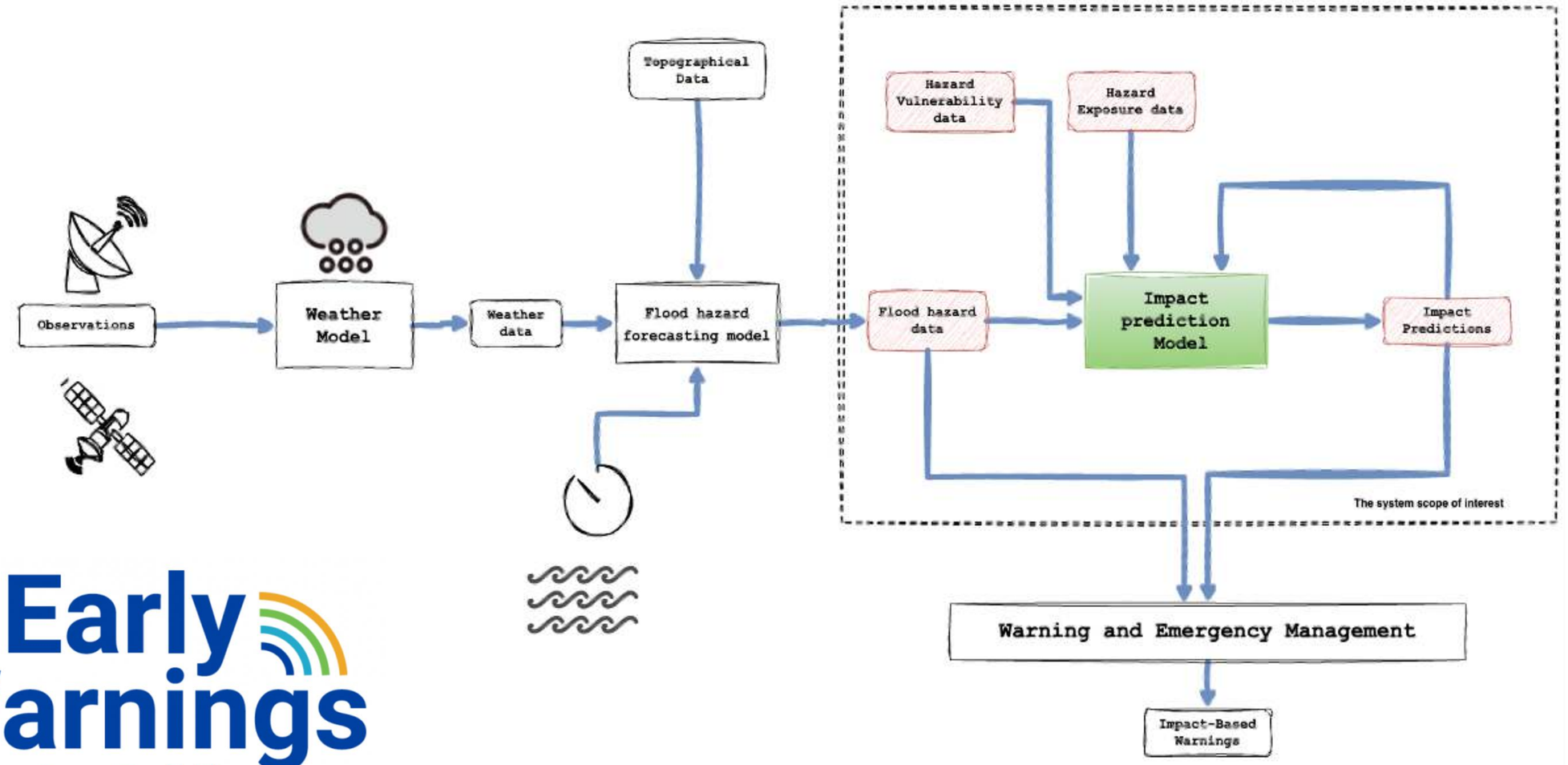




# Multi-Source Multi-Modal Deep Learning for Enhanced Situation Awareness



# Application of Machine Learning for Developing Impact-Based Flood Forecasting

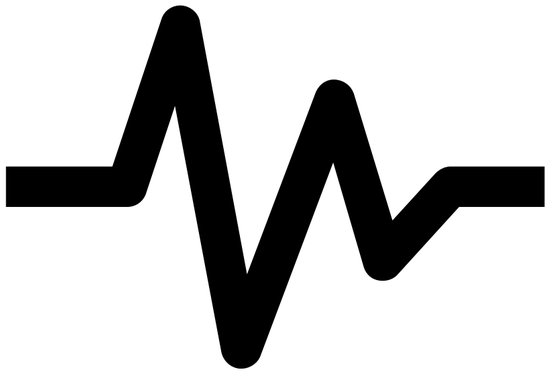



Early Warnings for All

# Seismometers in Schools: connecting earthquake and hazard education outreach programmes for schools in Aotearoa

L H Kaiser, K Tapuke, D M Johnston, M L Tan, R Prasanna, J Becker, E Campbell, E R H Mestel, F Illsley-Kemp, B Smith, G Leonard, K-L Thomas, B Alger, J Stewart

