Review of NeSI Training Strategy

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NeSI seeks 'to grow advanced skills that can apply high tech capabilities to challenging research questions'.

The purpose of this document is to provide:

- a snapshot of NeSI training activities over the years 2014-2017[1]
- the degree to which an estimate of the reach of these training activities can be made,
- an estimate of the penetration of training activities in the research sector,
- an estimate of the potential of NeSI training activities to provide direct or indirect support for researcher up-skilling,
- a framework to guide how future NeSI training activities could/should be deployed - taking into account NeSI's capacity - to maximise impact

This document focuses primarily on the higher education sector and CRIs, and within this on the direct training activities NeSI undertakes. It does not seek to address the informal acquisition of skills that lift researcher capabilities in our high performance digital environment.

1. Introduction

NeSI's training strategy developed in 2014/15 set out to deliver a number of training activities, some directly related to the use of infrastructure that NeSI supports, and others aimed at:

- Building working relationships with the New Zealand research sector aimed at building a network of knowledge, skills, and behaviours across New Zealand.
- Aligning NeSI's training with the researchers' own view of their development.
- Delivering useful and relevant training programmes to the research communities, some in partnership with other institutions.
- Promoting models of training delivery.

To achieve these goals, NeSI's focus was to aim at building partnerships with well-rounded, deeply committed researchers with the desire and ability to lead skills transfer within their communities. Many of the outputs discussed in this document were therefore achieved through collaborations.

A collaborative approach to training is consistent with NeSI's stated values, e.g.:

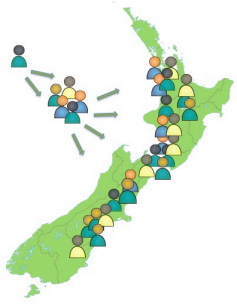
NeSI cooperates with researchers by providing superior computer power, support systems and training to underpin the integrity of their research.

It is through this lens that NeSI's activities and achievements are described.

[1] Data for 2017 is incomplete

2. NeSI's Training Strategy

Collaborating with technologists and researchers for specialised training as mentors and subject matter experts.



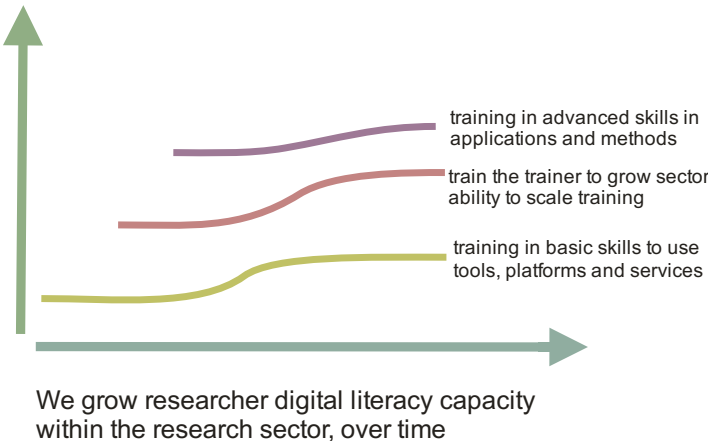
NeSI's strategy recognized that the adoption of advanced skills necessarily depended on researchers'' adoption and confidence in a set of basic skills. In addition to providing the necessary training in advanced skills, NeSI's strategy placed a strong emphasis on the deployment of basic skills, and the development of well-trained instructors able to increase the scalability of training in the research sector.

The training strategy roadmap presents a training model of 3 partially overlapping layers of training:

1. Training in advanced skills in applications and methods
2. Train the trainer activities intended to grow the sector's ability to scale training
3. Training in basic skills to use tools, platforms and services

"NeSI's Researcher Digital capability development plans see us move through three overlapping phases over the coming years, as our confidence grows and the sector takes ownership of sustaining training capabilities."

We build digital research methods training capabilities within partnerships to sustain research digital literacy



By its very nature, this strategy recognizes the intention that training leadership shifts from NeSI to the research sector, over time.

NeSI sees this review as an opportunity to reflect on what has been achieved, and to be a framework to guide how future NeSI training activities could/should be deployed - taking into account NeSI's capacity - to maximise impact.

