CEBRA research: harnessing past and new work to improve uptake and impact of best practice risk analysis approaches in MPI analysis

Final report for CEBRA Project 180702

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Acknowledgements

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1 Executive Summary

CEBRA has collaborated extensively with end users in both the Australian Department of Agriculture, Water and the Environment (the department) and the New Zealand Ministry for Primary Industries (the ministry) to improve adoption of methods and to increase the impact of recent research outputs. Most CEBRA projects include scientists from the department or the ministry in project development and execution. This enhances research outcomes and is thought to improve the likelihood that research findings will be adopted and implemented by those who commissioned the research. The ministry has not yet fully capitalised on existing research outputs from CEBRA and its predecessor ACERA. There remains significant scope to use methodologies and outputs from earlier projects to solve additional biosecurity problems and thus to benefit from investment in CEBRA.

Based on a perception that CEBRA outputs could be made more easily accessible, the objective of this project was to develop a 'mechanism' that would result in access for ministry staff to a tangible repository of CEBRA research projects, their outcomes and impacts — a CEBRA 'knowledge base'. Issues around the need for such a database, its development and future use were framed in a knowledge management context. Knowledge management refers to the set of processes an organisation uses to create, store, transfer and apply its information assets (knowledge) and is an important part of an organisation's 'knowledge culture'.

Qualitative analysis of interviews with ministry staff was the main approach used to understand contemporary knowledge management practices in the ministry. Interviews were undertaken during mid-2019 and were designed to elicit a broad understanding of awareness about CEBRA outputs. The analysis also revealed useful insights into the knowledge culture within the ministry and how this might be improved.

Development of the searchable repository was completed in 2020 and now allows:

- The efficient capture and dissemination of existing CEBRA research outputs.
- The efficient development of new projects.
- For an improved understanding of 'return on investment' in CEBRA projects.

1.1 Key findings

1. The ministry's knowledge culture will determine benefits from investment in CEBRA

Whether the ministry is able to capitalise on its relationship with CEBRA, and benefit from the CEBRA knowledge base, will rely fundamentally on the ministry's knowledge culture — the prevailing values and beliefs within the ministry that will either promote or hinder its capacity for creating sharing and implementing knowledge. Top-level management support and leadership is critical to this process, and to the ministry's knowledge culture in general.

2. The CEBRA searchable knowledge base cannot in and of itself lead to an increase in knowledge reuse.

It is a well-established principle that effective knowledge management requires hybrid solutions involving people and technology. A repository of knowledge cannot in and of itself lead to an increase in knowledge reuse — processes will need to be established that enable the use of the CEBRA knowledge base if benefits from its establishment are to be realised and measured. Both CEBRA and the ministry have a

role to play in embedding use of this new data repository into business-as-usual practices — CEBRA is largely responsible for the "supply-side" aspects of the database and the ministry is largely responsible for those on the "demand-side". Periodic analysis of the database inputs and outputs will provide insight into whether these processes are functioning adequately.

3. Improved visibility of CEBRA staff members amongst ministry staff is likely to improve uptake of CEBRA research.

Staff responses to interview questions indicated a desire for more interaction with visiting CEBRA staff and a lack of awareness about many of CEBRA's projects. That staff would like more social interaction with staff fits with evidence from the literature that people, including scientists, do not evaluate knowledge solely on the basis of objective criteria (such as quality and content) but also according to subjective criteria including attitudes and social relationships. Interview responses showed ministry staff turn to their professional networks when seeking knowledge. This behaviour can be capitalised on by extending the ministry's social networks to reach key CEBRA knowledge brokers.

1.2 Recommendations

As this project was nearing completion the ministry embarked on an overhaul of its research practices and processes. One notable change was the creation of the Biosecurity Science and Technology Research Committee, consisting of Directors of the ministry's various divisions. This committee is ideally placed to pursue positive changes in the ministry's research and knowledge culture and to implement the recommendations outlined in this report.

1. Improving knowledge culture within the ministry

To improve the knowledge culture within the ministry in general, and to benefit more fully from the relationship with CEBRA, we recommend that:

- New/existing 'knowledge brokers' be identified and appointed to focus on improving the values and beliefs around research, with a view to promoting the ministry's capacity for creating, sharing and using knowledge, establishing and maintain links between researchers.

- Initiatives to promote a knowledge culture would include appointing an 'executive sponsor' who has overall responsibility for improving knowledge culture in the ministry; developing a knowledge 'yellow pages'; and setting up social initiatives and incentives to foster knowledge sharing, not only within the ministry but also between the ministry and CEBRA (see Chapter 5 for details).

2. Realising the benefits from the CEBRA knowledge base

In order that benefits from the CEBRA knowledge base are realised we recommend that the following occur:

- CEBRA's project 'endorsement' process should be modified to include automatic i) uploading of new project outputs onto the searchable database; and ii) alert emails to key ministry research networks summarising the new outputs.

- Ministry processes for the development of biosecurity-focused projects should be modified to require searching of the CEBRA knowledge database to understand existing methodologies and outputs.

- Knowledge brokers and research leaders in the ministry should play a role in stimulating the demand for the information contained in CEBRA knowledge base ministry via a requirement for more-thorough reporting on the use of the CEBRA knowledge base (see also Recommendation 5; details in Chapter 5).

3. Measuring the value of CEBRA research

One of the objectives of this project was to use the repository of research to understand the ministry's return on investment in CEBRA research. In order to achieve this objective, information on adoption of outcomes will be required. This would involve recording instances where research outcomes led to an improved biosecurity practice or to the development of a new project. If adopted, initiatives suggested in Recommendation 2 will make this information available (see Chapter 5 for more details).

4. Monitoring the use of the CEBRA knowledge base

In order to understand the use of the repository we recommend that it be publicised at least every 3 months or as new CEBRA research is completed.

5. Visibility of CEBRA and connecting with CEBRA experts

In order to increase interaction between the ministry and CEBRA staff and awareness about projects we recommend several initiatives to be facilitated by ministry knowledge brokers with the assistance of CEBRA research leaders:

- 'Exit' seminars be delivered to ministry staff upon completion of each CEBRA project and CEBRA staff provide regular 'news items' about past, current and future projects, for distribution to ministry staff.

- CEBRA continues to facilitate regular online meetings where current CEBRA projects are discussed among ministry and departmental research leaders.

- The development of an inter-organisational professional social network based around communities of interest.

2 Introduction

CEBRA has collaborated extensively with end users in both the Australian Department of Agriculture, Water and the Environment (the department) and the New Zealand Ministry for Primary Industries (the ministry) to improve adoption of methods and to increase the impact of recent research outputs. The ministry has not yet fully capitalised on existing research outputs from CEBRA and its predecessor ACERA. There is scope to use these methodologies and outputs from projects to solve additional biosecurity problems.

This project reports on the development and potential use of the CEBRA knowledge base, a tangible summary of outputs produced by CEBRA projects. A qualitative approach, based on interviews with relevant biosecurity staff, was used to inform the development of the database, and to inform improvements to knowledge management within the ministry more broadly. The main outcome of this project will be improved use of research outcomes and impact activities from CEBRA projects, including those undertaken with ministry staff.

2.1 Objectives

The main objective of this project was to develop a 'mechanism' that would result in access for ministry staff to a tangible repository of CEBRA research projects, their outcomes and impacts — a CEBRA 'knowledge base'. As such it has assembled the approaches, methodologies, subject areas, and best-practice conclusions developed in CEBRA research projects over many years.

This improved knowledge management system allows:

- The efficient capture and dissemination of existing information on methodologies, impact, adoption and engagement activities that occur directly and indirectly as a result of CEBRA projects;

- The efficient development of new projects; and

- Ministry decision-makers to understand 'return on investment' in CEBRA projects.

