Exploring eDNA Adoption

Analysing Sector Specific Drivers and Barriers

eDNA Conference - Wellington, NZ 2025

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We all have a journey…. mine had a problem…

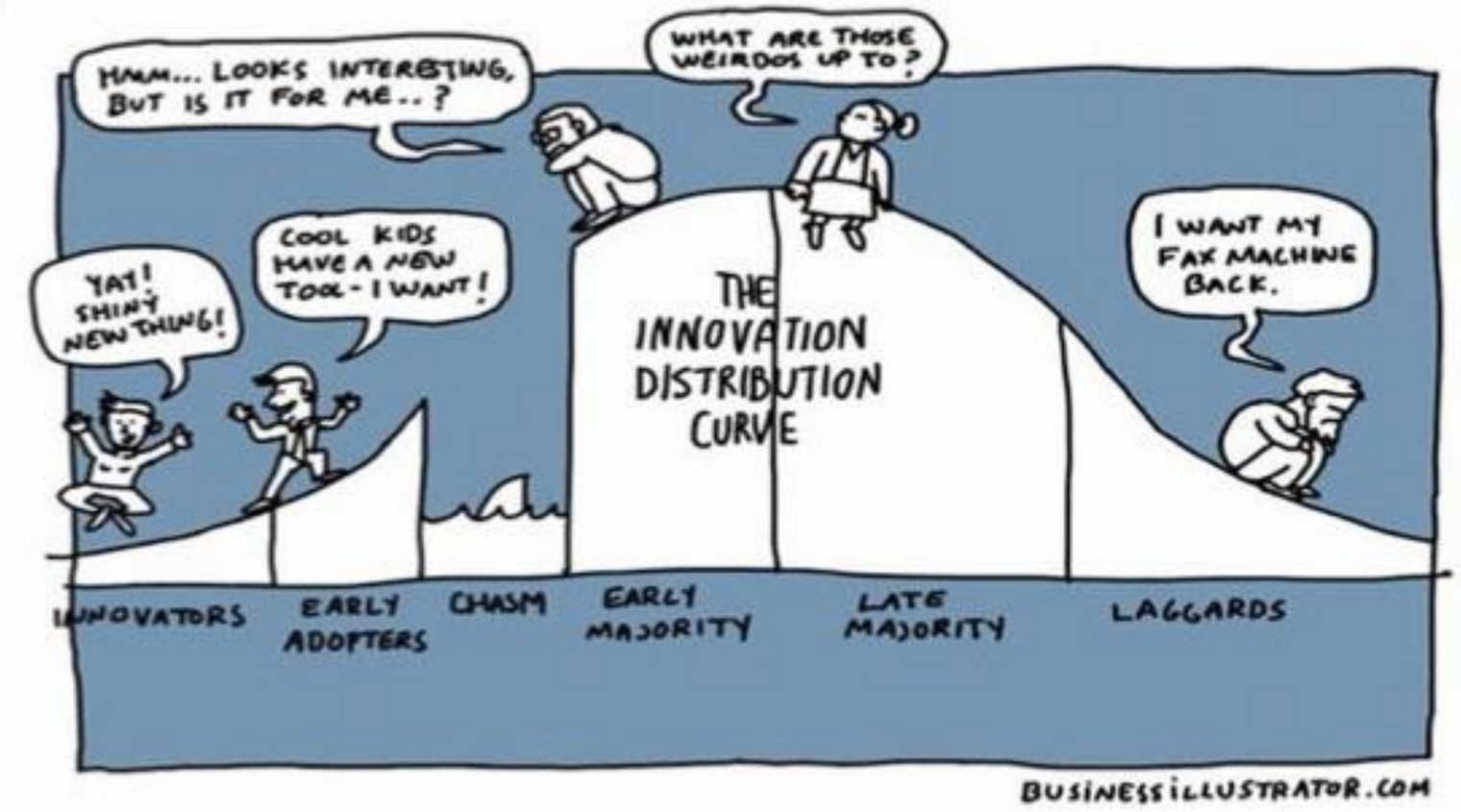
Going to ecosystems like this….

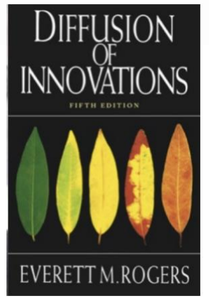
with equipment like this….