3. Approach

In reviewing the training strategy, our approach has been to attempt to:

- quantify the outputs
- estimate the impact of NeSI's training activities in proportion to overall sector capacity
- make some inferences on the possible extent of need.

We have done this through the following steps:

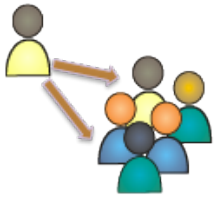
1. Estimate workforce capacity for Higher Education Institutes and Crown Research Institutes
2. Map the use of NeSI infrastructure against these workforce estimates (not included)
3. Identify the reach and gaps in the current NeSI training initiatives

4. Training activities

"A NeSI-centred view of training enables us to build working relationships with New Zealand research communities over time. We establish training as a programme, looking beyond one-time events or engagement, viewing our activities as connecting an ecosystem of offerings and stakeholders to realize their potential. This helps us build a network of knowledge, skills and behaviours across New Zealand."

NeSI engages in a number of training and outreach events. Over the period of 2016-2017 the large majority of training events were focused on general skill gaining and awareness raising, with a minority being focused on specific skills associated with the use of specific infrastructure.

4.1. Advanced skills in applications and methods



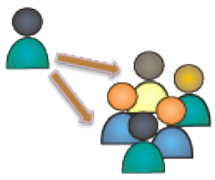
"Leveraging successes from earlier work, NeSI shifts to provision of advanced, methods-aware training."

The goal of this layer of training aims to support researchers with world-class digital literacies to approach challenging research problems. Training in advanced skills in applications and methods consists of, for example, HPC-specific workshops.

Building capacity (2014-2017)		**Planned**	**Delivered**	
Advanced skills	HPC-specific workshops	6+	17	✓

It is expected that this layer will become a more important focus as train the trainer initiatives and basic skills training activities become primarily led by local communities.

4.2. Grow sector ability to scale training



"NeSI adds train the trainer activities into the programme, enabling others to take a lead, to grow the scale of training activity across the sector. [...] the expectation is of a growing number of local community-led events with NeSI's initial help through mentorship, sponsorship and support."

Through '*train the trainer*' activities, NeSI shares their practices as instructors, enabling institutions and communities to assume a lead role. This approach looks to build partnerships to sustain capabilities over time.

Train the trainer activities are focused primarily on Software Carpentry instructor training. Instructor training is a key element that facilitates the deployment of trained instructors across New Zealand.

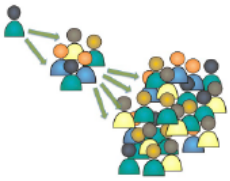
Building capacity		**Planned**	**Delivered**	
Training instructors/ helpers	Software Carpentry instructor training	58 instructors	66 instructors	✓

NeSI has been responsible for the organization and delivery of instructor training sessions. There were 4 instructor training sessions (one of these was online, and a second one was reserved for NeSI staff). Participants from 15 organisations attended instructor training.

The checkout process was completed by 39 (55.7%) of of the attendees, which matches global values (~ 55%[2]).

Aside from 1 participant from MBIE (who did not complete the checkout process), all other instructors trained are associated with a University or CRI. The distribution of instructor training participants across institutions indicates that NeSI is doing well in deploying trained instructors across the HE/CRI sector (See Section 5.1).

4.3. Basic skills to use platforms tools and services



"NeSI takes an active role in leading and organising events, collaborating with local research communities and institutional hosts, building capacity and community using Software Carpentry and other approaches."

This layer of training aims to build NeSI's confidence in its reflective training strategy, inform NeSI's strategy through engaging with researchers, their institutions, and communities of practice. Events that are included in this layer include Research Bazars (ResBaz), training Boot camps, community led events, and Carpentries (Software carpentry, data carpentry, etc.)

Thirty-one institutions or organizations (national and international) have engaged with some form of NeSI activities.