2.2 Methodology

This project focused on 'knowledge management': the set of processes the ministry and CEBRA use to create, store, transfer and apply research outcomes and outputs.

Phase 1 of this project (2018-2019) involved:

- interviews with ministry staff in order to assess their potential use of a database of research outcomes and outputs, their past use and knowledge of CEBRA research, and appropriate methods to encourage future use of any database developed in this project.

- assembling the CEBRA knowledge resource, including an assessment of the different types of information that should be captured and stored, and how this storage process can become business as usual. This includes suggestions for how automated reminders could be managed for CEBRA and ministry researchers to upload new outputs and new adoption activities.

Phase 2 of this project (2019-2020) involved:

- activities to make staff aware of the research outputs and to encourage the distribution and use of this knowledge.

- capturing information about attempts to access CEBRA research outputs.

2.2.1 Interviews with ministry staff

Semi-structured interviews were conducted with ministry staff involved in biosecurity science and research including implementation. Interviews were designed to elicit a broad understanding of knowledge management in the ministry, particularly in respect to potential use of a CEBRA knowledge database, past use and knowledge of CEBRA research, and appropriate methods to encourage future use of the database. Details of the interview process and insights gained from the interviews are given in Chapter 3.

2.2.2 Assembling, using and evaluating the CEBRA knowledge base

During 2018 and 2019, CEBRA outputs were assembled and developed into an online searchable database (Arndt et al., n.d). Users are able to search the database by author, topic, and/or keyword. More details on the database, recommended awareness activities, and collecting information on database use are given in Chapter 4.

2.3 Knowledge management

Knowledge management refers to the set of processes an organisation uses to create, store, transfer and apply its information assets (knowledge). The purpose of knowledge management is to create business value and generate a competitive advantage (Tiwana, 2002). The relatively new field of knowledge management builds on theoretical foundations from a wide range of disciplines: information economics, strategic management, organisational culture, organisational behaviour, organisational structure, artificial intelligence, quality management, and organisational performance measurement (Baskerville and Dulipovici, 2006).

Knowledge management is typically characterised as consisting of four separate activities: i) knowledge acquisition; ii) knowledge storage/retrieval; iii) knowledge distribution; and iv) knowledge application and uptake (Alavi and Leidner, 2001; Baskerville and Dulipovici, 2006; Burstein et al., 2010; Laudon & Laudon, 2016; Cegarra-Navarro and Martelo-Landroguez, 2020). These characteristics may be summarised as follows:

i. *Knowledge acquisition* is the process of development, creation and accumulation of insights, skills and relationships. It involves capturing key documents (e.g. reports, spreadsheets, templates, code, presentations, project outcomes, journal articles) in an organised and systematic way to ensure that corporate memory is not lost when staff change roles or leave an organisation. It also provides a way of bringing new employees up to speed quickly.

i. *Knowledge storage/retrieval*, or organisational memory, is the process of storing knowledge in a way that allows its retrieval and use by other employees in order to benefit decision making. Data-management systems and repositories may be developed for this purpose.

ii. *Knowledge distribution/transfer* involves the distribution of knowledge within an organisation. It is important to consider how employees will actually discover key knowledge generated by past research projects and use this in future projects.

iii. *Knowledge application and uptake* refers to the use of knowledge on a daily basis. ***If knowledge is not shared and applied then no value is added from its acquisition***.

Applied in the current context, this framework suggests that both the ministry and CEBRA play a role in the CEBRA knowledge management process — CEBRA is largely responsible for activities i. and ii. (knowledge acquisition and storage); while the ministry plays a central role in iii. and iv. (knowledge distribution and application) — these were the focus of interviews with staff. This encapsulates a key challenge that lies at the crux of the inter-organisational knowledge reuse/application issue — successful completion of the knowledge management cycle is dependent on a 'handover' between the two organisations — the 'transfer' and 'sharing' stages as illustrated in Figure 1.
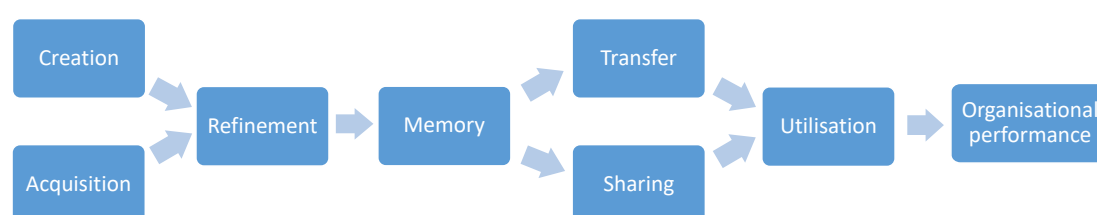
Figure 1. Knowledge management process model, modified from King (2009).

Those people who are being encouraged to use the CEBRA knowledge and who will benefit from using it have not necessarily been involved in creating it, and they may not know its creators. Effectively transferring or sharing information between organisations is no small challenge. The same socialisation practices that help to build organisational and group identity and affiliation are known to contribute to the "not invented here syndrome"; i.e., an unconscious bias towards internally created knowledge and the corresponding undervaluing of externally created knowledge (Katz & Allen, 1982; De Araújo Burcharth et al., 2014). As a result, knowledge management strategies often involve elements of both *codification* — knowledge is carefully codified and stored in databases; and *socialisation* — knowledge is shared mainly through direct person-person contact (Hansen et al. 1999).

The success of any knowledge management initiatives will rely fundamentally on the 'knowledge culture' — the prevailing values and beliefs within an organisation that will either promote or hinder its capacity for creating sharing and implementing knowledge (Intezari et al. 2017). Top-level management support and leadership is critical to developing and implementing a strong knowledge culture (Earl and Scott, 1999), enabling the effective promotion of knowledge sharing by creating an appropriate organisational culture, and making arrangements for corresponding policies and procedures across the organisation (Burstein et al., 2010). Such leadership may be in the form of a 'knowledge broker' — an individual (or organisation) who facilitates the creation, sharing and use of knowledge, establish and maintaining links between researchers (Meyer, 2010).

Issues related to knowledge culture within the ministry were explored in staff interviews (Chapter 3).

3 Interviews

Semi-structured interviews were conducted with ministry staff involved in biosecurity science and research including implementation. Interviews were designed to elicit a broad understanding of knowledge management in the ministry, particularly in respect to:

- methods used to locate relevant research when developing new projects;
- suggestions for how research outputs could be stored in order that it be easily and routinely accessed in the future;
- Suggestions for increasing staff awareness about research outputs, including those produced by CEBRA;
- Suggestions for effective methods and practices to disseminate research outputs;
- knowledge of CEBRA research;
- past use of CEBRA research; and
- Perceived barriers to uptake of research outputs.

The project team developed a semi-structured interview template (Appendix A). Interviews ranged in length from 20 minutes to over 60 minutes.

Selection of interviewees

Names of potential interviewees were supplied by the ministry, and included staff who were involved in biosecurity science. A total of 18 senior ministry staff were interviewed from a range of biosecurity areas (Table 1). Of these, 80% were managers, with the remainder in senior advisor roles. Interviewees had been in their roles for an average of 4 years, with most having worked within the ministry for at least 6 years. Several interviewees had roles that overlapped 'biosecurity areas'; almost one third of interviewees worked in plant health (Table 1). Interviews took place between May and June 2019. Interviews were undertaken via telephone or during face-to-face meetings.

