

Managing Information and Data for a More Resilient New Zealand

The Data Integration and Visualisation En Masse (DIVE) Platform: Lessons Learned and Future Pathways

March 2019

Becca Fraser
Joanne R. Stevenson
Elora Kay

About the Authors

Becca Fraser is a master's student at the University of Canterbury and lead research assistant for the DIVE Uptake Enhancement Project.

Dr Joanne R. Stevenson is a Principal Consultant with Resilient Organisations Ltd.

Elora Kay (ellie.kay@resorgs.org.nz) is a Research Consultant with Resilient Organisations Ltd and corresponding author for this report.

Acknowledgements

This work has been funded by the Ministry of Business Innovation and Employment through the Resilience to Nature's Challenges Kia manawaroa – Ngā Ākina o Te Ao Tūroa. Development of the DIVE Platform was also supported by the Tertiary Education Commission through the Centre of Earthquake Resilience (QuakeCoRE).

We would also like to thank all of the people who generously donated their time and expertise to surveys, workshops, interviews, and many in-person and emailed conversations at every phase of this project.

Table of Contents

<i>Overview</i>	1
<i>DIVE Programme Review</i>	2
Uptake Enhancement Project	3
<i>Uptake Enhancement Results and Discussion</i>	6
Uptake Enhancement Project Conclusion	7
<i>Future Development Pathways</i>	8
Resilience Hub	8
Resilience Information Network	11
Ad Hoc Partnerships	11
Status Quo	12
<i>Conclusion</i>	12
<i>References</i>	14
<i>Additional Reading & Resources</i>	16
<i>Appendix A: Methods to increase engagement with the DIVE programme</i>	17
<i>Appendix B: Results of the Data Management Systems Review</i>	21

Overview

The Data Integration and Visualisation En Masse (DIVE) pilot project was funded by the NZ Centre for Earthquake Resilience (QuakeCoRE) and the Resilience to Nature's Challenges (RNC) National Science Challenge – Kia manawaroa – Nā Ākina o Te Ao Tūroa, to improve researchers' ability to address complex social problems, enabling New Zealand to become more resilient through data sharing, improved access to public data sources, and the analysis and visualisation of integrated data sets. The pilot project consisted of an initial consultation phase (a survey of researchers and research stakeholders and a series of workshops), the development and testing of a beta version of a web-based open data catalogue for disaster risk reduction (DRR) and resilience research and information, and an uptake enhancement project (Figure 1).



Figure 1 DIVE development timeline.

The consultation phase of the project provided an assessment of the data and data management needs of New Zealand DRR and resilience research stakeholders (more on the consultation workshops and their outputs can be found in Stevenson et al. (2016), Stevenson & Vargo (2016), and Stevenson et al. (2017)). The workshops established the research stakeholder needs and facilitated the development of use cases for a DRR and resilience information management system, which then served as the foundation for a small project to develop the web-based NZ Resilience DIVE Platform. A beta version of the DIVE platform was launched in June 2018¹ to assess the ability of an open metadata catalogue to help unify New Zealand's disjointed landscape of disaster risk reduction (DRR) and resilience information. Researchers from QuakeCoRE and RNC were invited to catalogue,

¹ The web-based DIVE Platform was available at <https://resiliencedata.org.nz/> between June 2018 and March 2019 and provided metadata cataloguing and a limited data repository for research and information relevant to disaster risk reduction (DRR) and resilience in New Zealand.

discover, share, and use DRR and resilience data on the platform with the aim of improving resilience-related decision-making, enhancing problem-solving, and innovation.

While the web-based DIVE Platform could meet the demand for data cataloguing and improving metadata capture, incentivising stakeholders to engage with the platform and use its capabilities was challenging. The uptake enhancement phase of the project showed two major barriers to engagement with the DIVE Platform: inadequate incentives for use and concerns about the lack of longevity of the platform. Funding for the DIVE pilot project has now finished, and this report offers a final reflection on the lessons learned from the development and implementation of the DIVE Platform, and an exploration of future development pathways for collaborative management of DRR and resilience information in New Zealand.

DIVE Programme Review

Making New Zealand more resilient requires a huge multidisciplinary effort and, associated with this, effective information management to ensure that the work being done is efficient and relevant. Formed, in part, as a response to the growing output of resilience and disaster information spurred by the funding of the large transdisciplinary, multi-institutional research programmes QuakeCoRE and RNC, the DIVE Platform pilot project aimed to help researchers make better use of New Zealand's disaster risk and resilience data.

The consultation phase of the DIVE pilot project conducted with DRR and resilience researchers, data users, and agencies that hold or manage relevant data, highlighted a range of stakeholder needs (Figure 2).² Needs expressed by participants in the survey and workshops included the establishment of a forum where researchers could share their datasets with a broad range of research stakeholders, and the need to support decision making with an integrated information infrastructure allowing input from researchers and even 'citizen scientists' (Figure 2). Once the needs were established, the DIVE Platform received a small amount of additional funding to develop a working prototype of the web-based platform.

Catalyst Net Ltd was contracted to develop the web-based DIVE interface on a CKAN platform. CKAN is an open source data platform with tools to streamline publishing, sharing, finding, and using data. In its most basic form, CKAN acts as a data federation portal and catalogue. It also has several built-in tools for exploring and understanding data. CKAN is used by data.govt.nz and DigitalNZ, which created the opportunity for DIVE to be integrated into a federated network of data portals sharing data between each other.

² The methodology, results, and associated outputs of the consultation phase of the DIVE project are extensively documented and references are available in the Additional Reading and Resources section of this report.

The initial scope of the development work included creating a metadata catalogue, federated search, and data harvesting capabilities, along with trialling applications on the CKAN platform allowing enhanced data integration and visualisation of multiple datasets. Once development commenced, however, Catalyst Net Ltd. found that the budget was only sufficient for the development of the basic web-interface, metadata catalogue, data repository, and inbuilt CKAN features such as the capacity to establish working groups and organisations. As a result, the DIVE Platform web-interface was only able to deliver a limited number of the stakeholder needs identified in the early consultation phase (Figure 2).

Despite its limitations, the DIVE Platform offered the only designated location for information about DRR and resilience research and data in New Zealand. As part of the metadata intake process, DIVE used validation and required fields to ensure metadata quality, increasing the usability of information entered on the platform. It also hosted a small collection of data literacy aids, including a series of videos and a booklet to help people create effective metadata.