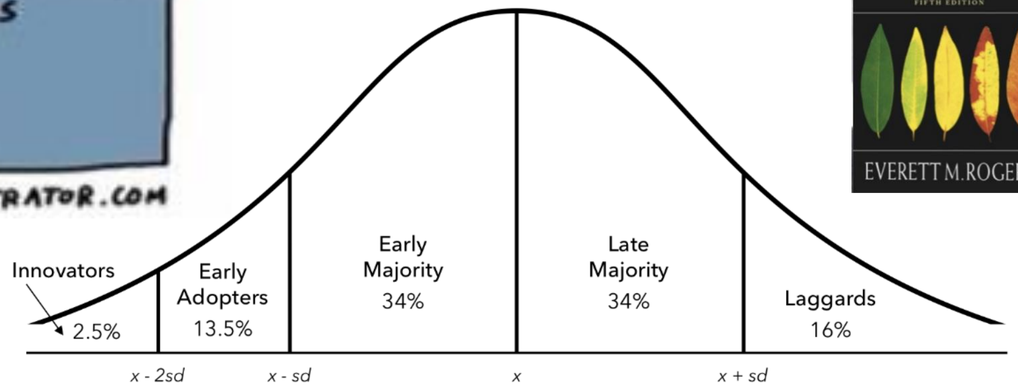
and generating waste like this!

then a solution…and a wild ADVENTURE!

Innovation "Adoption" Curve







Relationship between types of adopters classified by innovativeness and their location on the adoption curve.

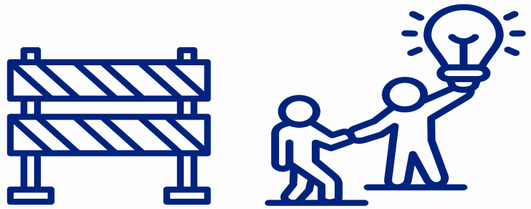
SOURCE: Everett M. Rogers, *Diffusions of Innovations*, 5th ed. (New York: Free Press, 2003), p. 281.

The Innovation Curve or Diffusion of Innovation Curve was created by the eminent sociologist Everett Rogers. It was first published in his book *Diffusions of Innovations*, one of the most widely cited works in all of the social sciences.

Objectives

This research aims to reveal how to best **drive adoption** of eDNA technology across 3 stakeholder groups

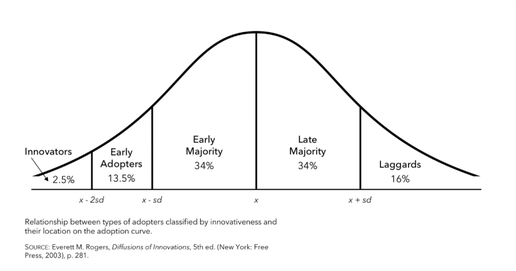
But ultimately, I want to really understand how we drive innovation adoption at scale beyond the eDNA case study



Objective 1

Assess Adoption-3 Stakeholders

- Scientists
- Industry
- Management



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Objective 2

Relate to Adoption Theory?