Table 1. Number of interviewees by biosecurity area

Biosecurity area	Number
Animal Health	1.33
Aquatic Health	1.33
Plant Health	5.83
Hitchhikers	1.50
Intelligence	3.00
Innovation & Technology	1.00
Operational Research	2.00
Policy	2.00
Total	18.00

Analysis of interview data

Interviews were transcribed and analysed using the qualitative data analysis package NVivo 12 (QSR International, 2018). Interview data was coded according to a set of emerging themes. In qualitative research, coding refers to the process of identifying or 'tagging' blocks of text that convey a unique meaning across interviews (Bazeley and Jackson, 2013). Coding recontextualises data, in this case, moving the frame of analysis from the interviews to the emerging patterns or codes that link the interviews.

'Representativeness' in qualitative data[1]

Representativeness is a *quantitative* concept, primarily concerned with statistical validity and drawing on concepts from probability theory. The question of representativeness in a *qualitative* study is concerned more with the quality of the data collected, rather than the number of interview participants (Patton 1990; Morse 1994). No single interviewee can provide a complete and 'true' insight; one interview represents one subjective story, contingent upon the person's relevant social, political and cultural context. Therefore, the more interviews conducted, the broader the insights or views that can be gathered.

The frame from which interviewees were selected was purposeful, based on predetermined criteria — specifically, the degree of experience in undertaking or planning projects and research involving biosecurity science. While the data gathered from interviewees are not likely to be completely representative of all ministry staff involved in undertaking biosecurity science, it is possible to make 'logical generalisations' from the data because of the criteria applied in selecting interviewees (Patton, 1990). Essentially, the behaviours and experiences of this group is likely to illustrate behaviours of the broader group of staff.

It remains, however, to determine how many cases are adequate. Typically, sufficient interview data are collected when researchers find 'informational redundancy' or 'data saturation' — a point in data collection when no new information or themes emerge (Saumure and Given, 2008). Based on the experience and insights gained from the interviews, 18 interviews allowed establishment of a baseline for the purposes discussed above.

3.1 Insights from interviews

The interview template is given in Appendix A. The following discussion refers to question numbers from the template.

3.1.1 Knowledge distribution

Strategies for research discovery

Interviewees were asked several questions aimed at understanding their strategies for discovering key research for use in project development, from both within the ministry (Q 4a part i) and from other organisations (Q 4a part ii). The most common strategies used to discover research undertaken within the ministry were to:

- talk to other ministry staff including: in-house subject matter experts who in some cases would facilitate engagement with their networks; ministry staff whose role is to collate and facilitate operational research needs (Operational Research team now in NZ Food Safety although also responsible for biosecurity and animal welfare research procurement); or other ministry staff who might have some knowledge of past research, including senior managers;

- search Piritahi — the ministry's repository of work, including research projects — although comments about the usefulness of this in-house database to discover past research were mixed (see 3.1.2):

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[1] The following discussion on representativeness is modified from Rossiter et al. (2019).

- One staff member mentioned the existence of an excel spreadsheet in Piritahi that lists all science projects, with links to each piece of work; although the staff member was unclear about whether staff knew this resource existed.
- consult networks, including a staff member's own network, and the MPI Science network.

Other strategies used to uncover internal ministry research, each mentioned by a single interviewee, were:

- search the ministry's publications website;
- attend the annual MPI Science conference which showcases internal ministry science;
- review own records;
- attend monthly ministry Science seminars; and
- Assemble a Strategic Science Advisory Group (SSAG) containing internal and external experts who would uncover all relevant internal (and external) research relevant to the problem at hand.

Common strategies used to discover research undertaken outside the ministry were to:

- undertake web searching via Google, CABI, SciQuest and web searching of institutions that are known providers of research such as the Crown Research Institutes (CRIs), the European Food Safety Authority and National Plant Protection Organisations;
- consult networks: either the staff member's own networks or those of other ministry staff; and
- consult colleagues in collaborating institutions — most commonly mentioned were the CRIs and B3; CEBRA and NIWA[2] were each mentioned by 1 respondent.

Consulting both formal and informal networks appears to be the most common strategy for research discovery, followed by web searching for discovering non-ministry research. It is unclear from responses whether staff networks may include CEBRA personnel and whether CEBRA research outputs may be uncovered during web searches.

Awareness of past and current research

The ministry is a large organisation, and interviewees acknowledged that this can lead to difficulties in communicating relevant research activities, outputs and outcomes:

> *"There is lots of activity in silos."*

> *"There is lots of knowledge in MPI, but not always joined up."*

> *"Different directorates can learn from each other."*

> *"[It is all about] connectedness – who you know. This is risky."*

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[2] National Institute of Water and Atmospheric Research

Interviewees are effectively confirming that 'organisational silos' have developed within the ministry. These silos, often based around divisions or departments, are known to be a significant impediment to knowledge sharing when individuals in silos do not interact to share knowledge (Zyngier 2008; de Waal et al. 2019).

When asked for suggestions to improve awareness of research activities (Q4b), interviewees provided the following solutions:

- Ensure research programs have external facing information sites (discoverable by web browsers) that provide adequate descriptions of the research;

- Make use of the MPI Science Register, currently managed by the Science Skills and policy team — all projects are listed on this register;

- Undertake awareness activities via the ministry intranet (Kotahi), ministry newsletter or an email prompt;

- Increase the number of presentations about research. One suggestion was to give ministry -wide seminars and also discuss research projects at individual team meetings; and

- Modify the research development and implementation process to make beneficiaries aware of the research during each stage of the research process.

The knowledge management literature also offers 'silo-busting' solutions (de Waal et al. 2019), including the following:

- develop a "knowledge yellow pages" to map internal expertise. The yellow pages would contain profiles of employees and document their technical knowledge, experiential knowledge from previous projects, and knowledge of research or networks (see Gretsch et al. 2011), and

- identify the existing cross-silo knowledge brokers (e.g., through social network analysis) and work with these people to improve and reward more proactive knowledge sharing and 'translation' behaviours (Newell 2015). This would likely help facilitate the success of any assigned knowledge leadership role to implement cultural change (see Chapter 4).

Staff access to research outputs

Interviewees were also asked about their access to research outputs (Q4c). Many cited lack of a single repository of research as problematic. Other issues raised involved:

- Problems using Piritahi to access internal research (discussed in 3.1.2).

- Lack of access to international journals

- Lack of time to devote to the research discovery process:

    "Policy doesn't have time to bring it all together. Want this from others. [It would be] rational for Business Intel team to supply it."

Many interviewees suggested a single repository for both ministry and non-ministry work as a potential solution. Such a repository would be a 'one-stop-shop' for access to research. Additional suggestions in this vein included:

- The Business Intelligence team could supply research, with staff making requests to the team;

- Development of a catalogue system, where staff can make catalogue queries; and

- That the contents of any repository should include "failed" research and a database on symptoms of pests and diseases.

Once interviewee noted that even if such a repository were developed, awareness activities would have to be undertaken in order to make people aware of the database and new work that has been stored within it. Another interviewee acknowledged that any database would require ongoing resources to manage:

> *"MPI doesn't have an established database. Something like this could work. And it would not necessarily always work — it could become redundant. MPI would need to manage what is on there."*

The issue of maintaining a database and the resources required to undertake this task are part of a theme that emerged during the interviews around the need to modify processes, roles and responsibilities in order to improve research practice. These are discussed in under 'Barriers to research and research uptake'.