Building capacity		**Planned**	**Delivered**	
Basic skills	Research Bazar/Bootcamps Carpentries Community led events	24	33	✓

NeSI has played a fundamental role in bringing the Carpentries to New Zealand and coordinating the training of instructors (Section 4.2). This set of activities has the largest potential to become

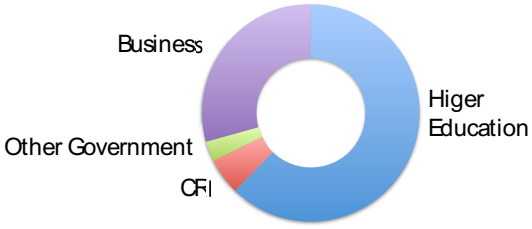
[2] http://www.datacarpentry.org/blog/instructor-metrics/

community driven, as these are supported and coordinated by a much larger international community.

NeSI may be best suited to play a role coordinating teaching resources and quality control, supporting instructor training, and coordinating a national database of participants and instructors that may help measure the impact that these activities have in the research sector, how this impact aligns with the national science priorities, and fill in the gaps, where the leadership may be lacking, or where organizing institutions may limit access to the training events.

5. Reach of NeSI's training activities

In order to understand the proportion of New Zealand's research workforce NeSI has supported through its training initiatives, we must first size the workforce[3].



Proportion of the research workforce across different sectors

Role	HE	CRI
Researchers	10,700	1,860
Technicians	2,000	558
Students	16,400	0
Total	**29,100**	**2,557**
Percent	*92*	*8*

Proportion of research workforce in Higher Education (HE) and Crown Research Institutes (CRI)

The large majority of the workforce is in the HE and business sectors, and less than half of the HED sector is supported by permanent staff[4]. Due to the lack of data to describe the distribution of researchers in the business sector, it is mostly excluded from this report. The share of the research workforce in HE institutions and CRIs is shown in the table above.

5.1. Reach of training activities

Instructor training was delivered to participants from at least 15 institutions. There is an observable increase in the number of trained instructors over 2016/2017, which reflects the ability to train instructors within New Zealand.

[3] The research workforce in higher education institution or discipline were estimated based on the number of funded EPs in the 2012 PBRF round for each institution/discipline and normalized to the size of the researcher workforce reported in the 2016 R&D survey. Student numbers are the sum of TEC reported Ms and PhD students, normalized to the 2016 R&D survey totals.

[4] Note: It is expected that many students may be working either in the business sector on in CRIs, but, as they must be registered within a tertiary education institution for their degrees, the numbers are hence associated with the HE workforce.

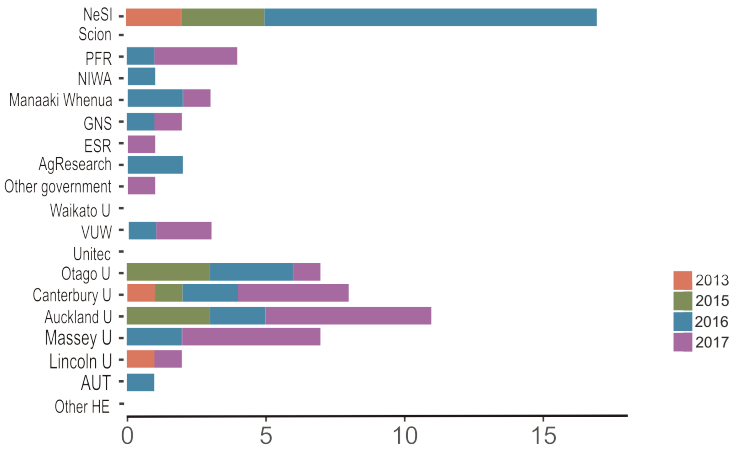


Figure 1: Number of trained instructors per institution

It is worth noting that the number of trained instructors per institution does not parallel the institutional share of the workforce.

Most participants (95%) in NeSI training activities are affiliated with Universities and CRIs, although the penetration of training in the CRI sector is larger when normalized to the size of the workforce.

	Total learners	**% Learners[5]**
HE	513	1.76
CRIs	129	5.05
Other learners	32	N/A

Workers at all universities, with the exception of Unitec, and workers at all CRIs, with the exception of AgResearch and ESR, have participated in training activities. Within the HE sector, the Universities of Otago and Auckland have the largest share of learners. This is not surprising as these institutions have clear leadership involved in promoting and organizing carpentries and ResBaz-like events.

However, when the number of learners is normalized to the estimated size of the workforce, training activity appears to have a bigger penetration in CRIs than in HE institutions.