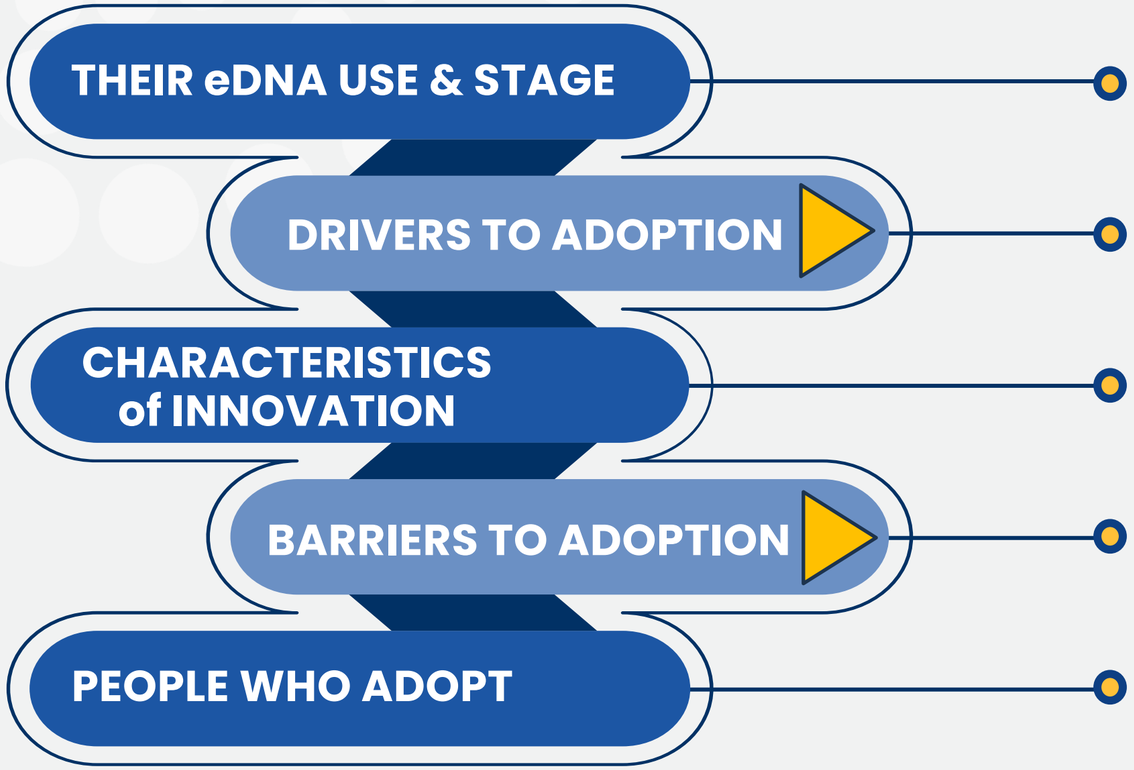
Objective 3

Can these findings be translated to key recommendations for driving “ANY” new innovation at scale?

Semi-Structured Interviews

RELATES TO ROGER'S CHARACTERISTICS

- **Relative Advantage** - The degree to which an innovation is seen as better than the idea, program, or product it replaces.
- **Compatibility** - How consistent the innovation is with the values, experiences, and needs of the potential adopters.
- **Complexity** - How difficult the innovation is to understand and/or use.
- **Triability** - The extent to which the innovation can be tested or experimented with before a commitment to adopt is made.
- **Observability** - The extent to which the innovation provides tangible results.
- **Flexibility**- The ability to refine or transform an innovation to better aligns with adopter desires and constraints



When did they HEAR, how long have they used it, will they CONTINUE to use it, what APPLICATIONS & environments etc., CONCURRENT methods, FUTURE use

From your perspective what would DRIVE adoption the fastest

What are the 3 most important features of the technology that will make people want to adopt

From your perspective, what are the BARRIERS, are there any MEASURES to take to overcome them, relationship with existing POLICY & WORKFLOW.

Looked at the specific CHARACTERISTICS or QUALITIES of people who adopt new technologies and eDNA specifically

Methods:

40+ semi-structured interviews, paired online survey
Otter-voice to text transcription software using AI
NVIVO-qualitative analysis program- thematic analysis & coding
NotebookLM- large language module trained on "your data" only

Key Findings

01 Needs do VARY by stakeholder group. AND there is quite a bit of variation within groups as well.

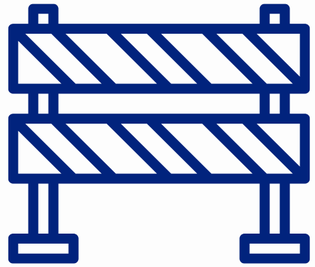
02 Stage of ”adoption” and uptake is quite different between groups. Scientists are much further along the adoption curve

03 Qualitative analysis of interviews is extremely time consuming but yields a VERY deep understanding.

04 NotebookLM is AMAZING at consolidating large volumes of data! Check this tool out if you haven’t before.

Drivers

Barriers



Who are our MANAGERS?

Various federal and state stakeholders including marine park managers, managers of regulatory bodies, biosecurity officers and policy makers

Key Barriers of Adoption- MANAGERS

Cost The cost of national-scale implementation can be a major barrier

Lack of standardised protocols and validation
False positives/negatives False positives and negatives implications in management

Incomplete reference libraries A lack of effective reference libraries can be a barrier
Data management and infrastructure Robust data infrastructure is needed to manage the large volumes of data generated by eDNA studies
Expenses Associated with Infrastructure-Specialized laboratories and staff Highly specialized laboratories and staff are needed to handle eDNA samples
Bioinformatics support Bioinformatics support may be needed to understand and analyze data

Community concerns how eDNA data may be used, concerns from Indigenous owners about access and use
Science Literacy and Communication Good science communication is needed because many policy people don't have a science background

Policy and frameworks A lack of policy and frameworks to deal with eDNA can cause nervousness about trade and decisions

Confusion About the Technology The many different companies, products, and hardware can overwhelm people

MANAGERS

MANAGERS

Some Primary Concerns Categorised

Sub-groups within "Managers"

All subgroups say **COST** is a significant concern!

Environmental Managers

Priorities: Resource allocation and balancing eDNA with traditional monitoring methods
Addressing community concerns: Must consider community worries and inform policy
Need for prioritization: Need to prioritize what information is needed
Actionable results: They require simplified information that leads to management action

Government Agecies

Navigating policy frameworks and biosecurity protocols: Must work within existing regulations & guidelines
Funding constraints: They must deal with limitations on available financial resources
Need for national consistency: A desire to standardise eDNA practices across the country is important
Education & knowledge: Education is needed to promote understanding of what eDNA is and what it means
Cautious approach: Are very cautious about interpreting results
Trade implications Concerned about trade implications from eDNA findings

Indigenous Communities

Protecting traditional ownership and data sovereignty: Maintain control over their knowledge and resources
Avoiding use of eDNA for compliance: Want to prevent eDNA being used to restrict their access to resources
Community engagement a gateway to engage the community and have them learn by doing
Ownership eDNA technology can create greater interest and ownership over country