The DIVE Platform was launched in June 2018. Researchers across QuakeCoRE and the RNC were notified of the launch via email, newsletter, and social media channels and asked to contribute descriptions of their research, publications, or datasets. The project team also presented the DIVE Platform in a webinar with QuakeCoRE Researchers, a short article in the *Australasian Journal of Disaster and Trauma Studies* (Stevenson et al., 2018), and in a presentation and paper at the ISCRAM Asia Pacific Innovating for Resilience conference (Kay et al. 2018, Stevenson et al. 2018). Only four metadata records were added to the DIVE Platform as a result of this outreach campaign. The project team added seven more records for a total of 11 entries on the platform between June 2018 and December 2018.

Uptake Enhancement Project

In the hopes of achieving critical mass and to gain a better understanding of the barriers to engagement, the research team initiated the Uptake Enhancement (UE) Project. In December 2018, a research assistant was contracted to foster further engagement with DIVE. The UE Project consisted of three parts. The first part was an outreach campaign to contact researchers within the RNC programmes, QuakeCoRE, and other interested stakeholders to sell the concept of DIVE and guide them through the process of entering metadata and engaging with the platform. In the second part of the project, the research assistant interviewed a small number of DRR and resilience data stakeholders to gain additional perspective on the issues that may be relevant to DIVE uptake and future development. The final stage included a review of systems offering DRR and resilience information management capacity, and that may serve as alternate systems for New Zealand researchers once the DIVE programme was completed³.

³ Methods of engagement are outlined in Appendix A in more detail and the results of the alternative programme evaluation are included in Appendix B.

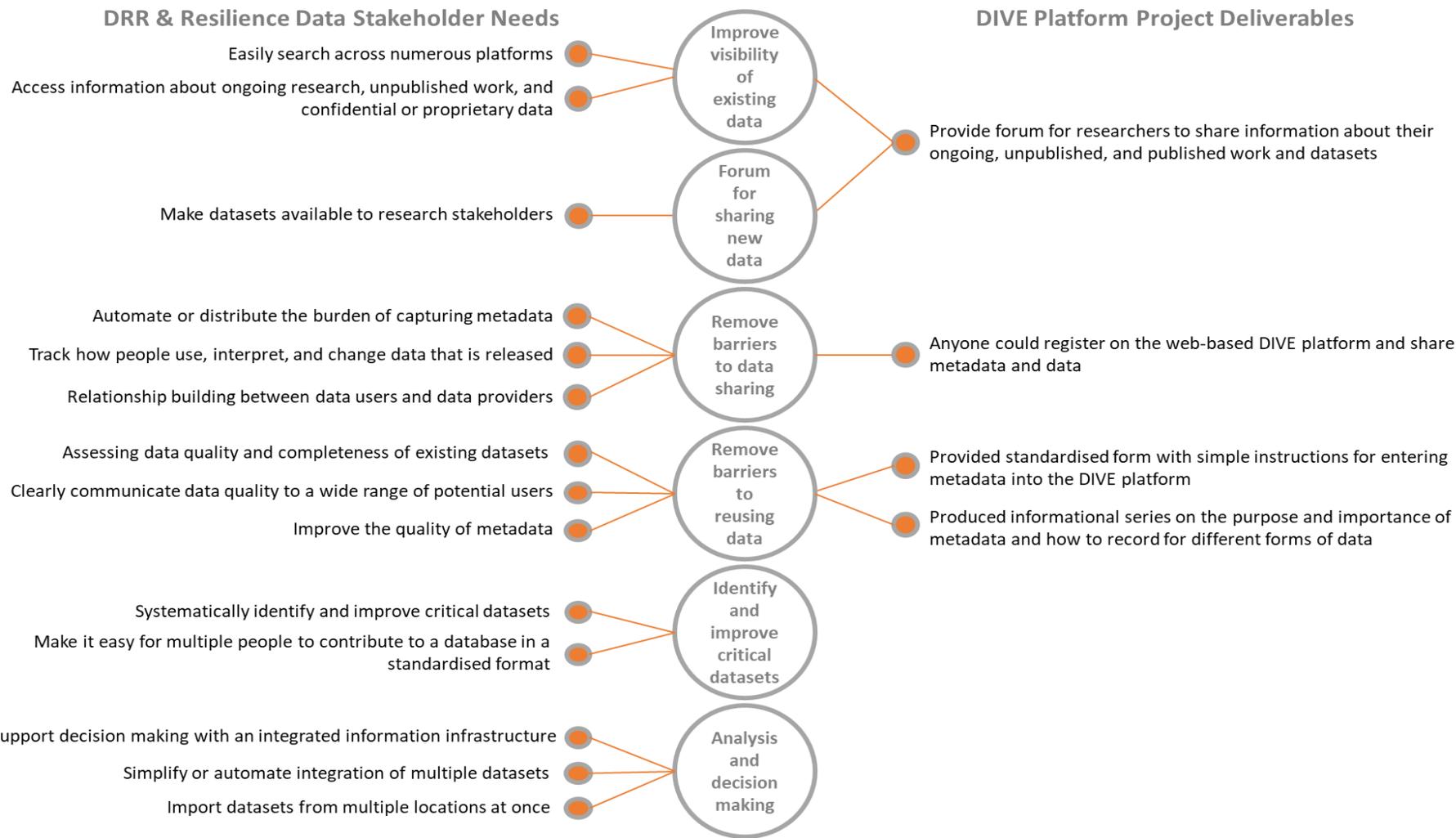


Figure 2. The data and data management needs of DRR & Resilience research stakeholders and DIVE Platform pilot project deliverable.

In the first part of the UE Project, 71 New Zealand researchers were contacted, and 10 researchers responded with questions about the platform. Table 1 lists the number of researchers contacted and their institutional affiliations. The largest of these were the University of Auckland (30%), Massey University (15%), University of Canterbury (13%), and other affiliations (21%). Most responses (90%) came from RNC researchers and QuakeCoRE (10%). These results most likely reflect the proportions of researchers contacted and their affiliations but could also be an indicator of data needs in these programmes.

Despite repeated approaches to researchers over the course of three months (December 2018 to February 2019) and the offer of individual assistance to upload metadata, the UE Project did not generate increased engagement with the platform. There were fewer than 15 responses from researchers interested in DIVE, and only 5 researchers expressed a willingness to upload information but wanted to wait until the completion of their projects.

Table 1. DIVE Increasing Engagement Project – List of contacted researcher affiliations.