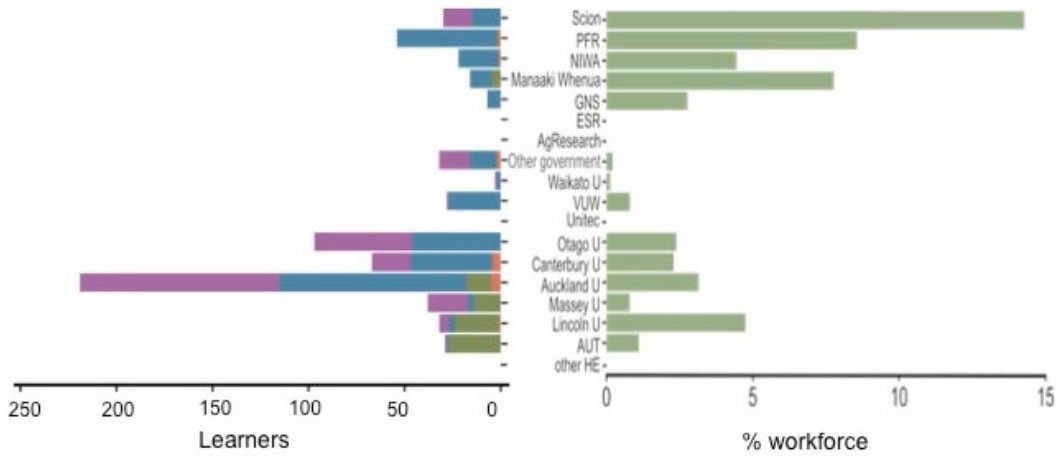


Figure 2: Distribution of Leaners in HE and CRIs

The current data does not provide sufficient information to identify the distribution of learners across specific offerings, which would be necessary to evaluate training participation against the training strategy roadmap.

There is no one-to one mapping between the institutional membership of trained instructors and of individuals participating in training activities, with some institutions (e.g., ESR and AgResearch) having participated in instructor training, but not in other training activities. This is more apparent in the CRI sector.

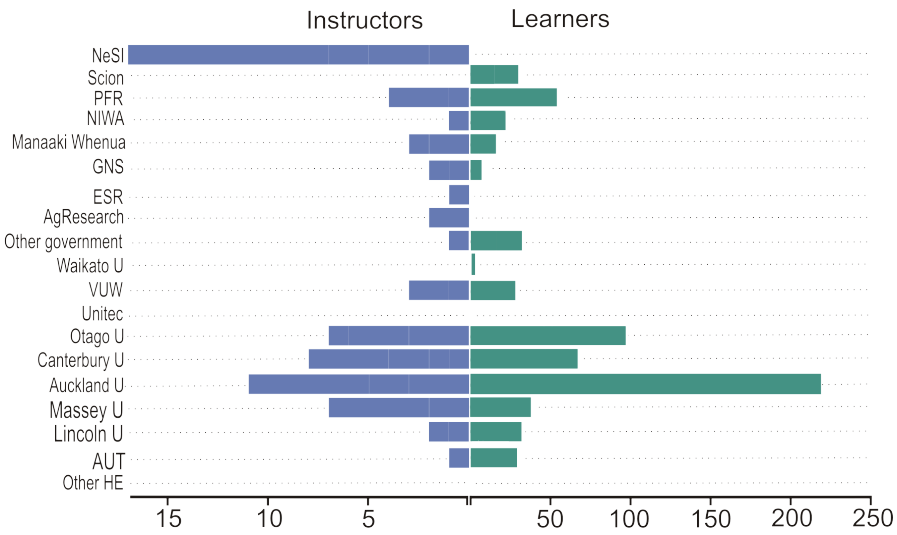


Figure 3: Number of trained instructors and learners by institution

It is the intention that researchers that have undertaken instructor training contribute to training activities. More longitudinal tracking will be needed to understand where trained instructors are currently located and how this asset is (or is not) being exploited locally to support the deployment of skills.

There would be value in having a NZ database of trained instructors, and reflect on the possible benefits of having motivated instructors associated with key institutions or geographical locations. Trained instructors could be encouraged to lead local support activities, such as Hacky Hour, or helping organise and promote Carpentry workshops.