Other solutions to the problem of accessing research outputs included: paying an outside provider to do a literature review — past experience of this was viewed as 'bang for buck'; and several staff suggested the use of a knowledge broker or research leader to *"to dig into the past"*:

> *"Thought about 'knowledge broker' style of person in business navigate research, they would understand problems."*

> *"Need a coordinator, librarian, to push info out."*

> *"[MPI] Has a Chief Scientist which is good. Need someone with a role to play with research that MPI needs. A 'coordinator of knowledge'; knowing who to call on internally. Keeping connected — everyone has networks. They would piece them together. Need someone to be knowledge leader."*

Appointment of a knowledge broker, whose role is to facilitate the creation, sharing and use of knowledge, establishing and maintaining links between researchers (see Section 2.3) would be a positive step in facilitating any initiatives implemented to improve research culture, including the use of the CEBRA knowledge base.

Knowledge of CEBRA research

CEBRA (including ACERA) has undertaken 87 unique projects since its inception in March 2006. Projects relate to seven classes of biosecurity activities: *anticipate* biosecurity risk; *prevent* biosecurity risk material arriving at the border; *screen* entry pathways to detect non-compliance; *prepare* for an incursion or outbreak of pests and diseases; *detect* pest and disease incursions or outbreaks in Australia; *respond* to an incursion or outbreak of pests and diseases; and *recover* from an incursion or outbreak and adapt to new circumstances (Schneider et al. 2018). Researchers involved in undertaking projects typically prepare final reports[3] for project sponsors, the majority of which (~ 100) are freely available on CEBRA's website. In some cases, projects have also produced spreadsheet-based tools, Shiny apps and templates. Research

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[3] Reports are reviewed by at least two external experts.

outcomes are often made available to a wider audience through peer-reviewed international scientific journals.

The ministry commenced its formal collaboration with CEBRA in July 2013. During 2013-14 the ministry did not put forward its own projects due to the timing of the funding process. Rather, the ministry became a formal collaborator with DAWE in 5 projects. In the following years ministry staff led 13 CEBRA projects. The full set of these ministry projects for the period 2013-14 to 2018-19 is given in Table 2.

Interviewees were asked about their awareness of current and past CEBRA projects – specifically whether they had been a ministry lead or a team member of a CEBRA project — and to name those projects and/or any others they were aware of (Q 6c and 6d). Interviewees named 17 projects[4], two of which were not CEBRA projects *per se*, but were projects in which CEBRA had played a role, either by providing workshops or organising an expert to run a workshop (Table 2).

Other points to note about responses are:

- Three interviewees were unable to name at least one CEBRA project; of these two staff had been in the organisation for less than a year and one had been with the organisation for more than a decade;

- Of the 17 projects named, eight were ministry-led projects, six were DAWE-led projects, two were collaborations between both agencies; and two involved workshops on methodology;

- Each of the four 2017 ministry-led projects were recalled by at least one interviewee;

- All but two of the projects recalled by staff had been undertaken since the ministry joined CEBRA in 2013, and the two pre-2013 projects were recalled by a staff member who had a connection with CEBRA through previous employment;

- The most commonly recalled project (5 recalls) was CEBRA 1606A 'Development of a generic sample size tool for the importation of small seed lots', a project led by the ministry. This probably reflects the large number of interviewees (~one third) involved in plant health (Table 1).

Visibility of CEBRA

While it was unclear whether CEBRA staff were included in networks used by interviewees in the research discovery process, the level of recognition of CEBRA projects would suggest reasonable visibility of the organisation amongst ministry staff. Many staff had become familiar with CEBRA (Q 7b) through interaction with its current and past Directors, (Andrew Robinson and Mark Burgman) and through interactions with Christine Reed (the key CEBRA/ministry relationship manager) and her team. Others had become aware of CEBRA through:

- Collaborations on CEBRA projects (particularly argument mapping work);

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[4] Projects were recalled by their colloquial names, rather than by project ID or official title.

Table 2. CEBRA projects 2013/14-2018-19 in which the ministry has played a role; non- ministry projects recalled by interviewees, and the level of recall by staff of these projects

Project ID*	Project Title	Lead#	Recalls¥
CEBRA projects in which MPI has played a role			
180702	Harnessing past and new work to improve uptake and impact of best practice analysis approaches in MPI	MPI	N/A^
180601	Models for border inspection for pelleted seeds: How much assurance?	MPI	1
170618	Optimising NZ's marine surveillance programme	MPI	2
170615	Assessing ant pathways to better inform site selection for ant surveillance	MPI	1
1608F/170820	Biosecurity response decision support framework	MPI	2
1606E/170621	Proportional Value of Interventions across Pathways and Layers of New Zealand's Biosecurity System	MPI	3
1606A	Development of a generic sample size tool for the importation of small seed lots	MPI	5
1502E	Risk maps for optimising biosecurity surveillance	MPI	?
1501F	Performance Indicators for Border Compliance	DAWE	1
1404D	Using decision support tools in emergency animal disease planning and response	DAWE/MPI	0
1405E	Use of unmanned aerial vehicles for biosecurity surveillance, incursions and response	MPI	0
1405A	Ornamental fish import surveillance systems	DAWE	0
1503B 1403A	Intelligence tools for regulated goods traded via e-commerce; Intelligence gathering and analysis/IBIS	MPI DAWE/MPI	1
1402C/1502C	National-level farm demographic data for preparedness of 3 highly-infectious livestock disease epidemics	MPI	1
1402B/1502B	Tools and approaches for invasive species distribution modelling for surveillance	MPI	0
1304C	Incentives for importer choices	DAWE	1
1304A	Cost effective surveillance for FMD	DAWE	0
1301B	Analytical assessment of leakage surveys	DAWE	1
1301A	Data mining to improve biosecurity risk profiling	DAWE	0
Other CEBRA projects recalled by interviewees			
170714	Health of Australia's biosecurity system	DAWE	1
1001A/B	DAFF Biosecurity Quarantine Operations Risk-Based Approach Overview of Case Studies	DAWE	1
0606	Tools for Anticipating Potential Problems in Biosecurity Applications	DAWE	1
Methodology workshops			
various	Expert elicitation: workshops used the IDEA framework to assist with thinking around risk-return resource allocation, and as part of CEBRA 1502B	CEBRA	4
2015	Argument mapping: delivered by a third party, facilitated by CEBRA	Tim van Gelder	3

*First year of code indicates commencement year. #Lead refers to the organisation leading and funding the project. ¥Refers to the number of staff who recalled the project. ^Current project.

- CEBRA newsletter;
- Participation in the Quads;
- Biosecurity innovation exchange;
- Internal ministry information; and
- Colleagues.

Staff responses also indicated a desire for more interaction with visiting CEBRA staff:

> *"There is not enough opportunity to 'talk' to CEBRA people. [MPI] need to tell [staff] when CEBRA are coming."*

> *"Need CEBRA presentations on latest projects, needs to be open to all, to get a flavour of projects".*

That ministry staff would like more social interaction with CEBRA staff fits with evidence from the literature that people, including scientists, do not evaluate knowledge solely on the basis of objective criteria (such as quality and content) but also according to subjective criteria including attitudes and social relationships (De Araújo Burcharth & Fosfuri, 2015). The same socialisation practices that help to build organisational and group identity and affiliation are known to contribute to the "not invented here syndrome"; i.e., an unconscious bias towards internally created knowledge and the corresponding undervaluing of externally created knowledge (Katz & Allen, 1982; De Araújo Burcharth et al., 2014).

MPI staff do not appear to hold a negative attitude towards using CEBRA research, but the interviews make clear that their existing knowledge seeking behaviours have a strong social dimension and that ministry staff do not know CEBRA staff well. MPI staff currently turn to other MPI staff, their networks and the MPI repository when seeking knowledge. It is therefore likely that improving uptake of CEBRA research will involve a mix of technology-based solutions (the repository of CEBRA work) and people-based solutions (socialisation activities).