<i>Institution</i>	<i>Number of researchers contacted</i>
<i>University of Canterbury</i>	<i>10</i>
<i>University of Auckland</i>	<i>21</i>
<i>Massey University</i>	<i>11</i>
<i>Scion</i>	<i>1</i>
<i>Landcare</i>	<i>1</i>
<i>University of Otago</i>	<i>2</i>
<i>Lincoln University</i>	<i>3</i>
<i>GNS</i>	<i>3</i>
<i>Waikato University</i>	<i>1</i>
<i>Victoria University</i>	<i>3</i>
<i>Other</i>	<i>15</i>
<i>Total</i>	<i>71</i>

The UE Project ran during the extended summer holiday period, a time when researchers tend to be either busy or on leave. As a result, it is possible the more extensive efforts in early 2019 could have generated more engagement with DIVE. The development team felt, however, that without a clear funding pathway for the future of the DIVE Platform it was better to focus the remainder of the UE Project on better understanding the barriers to engagement and mapping pathways for the future of DRR and resilience information management in New Zealand.

Uptake Enhancement Results and Discussion

There is a clear and expressed need in the New Zealand research community for some kind of resilience and DRR research information management system. In New Zealand's research environment, a comprehensive approach to data management is required and a small pilot programme such as DIVE did not have the structure to meet the needs of DRR and resilience research stakeholders.

The UE Project found two significant barriers to engagement with DIVE: concerns about the longevity of the DIVE Platform and inadequate incentives to engage in a data sharing and information management system. First, the lack of long-term funding and permanent host for the DIVE Platform meant that investing time to enter information on the system was high risk, low reward. Researchers would be dedicating time to trialling a system that was unlikely to remain operational long-term. Second, it was hard for researchers to see how contributing to a shared data infrastructure would offer tangible benefits to their current or future work. Even programmes with a Government mandate, such as the National Loss Data Collection System being led by the Ministry of Civil Defence and Emergency Management, spend significant resources establishing foundational processes such as aligning the priorities and needs of stakeholders and overcoming embedded practices such as ad hoc data sharing arrangements.

Following the UE Project review, there is clear need for investment in the foundational aspects of the information management system, including developing a robust set of data management processes that reflect the realities of research funding, competing time demands, and other stakeholder needs. For example, the New Zealand research environment is fragmented, but within the DRR and resilience space there are several formal and informal collaborative linkages between researchers to exchange data on an 'as needed' basis. This system meets most of the immediate needs for time constrained researchers and is, therefore, difficult to replace with a formalised system for data sharing with a wider audience with less clear immediate benefit. Risks related to sharing 'work in progress' and practical concerns about gaining permission from collaborators and funders to share datasets or project information also served as hurdles to engagement. Additionally, DIVE was neither mandatory nor was it set up to 'reward' participation. For example, stakeholders expressed a desire for DOI assignment to more clearly establish publication credit for their contributions. Without such incentives, the main motivation for engaging had to be a belief that information sharing would enhance resilience outcomes.

Additionally, the information management system needed to be underpinned by both formal institutional structures to host and fund the system and supported by a community of motivated stakeholders. Such important information management system support structures were highlighted in Stevenson et al.'s (2017) report scoping DIVE development but could not be adequately incorporated into the DIVE Platform pilot project. The establishment of these foundational components of an information management system could then sustainably support the development of a fit-for-purpose and adaptable web-based software programme.

Uptake Enhancement Project Conclusion

The limited prototype did not have the legitimacy or functionality required to appeal to the desired stakeholders. It was decided to cease further investment in the web-based DIVE Platform. The DIVE project should not, however, be seen as a failure. Rather it is a step forward in understanding the nature of New Zealand's resilience research landscape, offering a lesson in understanding the behaviour of stakeholders as opposed to stated needs.

Many unmet information management needs remain that hinder New Zealand's progress toward evidence-based disaster risk reduction and resilience enhancement. Issues including:

- Poor metadata recording in the New Zealand research environment limiting data sharing and reuse.
- Limited resources to identify and improve key datasets such as lifelines datasets.
- Poor visibility of ongoing or unpublished research and information limiting opportunities for collaboration, increasing the risk of redundant work.
- A lack of places to share data generated following disasters that could enhance response, recovery, and research.

There is a large amount of publicly funded DRR and resilience-related data output from RNC and QuakeCoRE projects with no clear home for sharing with a broader set of research stakeholders.

There are clear signals that there is continued appetite for improving data sharing and management and some (but not all) of those needs will be met over time by emerging systems. The New Zealand government, for example, continues its growing efforts to foster and support open government data, primarily using data.govt.nz as the main entry point for those interested in this initiative. There are currently more than 6,400 datasets available through the data.govt.nz portal from 158 local, regional, and central government organisations and entities (data.govt.nz, 2019).

Additionally, in the 2018 budget the government dedicated \$10.1 million in funding (over 4 years) for the development of the New Zealand Research Information System (NRIS) (MBIE, 2018). The NRIS will launch in September 2019 as a hub for information about research, science, and innovation in New Zealand. The programme is phased and aims to allow research organisations to become part of the NRIS – entering information about their research programmes and linking to relevant outputs and data – in late 2020 and 2021. The Resilience to Nature's Science Challenges – National Science Challenge will be integrated into this system.

Over the last few years, Land Information New Zealand (LINZ) has been working to identify 'key' datasets for enhancing New Zealand's readiness and ability to reduce risks related to natural disaster events and climate change (Whitcroft, 2019). They have identified relevant datasets based on the needs of relevant users (e.g., RiskScape, Tonkin + Taylor, lifelines organisations, local government, emergency services, and others) and are prioritising key datasets for further investment and improvement.

The DIVE programme has shown that significant hurdles remain to creating greater visibility and unity across the DRR and Resilience research and information space in New Zealand. Efforts to

improve the visibility and usability of resilience related research and data shouldn't cease. In the following section, we outline several future pathways targeted at New Zealand based researchers working on DRR and resilience-related research.

Future Development Pathways

We have outlined four broad pathways for the future management of DRR and resilience information in New Zealand (Figure 3). Figure 3 highlights focus areas for development within these future pathways. The selection of a pathway will fall to the major DRR and resilience research programmes, RNC and QuakeCoRE, and their governance and funding bodies, including the Ministry of Business Innovation and Employment. Elements of various pathways, however, will be supported by other stakeholders, such as LINZ, Tonkin + Taylor, or the Global Resilience Research Network. The first two pathways, "Resilience Hub Ongoing Development" and "Resilience Information Network" would both require a significant financial and time commitment. The third pathway, "Ad Hoc Partnerships" requires minimal direct financial investment, but does require research programme coordinators and individual researchers to dedicate their time to participating in existing information management systems. The final pathway refers to the current "Status Quo" with no efforts to coordinate resilience data management and sharing outside of data sharing agreements between individual researchers or short-term project-based systems.