Key Drivers

To promote eDNA adoption, managers suggest:

Local Expertise Funding to have local experts is key

Knowledge and Education Educating government on what eDNA is and isn't is important

Integration with Existing Methods: Utilizing eDNA alongside existing methods is important

Fit for purpose Pragmatic techniques that meet actual needs are more likely to be showcased or adopted

Immediacy The immediacy of refining eDNA technology to be like a COVID test could drive adoption

Standard methodology A standard methodology, quality assurance, and quality control systems facilitate eDNA adoption

Policy support A policy decision can motivate departments to collect environmental samples

Cost-effectiveness eDNA technology is cost effective

Which INDUSTRIES?

environmental consulting companies, eDNA service providers, mining, ports, water providers

Key Barriers of Adoption- INDUSTRY

- **Lack of regulatory endorsement and standardization** A major barrier is the absence of consistent methods and regulatory support
- **Cost** Expense can be an impediment, especially for smaller companies or projects
- **Data translation and interpretation** Difficulty in understanding and translating eDNA data can hinder adoption
- **Concerns about accuracy and reliability** Concerns about false positives, false negatives, and gaps in DNA libraries can create hesitation
- **Turnaround time** Long turnaround times can be a barrier
- **The perception that eDNA may lead to job loss** The perceived risk of job loss for an aquatic ecologist may be stopping its adoption
- **Competing priorities** Organizations may have many different things they need to be focused on
- **Lack of collaboration with academics and academic institutions** Industry needs to collaborate with academics and academic institutions to get the best and most forward-thinking approaches
- **Lack of understanding** Lack of understanding of DNA is a barrier
- **Legislation** (can be a key driver) but can also be a dual edged sword, in that it can stymie innovation
- **Facility and infrastructure** A good lab is needed to avoid contaminations, equipment and issues with scaling quickly

INDUSTRY

Some Primary Concerns Categorised

Common Concerns

Env Consulting Companies

Data Interpretation and Communication: They want clear tables outlining the pros and cons of eDNA versus other monitoring techniques to convince clients
Clear Communication: Want access to experts who deeply understand the science & can communicate it simply
Standardization and Reliability: Consistent methodologies to ensure reliable data comparison over time

eDNA Service Providers

Quality Control: They emphasize transparent quality control measures and awareness of potential issues related to data
Assay Design and Data Analysis: They focus on refining assays and providing primary and secondary levels of data analysis
Client Communication: There is an emphasis on consulting with clients on survey and sampling designs

Mining, Water & Ports

Regulatory Approval: Legislation drives their actions, so eDNA needs to be recognized as a valid survey method
Competing Priorities: Their biggest barrier is balancing eDNA adoption with numerous other responsibilities
Reputation and Factual Accuracy: They prioritize factual accuracy in public information and are concerned about potential misinterpretation
Justification and Repeatability: They seek justifiable and repeatable processes for environmental risk assessment

Education:
Cost and Finance:
Accessibility & Communication of Available Services: There is a desire for more resources on eDNA testing facilities and capabilities

SCIENTISTS

From academia, federal and state research organisations

Key Barriers of Adoption- SCIENTISTS

- **Cost** The cost of eDNA work is a barrier

- **Complexity and Practicality**
  - eDNA technology can be complex and overwhelming to start
  - Reconfiguring workflows from sample to analysis can also be a barrier
  - A lack of field-friendly sampling

- **Communication and Knowledge**
  - general lack of real-world examples and case studies
  - a need for clearer communication, information, and accessibility
  - A poor understanding of the technology's limitations can also impede uptake
  - confusion and misinformation also act as barriers
  - Issues in communicating the need for multiple samples

- **Expectations and Interpretation**
  - Over promising of results, over interpretation, and unrealistic expectations can limit adoption
  - Expectation management is a big part of eDNA technology

- **Data and Standardization**
  - A perceived inconsistency and a lack of standardized approaches can be a barrier
  - Need to integrate eDNA data with conventional records can impede adoption

- **Validation and Reliability**
  - Concerns over contamination and false positives are real issues to manage.
  - Uncertainty in results and a lack of validation can slow adoption

- **Integration with Existing Frameworks**
  - Policy issues, as well as concerns about replacing traditional monitoring methods, ca
    hinder adoption
  - A lack of consideration of eDNA as a possibility can also be a barrier

Incomplete reference libraries Need reference libraries

SCIENTISTS

Key Drivers

To promote eDNA adoption, scientists suggest:

- standardized guidelines
- user-friendly technology
- a repository of real-world applications
- clear communication of limitations and around the importance of managing expectations
- and continued outreach and education are also crucial

Future Recommendations

THANK YOU

AND LET'S KEEP TALKING!