Use of CEBRA research

Interviewees were asked whether they had used any CEBRA outputs to develop projects during the original interview (Q 6d part ii) and via a follow-up email twelve-months post-interview. Of the 18 interviewees:

- Three gave examples of where ministry projects had built upon outcomes of previously completed CEBRA projects:
    - CEBRA 170615 'Assessing ant pathways to better inform site selection for ant surveillance' has changed the site selection criteria for the Ant surveillance system;
    - various outputs had been used in setting Import Health Standards.

- o The department's Risk Return Risk Allocation (RRRA) project[5] was the kernel for CEBRA 1606E/170820 'Proportional value of interventions across pathways and layers of New Zealand's biosecurity system';

- o A new ministry Operations Research project builds upon CEBRA's project on visual inspection;

- o Methodology from CEBRA's expert elicitation workshops are being used in CEBRA 170621 and a ministry-B3 project on high priority organisms;

- o Argument mapping (delivered by a third-party) is being used within the ministry to write Import Risk Assessments and also in the risk management proposals that give the rationale underlying decisions in the Plant Import Health Standards;

- Four staff named projects they hoped, or felt certain, would lead to changes in ministry practice:

- o CEBRA 170618 'Optimising NZ's marine surveillance programme';

- o CEBRA 170714 'Health of Australia's biosecurity system' (not yet completed at the time of interview);

- o CEBRA 1606A 'Development of a generic sample size tool for the importation of small seed lots';

- o Expert elicitation (workshops).

- Eleven had not used any CEBRA outputs to develop projects.

That a much larger proportion of interviewees were able to recall at least one CEBRA project compared to the proportion who stated they had used CEBRA outputs in developing projects may indicate a problem with knowledge application. Since only a few interviewees volunteered further information about why they hadn't used CEBRA outputs in project development or to improve some aspect of biosecurity science, interviewees were sent a follow-up question via email, requesting more information about their use (or lack thereof) of CEBRA outputs. Responses from the original interviews and follow-up email indicating the following issues in using CEBRA outputs:

- Lack of suitable expertise to interpret research findings and implement in an operational environment. Several operational areas had reported this issue to one interviewee. As a result, plans are in place to provide the advice required to bridge the science/operational interface and ensure the research outcomes are utilised.

- Several interviewees stated that their role was to ensure the evidence generated from projects funded from the Ops Research Programme (rather than by CEBRA) were used to develop standards or make policy changes. These staff also noted the lag between completion of projects and uptake of research:

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[5] CEBRA provided some expert elicitation workshops to ministry staff as part of DAWE's internal RRRA project.

> *"We are in a similar situation as we need to measure the impacts of our projects too. One of the main challenges we find is that we need to regularly follow up with our stakeholders to see what they have done with the outputs. It can take a great deal of time before any changes are implemented to policy due to the findings of a research project".*

- One interviewee felt that CEBRA project reports were not an easily accessible research output and may be of variable quality and not succinct. That particular interviewee only used information from peer-reviewed journal articles in research.

- Several interviewees indicated there was a lack of time to devote to research activities; this is explored below.

Improving application of CEBRA research is likely to be solved through a mix of regular awareness activities; re- allocation and revaluation of staff time, and modifications to processes.

Barriers to research and research uptake

Interviewee responses to many questions indicated emerging themes around research culture that are likely to impinge on the ability of many staff to undertake effective research. These include: time pressures; a perceived lack of support from 'the top' for key research activities such as conferences; communication issues and problems caused when key staff leave:

- Staff in a number of biosecurity areas discussed time pressures they faced, and that this affected the time available to undertake research activities, including searching for, and using, CEBRA research:

    > *"First priority is business-as-usual — import requirements."*

    > *"CEBRA call for projects, but 'urgent' trumps 'important'."*

    > *"To be honest, research is at the bottom of the list because there are so many other things to get their heads around."*

    > *"I'm struggling to keep track of the work that is going on, just because the team is pretty busy. So picking up anything new is difficult."*

- Several staff also reported their perceptions of negative attitudes to research activities, particularly conferences, held by top-level management:

    > *"They send people to conferences, but conferences are not perceived as useful by managers/the system. These are perceived differently to the trade meetings ie. conferences are seen as personal development, networks are developed".*

    Travel to conferences has also been affected by changes to the approval process for international travel:

    > *"From the top level there has been push-back about international travel. Only 1 person from MPI can attend 1 event. Need to find out who this person is. To arrange travel you need to contact managers before and after, but they are very busy. Approval*

> *requires sign off by 2 DDGs and DG. The DG has the final say.*
> *Not sure if they log [the events]. Have to have 12 months' notice."*

- As previously detailed, several interviewees acknowledged that the size of the ministry can lead to difficulties in communicating relevant research activities, outputs and outcomes across the organisation. This is compounded by frustrations with *Piritahi* — a repository of ministry research outcomes and outputs (see 3.1.2).

- Several interviewees reported the problems faced by the ministry from the loss of experienced staff:

> *"When people leave, knowledge goes with them."*

> *"Fisheries: all the people who set up the quota management system have retired. Could implement, but no info on design. People's knowledge was lost."*

On a positive note, several staff were supportive of the recent appointment of a Departmental Science Advisor. The appointment was seen as a way of reducing bureaucracy and of improving the visibility of science:

> *"Issue is how do we get messages across to managers and quickly? Now have a Departmental Science Advisor, John Roche, from Dairy NZ. He reports directly to the DG."*

Staff have revealed some aspects of the ministry's research culture that may inhibit improvement in future knowledge management. As previously mentioned (Section 2.3), top-level management support and leadership is critical to developing and implementing a strong knowledge culture. Staff are supportive of the Departmental Science Advisor, and the Chief Scientist as conduits for research. Theory would suggest that initiatives and leadership of these individuals will still rely on the support of top-level management if research culture is to improve and thrive in the ministry (see section 2.3).

3.1.2   Knowledge storage

An effective knowledge management system requires that research outputs — documents, reports, code, templates etc — be stored in a way that allows retrieval and use by other employees. While no interview questions focused specifically on existing knowledge storage platforms and processes, the interviews provided useful insights into *Piritahi*, the ministry's repository of work, including research projects. Piritahi was used by a large number of staff in the research discovery process, with mixed success. While there was acknowledgement that the database was an extensive resource:

> *"It can be quite powerful if searched properly. You need time to search."*

there was much frustration with the searching process:

> *"Piritahi can get cluncky"* and *"Piritahi is a black hole."*

> *"Could look in Piritahi and try to find research. Current research is easy to find, but it is difficult to find old projects. It is critical to have the right keywords. IRAs are all in there. Not sure what gets missed with searching."*

> *"Piritahi has a better searching capacity but has heaps of info. Staff have got better at searching it."*

> *"Have tried a lot of things over the years. Internal research is in Piritahi. I used to be able to find things, not so now. It you know the exact title of the work in Piritahi, then it's ok."*

> *"Data would be in Piritahi, but Piritahi doesn't work with all software."*

and some uncertainty expressed by staff about the proper use of Piritahi, particularly in terms of what should be filed:

> *"This work was filed in Piritahi, but filing of this wasn't mandatory. Not sure what is mandatory."*

> *"Piritahi is a free [text] classification system. It can be a 'dumping ground'. Only new staff have adopted its use quickly. 'Older' staff not so much."*

> *"There had been a policy that web-based info couldn't remain on the website if it was > 3 years old. This policy may have changed recently."*

> *"It's hard to get metadata right. Not everybody is disciplined with use of Piritahi."*

Apart from insights into Piritahi, staff responses would also suggest that clear instructions need to be provided around what is collated in the CEBRA knowledge base and how searching should be undertaken.