Resilience Hub

Future pathways (shown in Figure 3) move from the highest resource requirements in terms of both time and money to the lowest. Ongoing investment in a built-for-purpose digital hub is the most resource intensive option but also the one with the most direct benefit to improving New Zealand's resilience information landscape. DIVE is the most basic version of what such a hub could offer. With further investment, the functionality, legitimacy, and appeal could be enhanced.

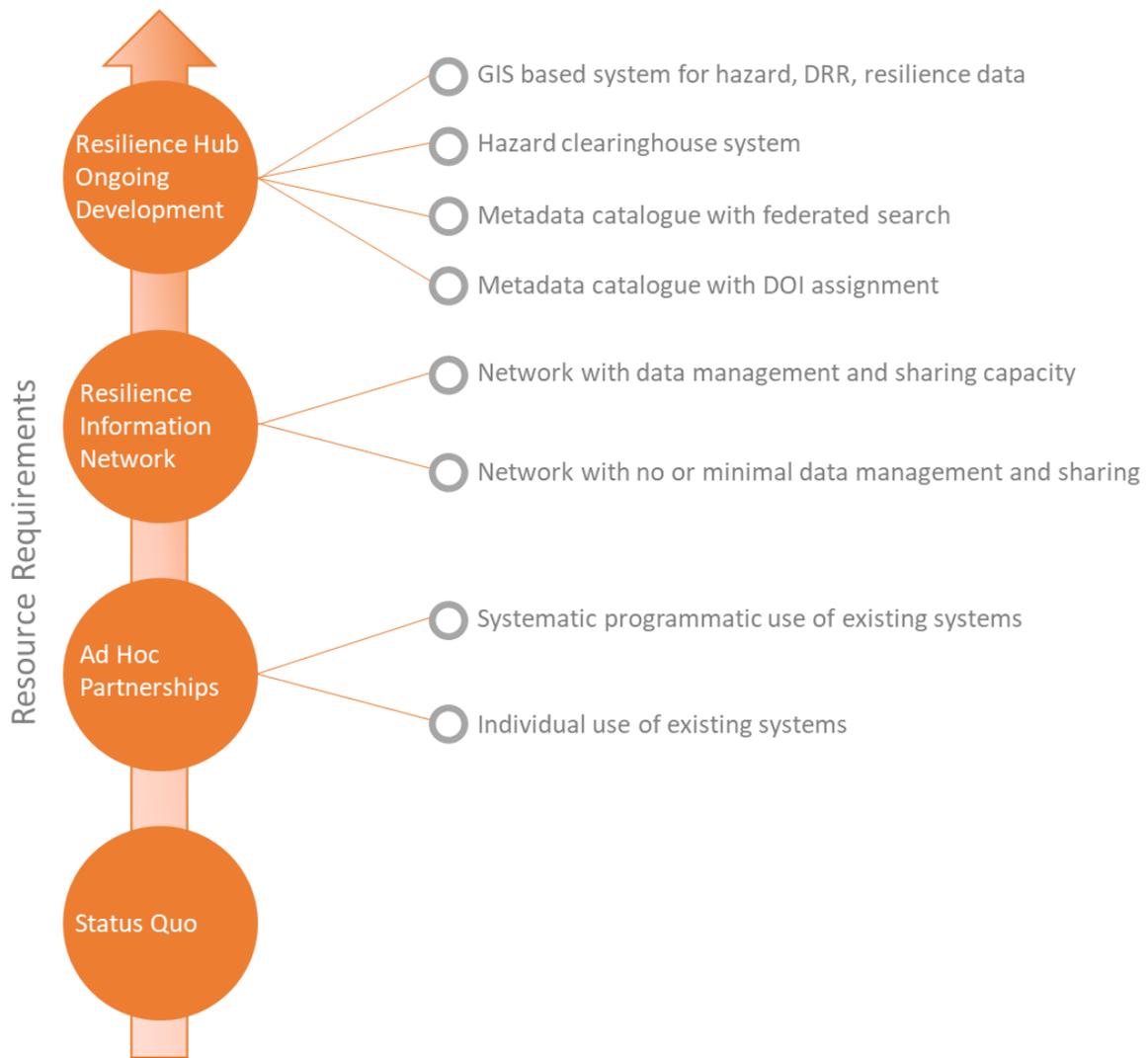


Figure 3. Future Pathways for DRR and Resilience Information Management for NZ Researchers.

GIS based system

Developments within the resilience hub could include tools that enhance decision making and collaboration. Systems such as the Kaikōura Earthquake Viewer (KEV), offer a useful template upon which a collaborative geographic information system (GIS) for DRR and resilience information could be based. KEV is an interactive GIS capable web map which allows for collaboration between the Earthquake Commission, private insurance companies, response and recovery agencies, engineers and researchers (Figure 4). Formed in response to the Kaikōura Earthquake and comprising a large repository of earthquake related data, it improved planning and communication between stakeholders in the form of a land damage index map and allowed for effective prioritisation, future planning, and loss estimation. KEV contributed to a better overall disaster response



Figure 4. Kaikōura Earthquake Viewer Interface (Carter, 2018).

Federated search

At the lower end of the resource spectrum are development options that would improve the functionality and uptake of a more general DRR and resilience information cataloguing system like DIVE. Federated search, also known as distributed information retrieval, parallel searching, meta-searching, or broadcast searching is a way of linking multiple search engines in a single system (Craven, 2006). This tool can be designed to retrieve relevant information from a range of relevant databases like Statistics NZ, LINZ, and Koordinates. A federated search capable resilience hub would allow researchers to compare and see a more complete picture of data available.