# Seismometers in Schools



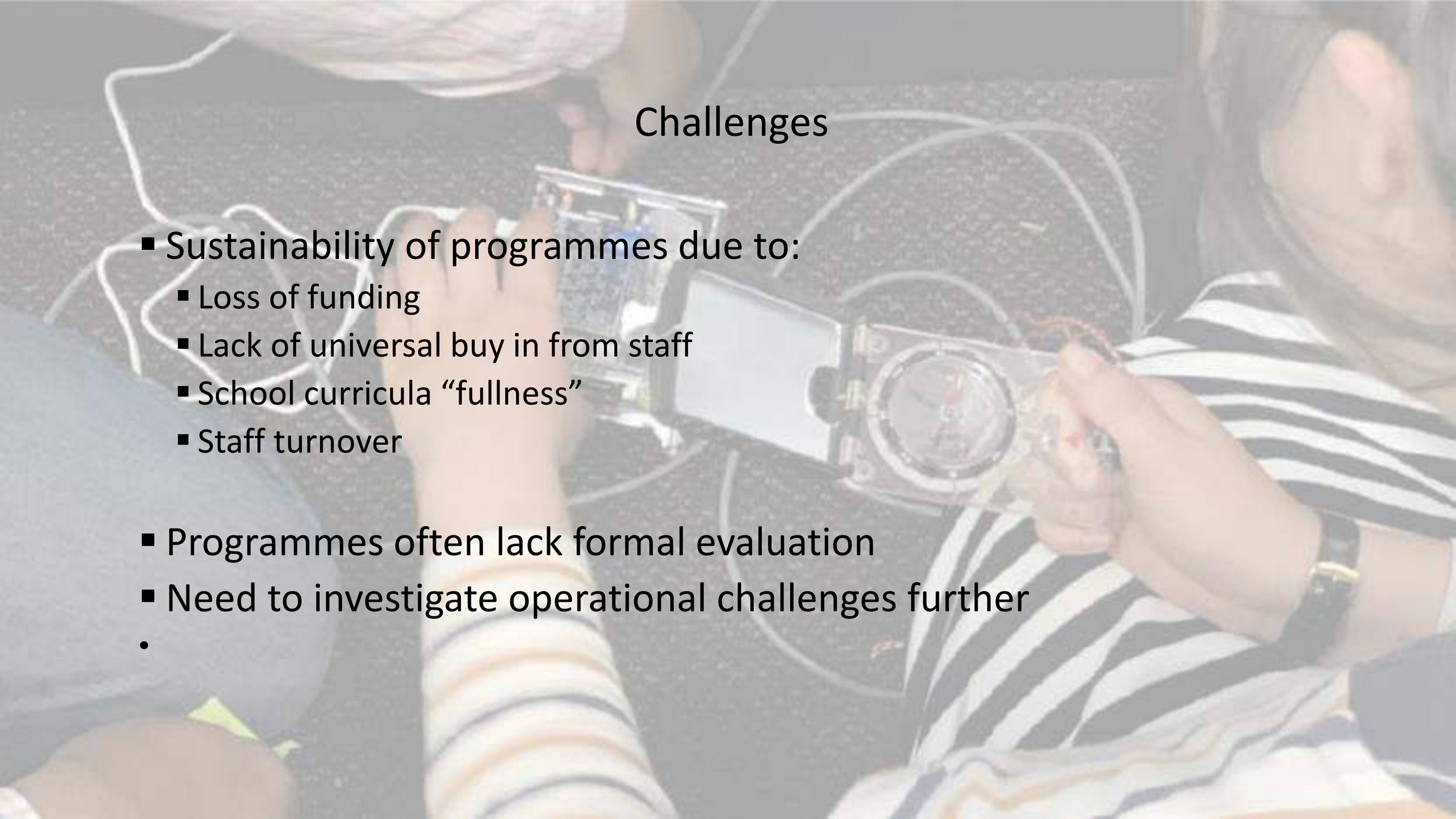
- Over the past decade several “seismometers in schools” programmes have been developed in Aotearoa New Zealand and overseas (e.g. Cochran et al. 2009; Subedi et al, 2020)
- These have been coordinated by a range of organisations, for a variety of reasons and aiming to achieve a range of outcomes
- Enhanced digital seismic networks, decreasing cost of sensors, cheaper and faster internet, and the increasing interest in “citizen science”
- A range of opportunities exist to further expand participation of schools and other institutions in this space

# Project Outreach Objectives

- To provide teachers with engaging classroom activities that can be built into the current science curriculum to increase student interest in Earth sciences.
- To disseminate seismic and hazard research to the community in an accessible manner.
- To foster stronger connections between research institutes/universities and the community, supporting science literacy and trust.