3.1.3 Summary

The interview questions were designed to elicit a broad understanding of knowledge management practices in the ministry, particularly in respect to CEBRA outputs and the visibility of CEBRA in general. Analysis of interviews showed that while there is a reasonable level of awareness of CEBRA's outputs, very few interviewees had used any CEBRA outputs in new projects. Interviewees expressed a desire to have more social interaction with CEBRA staff, and the literature suggests that increased social interaction would likely result in greater use of CEBRA outputs.

Analysis of interviews also provided useful general insights into the research culture in the ministry, including that: organisational silos have developed; time-pressures on staff result in less time to devote to research; there is a perceived lack of support for research activities from higher levels of management; and there is frustration with the ministry's repository of outputs. These issues appear to be hindering the ability of many staff to undertake effective research, including research that involves the use of CEBRA outputs.

Given the insights into research culture and knowledge management at the ministry it is clear that a repository of CEBRA outputs will not necessarily improve research outcomes for either organisation. Use of the repository will need to be enabled via changes to research culture in general. This is addressed further in the following chapters.

4   CEBRA knowledge base

The need for an easily accessible database of CEBRA outputs had been identified for a range of reasons, including the hope that improved accessibility of outputs would result in improved uptake by ministry staff. For databases to be effective, users need to intuitively access stored knowledge and the database itself needs to be organised, reliable and easy to navigate (Conway 2003). The interview process and review of the knowledge management literature were used to inform and refine database design and evaluation.

CEBRA outputs — technical reports, journal articles, tools, apps — were assembled and developed into an online searchable database during 2018 and 2019. The database is Chapter 2 of *Overview of ACERA/CEBRA Projects* (Arndt et al. n.d.), and appears as a clickable option when a user browses online using the search term 'CEBRA', or via https://overview.cebra.unimelb.edu.au/ (Figure 2). The whole website was generated from an R Markdown[6] document. The database of CEBRA outputs is constructed as a fully-searchable table, created using Datatable[7], a platform chosen for its simplicity and filtering/searching functionality.

Once the searchable database is selected, users are able to search by author, year, topic, keyword, project code etc. Searching will reveal relevant project reports, journal

Figure 2. Screenshot of the searchable database.

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articles and tools, and users are provided with a link to the document/s (Figure 2). Search phrases (case insensitive) may be enclosed in quotes in order to match them exactly. Otherwise multiple, unquoted terms, will identify documents that include *all* those terms (i.e. equivalent to a Boolean AND search). Hidden columns, including the abstract (where available), are also searched.

Allowing searching via keywords is important because interviews revealed that ministry staff were not very familiar with many CEBRA projects and/or authors. Adding keywords to each output is an ongoing process — not all outputs on the database were matched with keywords at time of publication. Further updates to the database itself will be added, refined and improved over time as additional outputs become available and as use of the database is evaluated (see 4.2).

Interviewees reported a lack of time to devote to research discovery, and suggested a single repository for both ministry and non-ministry work as a potential solution. The database developed in this project provides a one-stop-shop for completed CEBRA research. As such it provides utility for individual researchers to locate outputs, or for teams within the ministry (e.g. the Business Intelligence team) to compile a portfolio of completed research on a particular theme if requested — one suggestion for saving time in the research discovery process. The search process itself is straight-forward, simple and intuitive which should be favoured by time-poor staff.

After some initial testing with a small group of ministry staff, the database was publicised to whole of the ministry during November 2020, via an email alert containing a 'campaign link' to the database (Figure 3). If staff access the database via the campaign link, rather than accessing it via the CEBRA homepage, ministry usage will be distinguishable from usage by others in NZ. This information will be used to evaluate usage of the database over time (see 4.3).

Searchable database of CEBRA outputs now available

For more than a decade the Centre of Excellence for Biosecurity Risk Analysis (CEBRA) and its predecessor ACERA (Australian Centre of Excellence for Biosecurity Risk Analysis) have been undertaking research on biosecurity problems spanning a vast array of regulatory activities, reflecting the responsibilities of its funding agencies (Australia's Department of Agriculture and Water Resources (now DAWE) and NZ MPI).

You can now click here to search a comprehensive database of CEBRA/ACERA research output, including articles published in peer-reviewed journals, books and book chapters, software, and technical reports. You can search on author, key words, type of publication or area of biosecurity. This is a huge step forward in making CEBRA outputs more accessible to MPI, DAWE and other scientists. Well done to the CEBRA team

Please feel free to share the link

Figure 3. Information about the CEBRA searchable database sent via an email alert.

4.1   Realising benefits from the CEBRA knowledge base

The searchable knowledge base cannot in and of itself lead to an increase in knowledge reuse. Codifying knowledge from a trusted external source and improving its visibility is not sufficient to improve its uptake. This is because people do not evaluate knowledge solely on the basis of objective criteria (such as quality and content) but also according to subjective criteria including attitudes and social relationships. This subjectivity in evaluating knowledge has been found to apply even in the case of scientists (De Araújo Burcharth & Fosfuri, 2015). It follows from interview findings that making the new CEBRA knowledge base available, publicising it and encouraging its use needs to be complemented by socialisation initiatives designed to better connect the ministry and CEBRA staff. It is a well-established principle that effective knowledge management requires hybrid solutions involving people and technology (Davenport, 1997) — if project outcomes are to be realised, then processes need to be established that enable the use of the database as intended.

The project's business case lists several anticipated outcomes as a result of ministry staff having access to a searchable database of CEBRA outputs:

- the efficient capture and dissemination of existing information on methodologies, impact, adoption and engagement activities that occur directly and indirectly as a result of CEBRA projects;

- the efficient development of new projects; and

- an ability for ministry decision-makers to understand 'return on investment' in CEBRA projects.

Both CEBRA and the ministry play a role in ensuring these outcomes are realised — CEBRA is largely responsible for the knowledge acquisition and storage aspects of the database; while the ministry plays a central role in the knowledge distribution and application aspects of the database. **Both organisations must embed tasks related to these responsibilities into 'business as usual' processes.**

In order for this to occur, the following recommendations are made:

- CEBRA's project 'endorsement' process should be modified to include:

  o Automatic uploading of all relevant project outputs onto the searchable database.

  o An email to key ministry research network/s (e.g. the MPI Science Network) alerting members to the CEBRA output and the existing campaign link to access the database. This alert should be sent via a ministry research leader or knowledge broker.

- Ministry processes for the development of biosecurity-focused projects should be modified to require searching of the CEBRA knowledge database to understand existing methodologies and outputs

- Research leaders in the ministry should play a role in facilitating the use of the CEBRA knowledge base. This could entail:

  o Identification of biosecurity research leaders and subsequent CEBRA-led contact with those individuals or groups.

- o CEBRA research staff should be in semi-regular contact with ministry knowledge brokers and research leaders for all projects, including those funded by DAWE.

- o Creating social initiatives that better link key "knowers" and knowledge brokers across the boundaries of the ministry and CEBRA.

- o Stimulating the "demand-side" of the repository (demand for knowledge in the CEBRA repository) from within the ministry via a requirement for more-thorough reporting on the use of the CEBRA knowledge base:

  - Development of a methodology to formally record i) the use of CEBRA outputs in the development of new projects or ii) changes to the NZ biosecurity system from adoption of CEBRA project outputs/outcomes. This would also allow the ministry and CEBRA understand research impact.

- o Providing incentives for ministry staff to annotate CEBRA project report records with summaries on how the relevant CEBRA knowledge has been re-used and adapted by the ministry, with links to relevant work. The idea that organisations can encourage knowledge sharing via incentives (inducements for individuals to take actions that they would otherwise not consider) is widely accepted (Newell, 2015).