All Hazards Data Clearinghouse

There is a notable unmet need for coordinating and managing research and information generated during and directly following a hazard event. The resilience hub could provide a dedicated virtual space and set of processes for capturing, preserving, and sharing hazard-related data. Such an application would reduce redundancy in research spaces and increase transdisciplinary research collaboration. It could also address the common complaints of research subject fatigue and redundant information requests that often emerge following disasters. This is referred to in Figure 3 as a hazard ‘clearinghouse system’ and can be modelled on the Earthquake Engineering Research Institute’s Learning for Earthquakes (LFE) virtual clearinghouse system (EERI, 2016). Partner organisations from across government, industry, and academia contribute to LFE Earthquake Clearinghouse system in order to maximise the positive impact of their contributions. Such a platform could also provide better linkages between global and national data. For example, following the Kaikōura Earthquake global satellite data from the USA and China facilitated the discovery of over one thousand landslips, changing the emergency response strategy (Fakhrudin et al., 2018). Such data or metadata (if data cannot be publicly shared) could be hosted on a clearinghouse site so relevant decision makers were aware of its existence, improving overall disaster response and recovery. This would be a welcome addition to the New Zealand resilience data landscape but would also require a large multidisciplinary effort to overcome the different roles

and responsibilities between governing bodies, research, and the public and private sectors which are at present fairly non-integrated.

DOI Assignment

Finally, another minor enhancement to a simple metadata cataloguing site, like DIVE, that could enhance user uptake is enabling users to publish data or other resources with a Digital Object Identifier (DOI). DOIs legitimise material published online by giving them a unique content identifier and providing a persistent link to its location on the Internet. The DOI also persistently associates metadata with objects online, enhancing the long-term useability of the object. Such an addition could be a significant incentive for potential researchers to engage with these kinds of platforms.

Resilience Information Network

The second pathway is to develop a managed network of people, organisations, and research programmes who are considered resilience information management stakeholders. The Resilience Information Network would be implemented as a community of practitioners that provides a forum for information sharing and collaboration on resilience related research and data analysis. Templates that already exist for this include the Transport Knowledge Hub managed by the Ministry of Transport, which exists as a community of agencies and researchers who hold seminars and conferences, circulate relevant updates on research and events, and work together to inform decisions around priorities for transport research (Ministry of Transport, 2019). Topic hubs within the Transport Knowledge Hub provide “open environments” for sharing “data, evidence, knowledge, research, information, capabilities, and ideas” (Ministry of Transport, 2019).

Currently, there is no system like this in the DRR and resilience space in New Zealand. There are, however, networks upon which such a system could be built. For example, contributors to the DRR Data Newsletter regularly published by Tonkin + Taylor and those involved in the New Zealand GIS for Emergency Management Community represent groups of people who are engaged in efforts to improve data management for enhanced resilience outcomes. The development and funding of the Resilience Information Network would, however, likely need to come from a more established entity. It could, for example, be operationalised through the Ministry of Civil Defence and LINZ with the support of RNC researchers.

With adequate resourcing, the Resilience Information Network could be supported by a web-based system for data cataloguing and sharing like DIVE or supported by organisations like LINZ to identify and host priority datasets for resilience enhancement.

Ad Hoc Partnerships

The third pathway relies on existing data management and information sharing systems. Research programmes may decide to commit to using a pre-existing information management system. Part of the UE Project included an evaluation of existing systems to evaluate their capacity to address outstanding stakeholder needs. While each system offers unique benefits to its current and potential users, of the ten systems reviewed (see Appendix B), three are likely to offer the largest programme wide value to researchers involved in the large multidisciplinary collaborative research programmes,

QuakeCoRE and RNC. These three are the Global Resilience Research Network's Lynx-Net system, the Natural Hazards Engineering Research Infrastructure's DesignSafe-CI, and the Ministry of Business Innovation and Employment's forthcoming New Zealand Research Information System (NRIS) (Table 3).

These platforms do not offer a silver bullet for the issue of DRR and resilience information management. In other similar systems, it has been noted that despite calls for these kinds of tools from researchers, uptake is often slow. Introducing a new system is particularly challenging in an environment where there are many existing collaborative online tools, such as social media, Research Gate and LinkedIn. Systematic engagement must still be supported and incentivised at the research programme and funder level in New Zealand. Programmatic commitment to a pre-existing system for the research programme would require resourced staff time to assisting and incentivising time-constrained researchers to upload their information. Figure 3 includes the option of encouraging individual researchers to contribute to these pre-existing systems without additional programmatic support or incentives. It is almost certain, however, that there would be low uptake without further incentivisation.

Status Quo

The final pathway, Status Quo, is the continuation of the current fragmented resilience information management landscape. As the NRIS is implemented and grows over the next few years, government funded resilience research will be included in the system and ideally catalogued in a way that will allow for enhanced visibility of resilience research outputs. From a researcher perspective, this pathway represents a "wait and see" approach, where gaps and inefficiencies are accepted, researchers rely on traditional information channels such as conferences, seminars, journals, and newsletters to distribute information about relevant research and research data is primarily shared through interpersonal networks.

Conclusion

Energetic engagement in the consultation phase of the DIVE pilot project from a range of stakeholders and the ongoing government investment in open data, DRR, and resilience information management show that there is demand for this work. The future pathways presented in this report identify practical directions for future investigation and investment. The authors hope that the conclusion of the DIVE pilot project is only the beginning of a movement to improve our ability to address complex social problems that will make New Zealand more resilient through data sharing, improved access to public data sources, and the analysis and visualisation of integrated data sets.

Table 2. Review of Data Management Systems - Uptake Enhancement Project.

<p>LYNXNET</p>	<p>LynxNet is a global platform developed to enable visual research collaboration and information sharing among Global Resilience Research Network (GRRN) members. In its current form, Lynx-Net has 6 functional tools for researchers to use (GRRN-LynxNet):</p> <ul style="list-style-type: none"> • Data and publication repository • Collaborative project management tool • Resilience researcher profiles • Relevant funding opportunity information • Research project information for funders <p>There is a strong incentive for members to use the network in particular for the funding and collaborative project management opportunities. The virtual research collaboration tool aims to formalise networks between resilience researchers at a global scale.</p>
<p>DESIGNSAFE-CI</p>	<p>DesignSafe-CI is created and administered by Natural Hazards Engineering Research Infrastructure (NHRI). It specifically supports research workflows, data analysis and visualisation. Data can be formally published on DesignSafe with a Digital Object Identifier (DOI). Data can be shared, made available to the public, or formally published. Data can be analysed and visualised using MATLAB and Jupyter programmes and can be run interactively. There is a huge incentive for researchers with useful and usable online tools as well as the ability to publish data with DOI capabilities (Rathje et al., 2017)</p> <p>It is administered largely from an engineering perspective and aims to meet the research needs of the natural hazards engineering community. It embraces a cloud concept for the ‘big data’ generated in research.</p>
<p>NRIS</p>	<p>The NRIS is a platform created and funded by the Ministry for Business, Innovation and Employment to provide access to data on research, science, and innovation funded by the New Zealand Government. NRIS will allow research organisations to become part of the platform – entering information about their research programmes and linking to relevant outputs. Science and research outputs from the RNC and National Science Challenges programmes will be integrated into this system.</p> <p>The NRIS aims to provide a hub for information about research, science, and innovation in New Zealand.</p>