6. Building a national community of practice

While not explicitly stated in NeSI's Training Strategy, its tactics in building a national community of practice in training has underpinned its delivery and success. NeSI has modelled a national leadership role, bringing a planned approach to developing and facilitating communities of practice in training and related events and activities.

Community of practice tactics

- eResearch NZ - facilitate and contribute to sessions on training practices
- ResBaz - take on national coordination of local activities with participation by all local hosts, to share practice etc.
- Carpentries - training instructors, facilitating completion rates for instructors, certification, and support for delivery of subsequent carpentry events
- Science Coding Conference – Encourage the emergence of a community of Research Software Engineers
- Hacky Hour - advocate for Hacky Hours/ Study groups within local disciplinary or institutional communities

NeSI has prioritised its limited resources, and been inconsistent in applying some these tactics. Despite this, NeSI has delivered the targets set out in their Training Strategy, and has provided training efficiently. The effectiveness of the training, however, cannot be assessed confidently with the current data.

Target	Evidence	
Researcher communities capable of self-servicing basic research computing needs through nation-wide community led training activities	The number of community-led events (e.g., ResBaz, Winter Bootcamp, Software Carpentry) has been growing as has the number of institutions leading these events.	✓
Some universities providing basic research computing training programmes as part of standard postgraduate workshop	Research computing training is offered, typically at senior undergraduate or postgraduate level, by New Zealand Universities. NeSI supported a project to create and deliver computing training at the postgraduate level at the University of Auckland.	≠
Growing evidence of research computing capabilities within research communities	NeSI has partnered with the national genomics community on training, initially through NZGL, and most recently with Genomics Aotearoa, with adoption of Carpentries instructors and curriculum. Other communities have been trialling this approach.	✓

6.1. Learnings from community of practice tactics

The following should be considered in any future Training Strategy revision:

- Formalising these tactics and considering how they're scaled across communities and over time
- Supporting mechanisms that maximise the cross-hybridization across different training events
- Ensure that different training events have the right geographical and institutional coverage
- Support mechanisms that enable communities to run their own events, freeing NeSI staff to step in where local expertise is unavailable

7. Measurement & Evaluation

Participant information (including number of participants, affiliation, role, discipline, etc.) is not always readily available across all training activities in which NeSI has played a role. This, which makes follow-up data capture limited, makes it difficult to measure the impact of the past training activities. As NeSI considers its next training strategy, it would be of value to capture data that will make it possible to evaluate the extent to which these offerings are:

- growing HPC capabilities,
- promoting innovation,
- supporting research priorities,
- keeping up with international trends.

A well thought set of evaluation forms and follow up interviews may provide some insight about the effectiveness of these offerings. It is in this area of training where NeSI's efforts directly translate to the growth of advanced computational capabilities that are important not just for

the growth of research in New Zealand and the sustainability of NeSI as an infrastructure provider.

8. Overall Conclusions

NeSI set in place relatively clear goals in order to meet the needs of the sector with regards to basic and advanced digital skills for research. NeSI has met, and in many cases exceeded, the targets set in their training strategy. This places NeSI in a strong position to develop a new strategy that:

- Builds on the successes achieved so far
- Incorporates the learnings from the past years of training
- Leverages the collaborative relationships that were developed during this phase
- Addresses how to continue to build capability within NZ to meet future research needs

8.1. Observations

In considering NeSI's future strategy, it is valuable to consider some elements that could be improved to support future evaluations.

- NeSI works with key organisations to help address the limitations of data about the research workforce.
- The Evaluation Targets in NeSI's Training Strategy are a useful measure of outputs, yet measures of impact are missing
- NeSI collects data about training events that it supports the evaluation of NeSI's training effectiveness and evaluates NeSI's training primary goals, and how these may translate to uptake of infrastructure use.
- NeSI works with training collaborators to share data across different training initiatives to be able to measure the breadth and quality of training activities to:
    - Identify gaps and opportunities
    - Inform how different organizations can assume leadership roles in different areas
    - Ensure that training efforts are not duplicated at the expense of other needed training support,
    - Share methods for quality delivery and evaluation of training activities, to promote engagement as a community of practice
- NeSI incorporates the full 2017 data into this analysis.