4.2 Refining the database

The recently compiled database provides the basis for ministry staff to understand the range of CEBRA outputs. While the knowledge base cannot address all the user needs and barriers identified in the interviews, it will continue to evolve as needs of users, including those in the ministry, are further understood. The database will be updated as current and future CEBRA projects are completed, and it will be refined and improved over time as use of the database is evaluated (see 4.3). In the interim there are several planned improvements to the database, based on interview findings:

- Inclusion of additional project-related outputs, including conference presentations (slides), workshop summaries, templates and meeting notes.

- Inclusion of short, 'plain-language' summaries for major project outputs (final reports).

- Completion of keyword additions for existing outputs.

- Investigate the ability for users to 'subscribe' or receive notifications if new, related research is uploaded.

4.3 Evaluating the database

Evaluation of the database should be ongoing, with both the ministry and CEBRA sharing this responsibility The project's business case suggested several ways to measure the anticipated impacts of the CEBRA Knowledge base (listed in 4.1) and we recommend that these remain as metrics:

- Online surveys or face-to-face interviews of research staff at regular intervals to understand usage, gaps in the database and general feedback.

- Monitoring database access over time. This should occur using the ministry's campaign link — this link was accessed 79 times in the week following initial publicity (Figure 4).

- Monitoring the uploading of new outputs and capturing of adoption activities (timeliness, quality of information)

- Feedback from decisionmakers and research leaders who are required to report return on investment in CEBRA projects
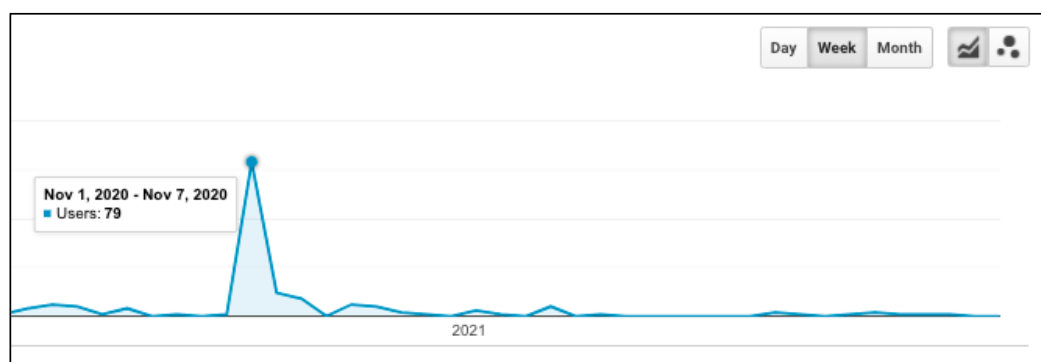
Figure 4. Use of the campaign link following initial publicity during early November 2020.

4.4 Summary

The genesis for this project was a sense that the ministry wasn't capitalising fully on its investment in CEBRA — that there remained significant scope to use methodologies and outputs from earlier CEBRA projects to solve additional biosecurity problems and thus for the ministry to benefit further from its investment.

Interviews with ministry staff were undertaken to understand more about awareness and use of CEBRA research, methods used by staff to accessing research more generally, and to inform the development of a readily accessible repository of CEBRA research. As part of this process insights were also gained into the contemporary research culture at the ministry.

Interviewee responses to many questions indicated emerging themes around research culture that are likely to impinge on the ability of many staff to undertake effective research, including finding, reviewing and using CEBRA research outputs. These included: time pressures; a perceived lack of support from 'the top' for key research activities such as conferences; communication issues and problems caused when key staff leave.

The CEBRA knowledge base was developed to assist research users within the ministry and elsewhere to access CEBRA research – time poor staff would be able to use the database to access all past CEBRA project outputs easily and logically. Proposed adjustments to CEBRA and ministry process, once adopted, should keep the database updated and in front-of-mind for ministry research staff. Those interested in return on investment metrics should also be able to use the database to improve their understanding of how CEBRA research has led to improvements in the NZ biosecurity system.

It is to be expected, however, that development of a new knowledge base cannot address all the user needs and barriers identified — this is in line with much research that shows

limitations of codification approach to knowledge sharing and reuse. While the database could be viewed as an enabler to improve 'knowledge culture' at the ministry, it does not remove all barriers to research and research uptake at the ministry. Importantly, there still remains a need for top-level management support and leadership in the development of a strong knowledge culture, as previously discussed. Some of the recommendations (Section 5) address this barrier. Recommendations for 'socialisation of research' are intended to reduce the unconscious bias towards internally created knowledge that also emerged from the interviews.

5 Conclusions and Recommendations

The impetus for the current project was the view by key research staff in the ministry that the organisation had not yet fully capitalised on the research outputs and outcomes of CEBRA (and its predecessor ACERA) despite a 7-year relationship between the two organisations. The main objective of the current project was thus to develop a 'mechanism' that would result in a tangible repository of CEBRA research projects, their outcomes and impacts — a CEBRA knowledge base. The repository would therefore become key to ministry staff understanding the depth and breadth of CEBRA outputs. It is hoped that the repository will, in turn, lead to the efficient development of new projects — new biosecurity research within the ministry would leverage off completed projects — and to implementation of biosecurity practices if relevant. It would also assist the ministry in understanding the value gained from its financial contribution to CEBRA.

The project thus focused on knowledge management, a discipline which builds on theoretical foundations from a wide range of disciplines related to management and organisational design. Insights from the knowledge management literature and semi-structure interviews with staff were used to understand the current use of CEBRA research, research culture at the ministry, refinements to the research repository, and recommendations for improving knowledge management in the future.

As this project was nearing completion the ministry embarked on an overhaul of its research practices and processes. One notable change has been the creation of the Biosecurity Science and Technology Research Committee, consisting of Directors of the ministry's various divisions. This committee is ideally placed to implement the recommendations outlined in this report and to pursue positive changes in the ministry's research and knowledge culture, as outlined in this report.

1. Improving knowledge culture within the ministry

Whether the ministry is able to capitalise on its relationship with CEBRA, and benefit from its research repository, will rely fundamentally on the former's knowledge culture — the prevailing values and beliefs within the ministry that will either promote or hinder its capacity for creating sharing and implementing knowledge. **Top-level management support and leadership is also critical to this process, and the ministry's knowledge culture in general**. Staff interviews gave examples of impediments regarding knowledge culture and management along with useful suggestions for how these could be removed. These would be supported by the knowledge management literature. In line with these insights we recommend that:

- Existing knowledge brokers be identified, their roles as research leaders be acknowledge and processes established that allow these individuals to:
    - improve the values and beliefs around research,
    - promote the ministry's capacity for creating, sharing and implementing knowledge,
    - establish and maintain links between researchers.

    These roles would be complementary to the roles currently undertaken by the Chief Scientist and Departmental Science Advisor.

We note that a single knowledge broker is unlikely to succeed in enabling the transformation of research values and beliefs without complementary initiatives to

foster improvements in knowledge culture. To this end we are recommending multiple knowledge brokers be appointed (as above) and adoption of the following initiatives to promote a knowledge culture:

- appoint an 'executive sponsor' who has overall responsibility for improving knowledge culture in the ministry, with periodic review of key knowledge culture metrics.
- develop a knowledge 'yellow pages' containing profiles of employees and documenting their technical knowledge, experiential knowledge from previous projects, knowledge of research or networks (for further information and examples see Gretsch et al. 2011), and
- set up social initiatives and incentives to foster knowledge sharing, not only within the ministry but also between the ministry and CEBRA.