References

- Carter, J. (2018). *Kaikoura Earthquake Viewer*. Presentation (22 August 2018). Tonkin + Taylor and the Earthquake Commission Resilience Team and Customer Care. Available from <https://www.eagle.co.nz/sites/default/files/John%20Carter%20-%20The%20Kaikoura%20Earthquake%20Viewer.pdf>.
- Craven, V. (2006) Federated search engines the unified search environment: the western library experience. Retrieved from <http://software.chem.ucla.edu/scifind>.
- Crowley, J., York, D., Soden, R., & Deparday, V. (2014). *Open Data for resilience initiative field guide*. World Bank Publications.
- Data.govt.nz: Discover and use data*. (2019). Available from <https://data.govt.nz/>.
- EERI. (2016). *EERI Learning from Earthquakes: Increasing community resilience through earthquake investigations*. Earthquake Engineering Research Institute. Available from <http://learningfromearthquakes.org/about>.
- EQC. (2018). *National Geohazards Monitoring Centre is Go*. Earthquake Commission. 13 Dec 2018 Wellington, NZ. Available from <https://www.eqc.govt.nz/news/national-geohazards-monitoring-centre-is-go>.
- Fakhrudin, B., Guoqing, L., & Robertson, R. (2018). Rapid damage mapping and loss data collection for natural disasters: Case study from Kaikōura earthquake, New Zealand. *China Scientific Data*, 3(4), 1–10. <https://doi.org/10.11922/sciencedb.605>.
- Kay, E., Stevenson, J.R., Bowie, C., Ivory, V., & Vargo, J. (2018) "The Data Challenges of Monitoring Resilience". [Conference presentation] ISCRAM Asia Pacific 2018: Innovating for Resilience. 6 November, 2018. Wellington, New Zealand.
- MBIE. (2018). *The National Research Information System: Overview (Version 1.1)*. Wellington, NZ.
- Ministry of Transport. (2019). *Transport Knowledge Hub*. Ministry of Transport: Te Manatū Waka. Wellington, NZ. Available from <https://www.transport.govt.nz/mot-resources/transport-knowledge-hub/>.
- Natural Hazards Research Management Platform*. NHRP Available from <https://www.naturalhazards.org.nz>.
- New Zealand Research Information System*. Available from <https://www.mbie.govt.nz/science-and-technology/science-and-innovation/research-and-data/nzris>.
- New Zealand Geotechnical Database*. Available from <https://www.nzgd.org.nz>.

QuakeCoRE: The Centre for Earthquake Resilience. Available from <https://wiki.canterbury.ac.nz/display/QuakeCore/QuakeCoRE%3A+The+Centre+for+Earthquake+Resilience+Home>.

Rathje, E. M., Dawson, C., Padgett, J. E., Pinelli, J. P., Stanzione, D., Adair, A., Arduino, P., Brandenburg, S. J., Cockerill, T., Dey, C., Haan, F. L., Hanlon, M., Kareem, A., Lowes, L., Mock, S., Mosqueda, G & Esteva, M. (2017). DesignSafe: new cyberinfrastructure for natural hazards engineering. *Natural Hazards Review*, 18(3), 06017001.

Smithies, J., Millar, P., & Thomson, C. (2015). Open Principles, Open Data: The Design Principles and Architecture of the UC CEISMIC Canterbury Earthquakes Digital Archive. *Journal of the Japanese Association for Digital Humanities*, 1(1), 10-36.

Stevenson, J.R., Vargo, J., Thomson, C., Walsh, L. J. (2017) *Resilience & Data in New Zealand: The Data Integration and Visualisation En Masse (DIVE) Platform 2016 Summary*. Resilient Organisations/QuakeCoRE Research Report. Available from: <https://wiki.canterbury.ac.nz/pages/viewpage.action?pageId=52692301>.

Stevenson, J. R., Kay, E., Bowie, C., Ivory, V., & Vargo, J. (2018). The Data Challenges of Monitoring Resilience. In K. Stock & D. Bunker (Eds.), *Proceedings of the Information Systems for Crisis Response and Management Asia Pacific 2018 Conference Innovating for Resilience 5 – 7 November*, Wellington, New Zealand (pp. 153–165). Wellington: Massey University.

Stevenson, J.R., Kay, E., & Vargo, J. (2018). Building a Data Integration and Visualisation Platform for Resilience Research in New Zealand: Practice Update. "Australasian Journal of Disaster and Trauma Studies". 22(1): 21-26.

The Global Resilience Research Network- LynxNet. Available from <https://globalresilience.northeastern.edu/network/>.

Whitcroft, A. (2019). *Help improve NZ's 12 key datasets for resilience and climate change*. Available from <https://data.govt.nz/blog/help-improve-nzs-12-key-datasets-for-resilience-and-climate-change/>.

Additional Reading & Resources

NZ Resilience DIVE Platform, NZ Centre for Earthquake Resilience & Resilient Organisations. (2018). Available from <https://resiliencedata.org.nz>.

Stevenson, J.R., Vargo, J., (2016) Data Integration and Visualisation EnMasse (DIVE) Platform Report: Programme Update September 2016. Resilient Organisations/QuakeCoRE Research Report. Available from: <https://wiki.canterbury.ac.nz/pages/viewpage.action?pageId=52692301>.

Stevenson, J.R., Vargo, J., & Brown, C. (2016) Data Integration and Visualisation: Prototyping the QuakeCoRE Data Platform for Diverse Needs. Resilient Organisations/QuakeCoRE Research Report. Available from: <https://wiki.canterbury.ac.nz/pages/viewpage.action?pageId=52692301>.

Stevenson, J.R., & Schindler, M. (Producers). (2017 September). "Spatial Data for Researchers" [video file]. DOI: 10.6084/m9.figshare.5536483. Available from <https://www.resorgs.org.nz/our-projects/measure-resilience/resilience-natures-challenges-resilience-trajectories-future-proof-new-zealand/>.

Stevenson, J.R., & Schindler, M. (Producers). (2017 September). "Spatial Metadata" [video file]. DOI: 110.6084/m9.figshare.5536489. Available from <https://www.resorgs.org.nz/our-projects/measure-resilience/resilience-natures-challenges-resilience-trajectories-future-proof-new-zealand/>.