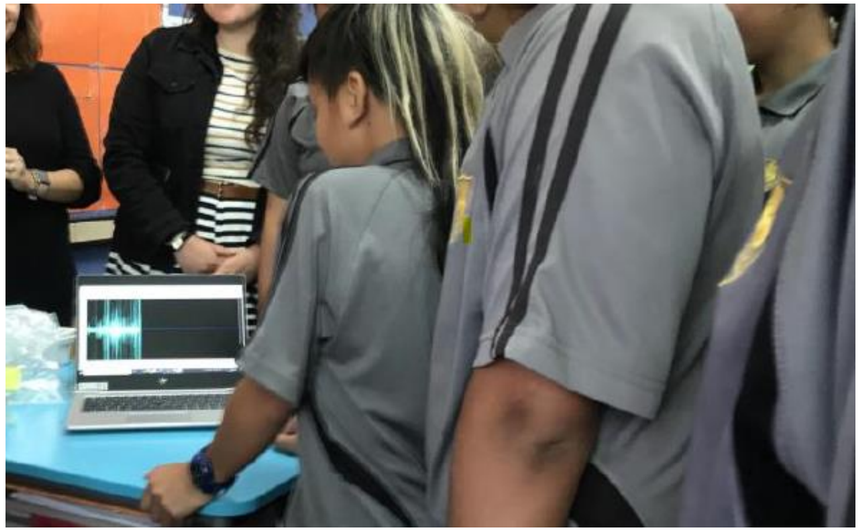
# Opportunities

1. Raising awareness of earthquake and hazards;
2. Raising awareness of subjects like seismology, geoscience and other Science, Technology, Engineering and Mathematics;
3. Promoting science as a possible career or are a of tertiary study
4. A tool to assist educators in their teaching of physics, maths, geology, geography and computer sciences
5. Linking school-based learning to household awareness and education around earthquake resilience
6. Connecting to wider community-based emergency management and disaster risk reduction activities
7. Contributing to earthquake detection research
8. Developing appropriate Te Reo Māori/Mātauranga Māori/Western science braided education resources that can be adapted for different rohe



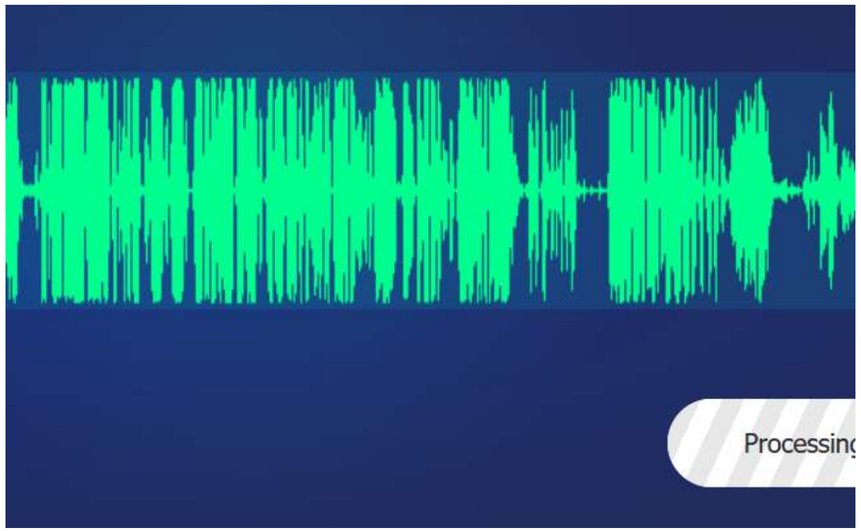
# Challenges

- Sustainability of programmes due to:
  - Loss of funding
  - Lack of universal buy in from staff
  - School curricula “fullness”
  - Staff turnover
- Programmes often lack formal evaluation
- Need to investigate operational challenges further
-



# Seismometer Deployment in Bay of Plenty Schools

- A team from Victoria University of Wellington, Massey University, University of Canterbury, and GNS Science collaborated on the deployment and education outreach events.
- Aim: to increase knowledge about earthquakes, tsunami and protective behaviour, to encourage interest in the role of science in understanding the environment, to show pathways to future education and careers, and to capture the curiosity of students, staff, and community
- Format: hands-on activities and Q&A with school children to capture their interest in Earth science, engineering, and community resilience.
- Four Raspberry Shake seismometers have been installed in Rotorua Primary School, Te Kura Kaupapa Māori o Te Koutu, Mokoia Intermediate School, and Matatā Public School.
- More seismometers to date have been deployed including in the Chatham Islands.




# Future planned activities

- Deployment of seismometers as part of a monitoring equipment set (weather stations)
- Build on existing kete of teaching resources for teachers to use in classrooms https://www.crisislab.org.nz/teachingresource
- Connect schools in Aotearoa and further abroad using seismometers
- Share your ideas with us!