2. Realising the benefits of the CEBRA knowledge base

The repository of CEBRA research is now publicly available and was initially publicised within the ministry via an email alert containing a link to the web site. **The searchable knowledge base cannot in and of itself lead to an increase in knowledge reuse**. Processes need to be established that enable the use of the database as intended. Both CEBRA and the ministry have a role to play in embedding use of the repository into business-as-usual practices — CEBRA is largely responsible for the "supply-side" aspects of the database and the ministry is largely responsible for those on the "demand-side". To enable both to function properly, the following recommendations are made:

- CEBRA's project 'endorsement' process should be modified to include:

    o Automatic uploading of all relevant project outputs onto the searchable database.

    o An email to key ministry research network/s (e.g. the MPI Science Network) alerting members to the CEBRA output and the existing campaign link to access the database. This alert should be sent via a ministry research leader or knowledge broker.

- Ministry processes for the development of biosecurity-focused projects should be modified to require searching of the CEBRA knowledge database to understand existing methodologies and outputs

- Knowledge brokers and research leaders in the ministry should play a role in stimulating the demand for the information contained in CEBRA knowledge base ministry via a requirement for more-thorough reporting on the use of the CEBRA knowledge base. This would entail:

    o Development of a methodology to formally record i) the use of CEBRA outputs in the development of new projects or ii) changes to the NZ biosecurity system from adoption of CEBRA project outputs/outcomes. These could occur as quarterly reminders via the ministry's Grant Management System (see also Recommendation 5).

    o Ensuring CEBRA research staff are in semi-regular contact with ministry knowledge brokers and research leaders regarding all projects, including those funded by DAWE.

    o Creating social initiatives that better link key "knowers" and knowledge brokers across the boundaries of the ministry and CEBRA.

       o Providing incentives for ministry staff to annotate CEBRA project report records with summaries on how the relevant CEBRA knowledge has been re-used and adapted by the ministry, with links to relevant work.

3. Measuring the value of CEBRA research

One of the objectives of this project was to use the repository of research to understand the ministry's return on investment in CEBRA research. In order to achieve this objective, information on adoption of outcomes will be required. This would involve recording instances where research outcomes led to an improved biosecurity practice or to the development of a new project. If adopted, initiatives suggested in Recommendation 2 will make this information available. It is envisaged that this additional recording could be undertaken using the ministry's existing Grant Management System (GMS).

To reiterate, we recommend that automated quarterly reminders flow to CEBRA project leaders (past and present) within the ministry requesting the following information:

- Progress with implementing recommendations from past CEBRA projects.

- Details of changes to ministry policies or practices that were made as a direct result of a particular CEBRA project:

  o nature of the change

  o date implemented

  o details of benefits, including dollar values

  o name of CEBRA project

  o details of related documentation

4. Monitoring use of the CEBRA knowledge base

In order to understand the use of the repository we recommend that:

- the repository is publicised on a regular basis. We suggest at least every 3 months or as new CEBRA research is completed (is endorsed and thus publicly available).

- the use of the repository be periodically analysed using data provided by Google Analytics.

5. Visibility of CEBRA and connecting with CEBRA experts

Staff responses to interview questions indicated a desire for more interaction with visiting CEBRA staff and a lack of awareness about many of CEBRA's projects. Interview responses also showed ministry staff turn to their professional networks when seeking knowledge. This behaviour can be capitalised on by extending the ministry's social networks to reach key CEBRA knowledge brokers. Additional engagement with CEBRA staff would likely i) improve the visibility of CEBRA projects and ii) play a part in improving uptake of CEBRA research outputs and iii) improve the development of new ministry projects. The widespread use of online meeting platforms during the recent COVID19 outbreak has opened up significant scope for more engagement between ministry and CEBRA staff.

In order to increase interaction between ministry and CEBRA staff and awareness about projects we recommend that:

- 'Exit' seminars be held upon completion of each CEBRA project, and that staff from the ministry and the department be invited to attend via online platforms where face-to-face meetings aren't possible;

- CEBRA continues to facilitate regular online meetings (these occurred during the CEBRA rebid process) where current CEBRA projects are discussed among ministry and departmental research leaders.

- CEBRA staff provide regular 'news items' about past, current and future projects, for distribution to ministry staff via its regular online news bulletins. These would include points of contact in CEBRA.

- The development of an inter-organisational professional social network based around communities of interest.

- Opportunities be created for ministry staff to showcase CEBRA knowledge reuse to CEBRA staff.

These initiatives would be facilitated by ministry knowledge brokers with the assistance of CEBRA research leaders.

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Appendix A: Interview template

The purpose of the interviews is to understand how staff currently use research outputs from MPI projects and from external organisations. Staff responses will be used to improve 'knowledge management' at MPI.

General questions about interviewee (NAME)

1. What is your current role in MPI?

2. What are the key responsibilities of this role?

3. How long have you been in this role?

Questions related to MPI staff member's use of 'knowledge' in project development

4. Are you involved in *identifying* (developing) new research projects? [**Yes/No**][*if no, go to Q 5*]

   [*If yes*]:

   a. When you identify and develop new projects, what do you do to ensure that you, or your staff, are aware of relevant research that:

      i. may have been undertaken by MPI?

      ii. may have been undertaken by other organisations?

   b. Do you have any suggestions for ways to improve the awareness amongst scientific staff about the research you have undertaken or are currently undertaking?

   c. Do you have any suggestions for ways to make it easier for staff to access relevant research in future, related to identifying and developing new projects?

Questions related to MPI staff member's dissemination of 'knowledge' from completed projects

5. Are you ever involved in *undertaking* research projects? [**Yes/No**]

   [*if yes]:*

   a. Once a project is completed, do you make sure the results and/or outputs are known throughout MPI, or to a wider audience? [**Yes/No**]

      [*if yes*]: how do you do this?

      i. Within MPI?

      ii. Outside MPI? [e.g. which organisations or fora; through which media]?

      [*if no]*: Why not?

   b. Do you regularly remind MPI staff of the project results? [**Yes/No**]

      [*if yes*]: how often and over what period of time would dissemination continue?

   c. Do you formally record the uptake of research findings from MPI projects? [**Yes/No**]

[*if yes]: How?*

[*if no]:* Why not?

New Staff

6. Do you have a process for bringing new staff 'up-to-speed' with past and current research relevant to their position? [if yes, please describe].

Questions related to CEBRA:

7. Have you heard of CEBRA (Centre of Excellence for Biosecurity Risk Analysis)? **[Yes/No]**

[*If yes*]:

    a. How do you know about CEBRA [e.g. other MPI staff, newsletters, Kotahi; Other]?

    b. Can you briefly describe what you know about the organisation?

    c. Have you been an MPI lead in a CEBRA project or part of a project team? [**Yes/No**]

        [If yes]:

            i. Which projects?

    d. Are you aware of any other current or past CEBRA projects or CEBRA outputs? [**Yes/No**]

        [*If yes*]:

            i. Which ones?

            ii. Have you used any CEBRA outputs to develop projects? [**Yes/No**] [*if yes*] Provide details

[*If no*]:

CEBRA, based at the University of Melbourne, provides innovative, effective and practical research in risk analysis to address the biosecurity challenges facing Australia and New Zealand. MPI, along with Australia's DAWR provide funding for CEBRA.

CEBRA projects are focused on three themes:

1. strengthening surveillance
2. building scientific capabilities
3. data and information

A large range outputs (reports, code, apps) has been developed by CEBRA and these are publically available on the CEBRA website: https://cebra.unimelb.edu.au/home

Final comments:

8. Are there any other comments you would like to make about how research outputs are currently used in MPI, or could potentially be used in MPI, to improve likelihood of adoption?