Stevenson, J.R., & Schindler, M. (2017 September). Getting the Most of Out of Your Research: Metadata, spatial data, and collaboration. Resilient Organisations. DOI: 10.6084/m9.figshare.5536513. Available from <https://www.resorgs.org.nz/our-projects/measure-resilience/resilience-natures-challenges-resilience-trajectories-future-proof-new-zealand/>.

Stevenson, J.R., & Schindler, M. (Producers). (2017 June). "Metadata Overview" [video file]. DOI: 10.6084/m9.figshare.5421853. Available from <https://www.resorgs.org.nz/our-projects/measure-resilience/resilience-natures-challenges-resilience-trajectories-future-proof-new-zealand/>.

Stevenson, J.R., & Schindler, M. (Producers). (2017 June). "Metadata: WhereDo I Start?" [video file]. DOI: 10.6084/m9.figshare.5536495. Available from <https://www.resorgs.org.nz/our-projects/measure-resilience/resilience-natures-challenges-resilience-trajectories-future-proof-new-zealand/>.

Stevenson, J.R., Vargo, J., Thomson, C., Walsh, L. J. (2017) Resilience & Data in New Zealand: The Data Integration and Visualisation En Masse (DIVE) Platform 2016 Summary. Resilient Organisations/QuakeCoRE Research Report. Available from: <https://wiki.canterbury.ac.nz/pages/viewpage.action?pageId=52692301>.

Appendix A: Methods to increase engagement with the DIVE programme

Phase one:

Email contact was made with 71 researchers (Table 1) of various research affiliations informing them of the recent launch of DIVE and its availability for data upload and engagement. The contact emphasised the collaborative and data sharing opportunities of the DIVE platform;

Ideally, there would have been two kinds of responses;

1. Researchers would open the DIVE database, make a profile and upload their own data.
2. If they needed support or had questions regarding what could be uploaded, they would contact us, and we would help them enter data/metadata.

“The Data Integration and Visualisation En Masse (DIVE) Platform - launched mid-2018, is now available and ready for data upload.

As part of our research community, we want you to be a part of a new and exciting approach to research and resilience outcomes for New Zealand.

The Platform is aimed at facilitating cataloguing, sharing and collaborating of New Zealand Resilience Data.

We want to meet the need for researchers to be able to integrate their data and share the unique projects they are working on. DIVE allows users to upload relevant metadata into the system and user friendly data searching.

We want to get more data and metadata entries on DIVE and are hoping to work with people across the Resilience to Nature's Challenges like you to share their data, reports, and other relevant items.”

A second email was focused on PhD students working within RNC who may also be keen to increase their research profile, offering a unique opportunity to upload to a New Zealand focused database and connect with other researchers. With a largely muted response (10 responses – unknown amount of engagement with the website itself) the research team re-evaluated whether the DIVE platform in its current format was meeting the needs it set out to meet.

Phase two:

Following Phase one, the research team conducted a series of supplemental informal interviews with a range of potential stakeholders from various backgrounds familiar with the resilience data environment and growth and development. The notes from three of the four interviews are included below for extra context. The fourth interview remains confidential, but insights from the interview are integrated into the report.

INTERVIEWEE	MAIN THEMES FROM INTERVIEW
<p>DR MATTHEW HUGHES SENIOR LECTURER IN DISASTER RISK AND RESILIENCE</p> <p>DEPARTMENTS OF CIVIL AND NATURAL RESOURCES ENGINEERING AND GEOLOGICAL SCIENCES</p> <p>UNIVERSITY OF CANTERBURY / TE WHARE WANANGA O WAITAHA</p>	<p>Dr Matthew Hughes is a Senior Lecturer in Disaster Risk and Resilience at the University of Canterbury with extensive research experience in GIS technologies and data management.</p> <p>During the interview, we discussed the various hurdles researchers face in connecting with and using platforms like DIVE. Notable themes include:</p> <ul style="list-style-type: none"> • There is a lot of resilience data already available albeit fragmented. Data needs to be used and usable e.g. specific spatial datasets will not be useful to everyone. • There can be significant copyright permissions and co-author hurdles to uploading data. • There may be a need for the research team to further distil the core incentive DIVE is using to attract researchers. • DOI capability could be a powerful incentive. <p>We discussed the benefits of doing further research into user needs assessments to tackle the incentive gap that DIVE had. The interviewee noted the benefits of research collaboration resources like DIVE, but also how to implement formal systems where informal systems of collaboration already exist.</p>
<p>GERARD MACKLE</p> <p>DIRECTOR & EXECUTIVE COACH</p> <p>MACKLE & ASSOCIATES</p>	<p>Gerard Mackle is an experienced consultant (Mackle & Associates), helping companies and researchers to develop strategies for growth and development. Having worked with clients in a vast array of different fields, he is skilled at providing a fresh perspective and helping clearly align the direction of projects. Notable themes from this interview include:</p> <ul style="list-style-type: none"> • What message is the research team trying to communicate? What is DIVE’s main selling point? • Stakeholders who engage with the platform need to feel that their input its valued and will have incentives for them. • Can the process of using DIVE be streamlined/made as easy as possible for time poor researchers? <p>The interviewee emphasised the need to make the process of getting people involved in DIVE as easy as possible and encouraged the research team to think about ways of improving the clarity of DIVE’s message and its functionality.</p>

<p>DR BAPON SHM FAKHRUDDIN</p> <p>TECHNICAL DIRECTOR NATURAL HAZARDS/DRR SPECIALIST TONKIN & TAYLOR</p> <p>CO-CHAIR DISASTER LOSS DATA, INTEGRATED RESEARCH ON DISASTER RISK (IRDR) & INTERNATIONAL SCIENCE COUNCIL</p>	<p>Dr Bapon Shm Fakhruddin is an international disaster risk reduction and hazard modelling expert with particular expertise on Early Warning Systems and Data Management Systems. Notable themes from this interview include:</p> <ul style="list-style-type: none"> • The state of resilience data in New Zealand at the moment is highly fragmented, with many different roles and responsibilities. • Legitimacy issues – DIVE may have a legitimacy issue, generally these kinds of databases need to be government backed or owned to give a sense of trustworthiness. • What is the perceived value for stakeholders? Do they understand how the data they upload will be used as well as the value they get out of it? How clearly is this value translated? • Make sure the DIVE programme is addressing resilience as a whole, this means reaching out to, and including data for many different sources. <p>The interviewee also suggested that in New Zealand there may be a gap between global data and local disaster needs. Useful data can often be provided from global sources but there often isn't a good conduit for these exchanges to take place and it is generally through ad hoc and informal processes. This process could potentially be formalised and remains a gap in the New Zealand resilience data landscape.</p>
--	---

These supplemental interviews informed the research team throughout the uptake engagement project. Different methods to help with uptake of the platform proposed are detailed below. As the DIVE project has concluded, these items may inform programme uptake initiatives.

PROPOSED OPTIONS TO INCREASE ENGAGEMENT WITH THE DIVE PLATFORM

Increase DIVE's online profile and push its networking advantages to researchers – this could include creating a LinkedIn page for DIVE, where researchers share with other researchers what they are doing, with an already established network like LinkedIn. Leveraging existing networks to fulfil DIVE's aims.

Explore the possibility of pre-registering researcher profiles on DIVE to make the sign-up process simple and quick to follow.

Explore the possibility of tracking analytics on the website to provide more insight into what parts of DIVE people are using and if there is unknown engagement with the platform.

Explore the possibility of DIVE becoming more of a resilience 'hub' with federated search capability. Federated search would be a huge incentive for people to engage with DIVE however would need ongoing, substantial funding for it to be a realistic possibility.

In the same vein, explore adding metadata about different resilience data wikis including QuakeCoRE and the UC Spark metadata directory, possibly including redirect buttons to increase functionality and draw.

Phase three:

The third phase of the UE Project included an evaluation of existing systems to evaluate their capacity to address outstanding stakeholder needs and understand what key incentives make their stakeholder uptake successful. Ten platforms are evaluated below (Appendix B).

Appendix B: Results of the Data Management Systems Review

System	Description	Key aims
CEISMIC/ UC QuakeStudies	CEISMIC is a digital archive created following the 2010/2011 Canterbury Earthquake Sequence. The archive is open access and allows end users to upload materials relating to the earthquakes. Holds not only hazard specific data but a range of information mediums (Smithies et al, 2015).	The aim of the archive is to preserve the knowledge and experiences surrounding this disaster, and brings together a range of different types of resources including, video, audio, images, and documents. The archive has federated search capability allowing end users to search multiple avenues for resources. CEISMIC also aims to inform future natural disaster preparedness and response practices.
Data.govt.nz	Data.govt.nz enables researchers to discover and use open data easily. Ongoing funding and technical development is controlled by the Department of Internal Affairs and Statistics New Zealand. There are thousands of data sets available for use which is a strong incentive for researchers (data.govt.nz, 2019).	Users of the website can search and explore freely usable datasets which have been released by NZ government organisations. It also provides guidance on how to use data effectively.
DesignSafe-CI	DesignSafe is created and administered by Natural Hazards Engineering Research Infrastructure (NHERI). It specifically supports research workflows, data analysis, and visualisation. Data can be formally published on DesignSafe with a Digital Object Identifier (DOI). Data can be shared, made available to the public, or formally published. Data can be analysed and visualised using modelling programmes (Rathje et al, 2017).	It is administered largely from an engineering perspective and aims to meet the research needs of the natural hazards engineering community. It embraces a cloud concept for the 'big data' generated in research.
EERI Earthquake Clearinghouse	The Earthquake Clearinghouse was created by the Earthquake Engineering Research Institute (EERI). It meets the urgent data needs of response agencies and scientists following hazard events (EERI, 2016).	The objective of EERI is to reduce earthquake risk, improve understanding of the impacts of earthquakes on the environment, and reduce the effects of earthquake disasters.

System	Description	Key aims
GRRN Lynx-Net	Lynx-Net is a global network with 6 functional tools to enable visual research collaboration and information sharing (GRRN-LynxNet, 2019).	To provide research collaboration among members of the Global Resilience Research Network and improved linkages between researchers and funding.
New Zealand Research Information System (NRIS)	The NRIS is a platform created and funded by the Ministry for Business, Innovation and Employment to provide access to data on research, science, and innovation that is being funded by the New Zealand Government. The platform will allow research organisations to become part of the NRIS – entering information about their research programmes and linking to relevant outputs. Science and research outputs from the Resilience to Nature’s Challenges and National Science Challenges programmes will be integrated into this system.	The platform aims to launch as a hub for information about research, science, and innovation in New Zealand.
NZ Geotechnical Database	Stakeholders can access New Zealand geotechnical data and share their own information. The database provides efficient access to geotechnical information and can also be used in disaster recovery, resilience research, and even informing land planning and regulatory processes (NZGD, 2019).	Aims to provide efficient access to geotechnical information and can also be used in disaster recovery, resilience research, and informing land planning and regulatory processes around New Zealand. Incentives include that it allows geotechnical information to be shared between public and private sectors. There is a reduced cost for storing and retrieving data and sharing your own. Facilitates more thorough geotechnical investigation of projects, leading to better outcomes and cost savings. Improved hazard management and loss modelling helping inform public, policy and economic decisions.
Open Data for Resilience Initiative	OpenDRI aims to apply global data to the process of improving resilience and reducing vulnerability in the face of natural hazards, index, database, and mapping tools (Crowley et al, 2014).	Similar to the previously discussed unmet need of creating linkages between international and national science, OpenDRI aims to apply global data to the process of improving resilience and reducing vulnerability in the face of natural hazards and the ongoing effects of climate change.
QuakeCoRE Wiki	The QuakeCoRE Wiki is a shared, primarily inward focused space for QC	The Wiki formalises informal networks between researchers and

System	Description	Key aims
	<p>affiliated researchers to collaborate and share data. The Wiki gives an overview of the Flagship multi institution and disciplinary research programmes undertaken by QuakeCoRE. Special projects that are externally funded and aligned with QuakeCoRE are included. Information includes technology platforms, workshops, emerging research, annual meetings, and even operational information such as working groups and reporting timelines (QuakeCoRE Wiki, 2019).</p>	<p>allows the sharing and collaboration of research and data from a range of disciplinary sources. Any projects produced under QuakeCoRE are uploaded allowing for effective tracking of outputs for funding and research purposes.</p>
<p>Natural Hazards Research Platform</p>	<p>The NHRP is a government platform that was established in 2009 to provide long term funding for research in natural hazards and to help researchers and end users work closely together, with the involvement of multiple agencies including GNS Science and NIWA, as well as the Universities of Auckland, Massey and Canterbury (NHRP, 2019).</p>	<p>The platform's aim is to provide government backed science advice, aligned to national interests and in line with the reduction, readiness, response, and recovery efforts taking place to increase resilience to hazards.</p>