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Graduate pathways: Support for Young Geospatial Professionals in New Zealand

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Scope of work

The research presented in this report was commissioned by the Geospatial Senior Officials Group Capability Committee (GSOGCC) in late 2014. The report forms a baseline of support provided to young geospatial professionals within employment in New Zealand. As such, the research conducted here is restricted to currently employed YGPs. The GSOGCC was established to support the development of geospatial capability in New Zealand and is intended to support YGPs "in their careers, with entry into the profession through a variety of options, including school leaver, internships or job applications".

Executive summary

The geospatial skills shortage in New Zealand is greatest for experienced and qualified professionals (de Róiste 2012). To ease this shortage, New Zealand Immigration added 'spatial scientist, other' to the Long Term Skills Shortage List in 2012 as a means of attracting experienced, overseas professionals (de Róiste 2014). This approach relies on the availability of overseas personnel. A longer term solution is the development of internal geospatial capability. New Zealand needs to attract and retain Young Geospatial Professionals (YGPs), and develop their skills and expertise. By detailing the current support landscape for young geospatial professionals, this report aims to identify current pathways for new geospatial industry entrants and development opportunities offered to young professionals to gain skills and experience. While this report focuses on young geospatial professionals under 35, many of the findings will also be applicable to new industry entrants who may join the industry as a second career.

The geospatial support landscape in New Zealand spans three stages: attracting potential new entrants to the geospatial industry, initial skill development prior to entering the industry, and continued skill development once in the industry.

1. Attracting new entrants: geospatial skills are not commonly taught in secondary schools but the number of students taking geospatial standards are rising.
2. Initial skill development: geospatial qualifications are primarily offered at postgraduate level with introductory courses offered at undergraduate. Formal qualifications may be increasingly expected as the industry matures.
3. Continued skill development: vendor and professional training courses are an important skill development avenue. Professional certification is available but uncommon. Networking is facilitated through a number of annual and biyearly conferences and industry events. However, these events are commonly software specific.

To determine the support available to young geospatial professionals, three phases of research were conducted. In phase 1, young geospatial professionals were surveyed about the support available to them in the geospatial industry. In phase 2, geospatial organisations were surveyed about the support they provide to geospatial professionals as well as whether their expectations of young geospatial professionals were being met. In the final phase, geospatial educators at tertiary institutions were interviewed to provide information on university-industry links and the perceptions of skills demanded by the geospatial industry.

The support landscape in New Zealand for young geospatial professionals is viewed positively by the majority of geospatial organisations and young geospatial professionals. To ensure that the New Zealand geospatial industry can fulfil future needs for both qualified and experienced geospatial professionals, the industry needs to attract, retain and develop staff. At each of the three stages of support, awareness of support opportunities could be improved as outlined in section 7. Promoting awareness of opportunities for support (e.g. courses, and internship opportunities) should facilitate the development of in-demand skills.

A number of opportunities exist to improve education-industry links and encourage new entrants into the industry as well as ensuring these new entrants have relevant skills. Collaboration between education institutions and industry in the development of sustainable curriculum and research possibilities will help ensure that new entrants to the industry possess relevant skills.

A strong case can be made for preferential support for young geospatial professionals and in particular for Māori and women professionals. The geospatial industry does not appear to attract a proportional number of Māori professionals and numbers are likely to be significantly below the proportion of the general population with Māori heritage. Whereas for young, female geospatial professionals, the key issue is retention. Women already in geospatial employment are significantly less likely to see themselves remain in the geospatial industry. Additionally, a substantial proportion of young male geospatial professionals also do not see themselves remaining in the industry. Preferential support may need to be offered to young geospatial professionals, and Māori and women in particular, to ensure that future industry needs for both experienced and qualified professionals are met.

Contents

1. Introduction

The geospatial skills shortage in New Zealand is greatest for experienced and qualified professionals (de Róiste 2012). To ease this shortage, New Zealand Immigration added 'spatial scientist, other' to the Long Term Skills Shortage List in 2012 as a means of attracting experienced, overseas professionals (de Róiste 2014). This approach relies on the availability of overseas personnel. A longer term solution is the development of internal geospatial capability. New Zealand needs to attract and retain Young Geospatial Professionals (YGPs), and develop their skills and expertise. By detailing the current support landscape for young geospatial professionals, this report aims to identify current pathways for new geospatial industry entrants and development opportunities offered to young professionals to gain skills and experience.

While senior professionals were in the greatest shortage, new entrants are also an acknowledged shortage. One such consequence of the under supply of qualified new entrants is that some new entrants do not have a geospatial education or substantial relevant expertise. A young geospatial professional may enter the workforce with skills and knowledge primarily gained through a formal university education with or without geospatial specialisation. Other entrants may have acquired skills and knowledge while volunteering, through hobbies or other informal means. Consequently, the support to enable and develop the capabilities of YGPs is critical.

Geospatial support in New Zealand comprises of three main stages; attracting potential new entrants, initial skill development, and continued skill development. Attracting interested future professionals to geospatial development opportunities relies on existing knowledge of the industry so that future professionals can make the appropriate education or skill development choices. The teaching of geospatial skills at secondary school and the visibility of the industry to students making career decisions underlies the support provided in this first stage. In the second stage, those interested in becoming professionals in the geospatial industry may need to develop geospatial skills prior to entering the industry, although existing geospatial skills are not required for some roles. A geospatial professional can enter the industry either by being hired directly or through a specific entry pathway, such as an internship or part time role while studying. This stage requires that the future professional is aware of the appropriate skills to develop, what entry pathways are available and how to access employment opportunities. The third stage is the support for the professional once they are employed in the industry. Young geospatial professionals are likely to need to upskill to respond to changing technologies (e.g. newer software versions), changing roles in the same industry which can require different skills (e.g. application development programming in comparison

to field GIS skills), or to mature into experienced geospatial professionals and take leadership roles in the industry.

This report details the results of a three part research project sponsored by Land Information New Zealand (LINZ) and the Department of Conservation (DOC). The project investigates the current geospatial educational landscape, the expectations of geospatial organisations and the experience of YGPs themselves. The report's scope was limited to YGPs under 35, already in employment (see Appendix 1 for the definitions used), however many of the findings will also be applicable to new industry entrants who may join the industry as a second career.

This report explores current support for YGPs in New Zealand from education to opportunities offered to YGPs by industry across three support dimensions. First, we explore the educational context within New Zealand. We detail education courses available to those interested in entering the geospatial industry and ask educators to identify skills that most relevant for graduates entering the workforce. Second, we report on geospatial employers' opinions and experience of YGPs. Third, we explore the perceptions of YGPs, themselves, of support provided within the industry. Definitions of the key terms used in this report are provided in Appendix 1.

In section 2, the report summarises the current support opportunities available in New Zealand across education, training, and both formal and informal network events. Section 3 details the perceptions of support offered to 101 young geospatial professionals in current employment. Section 4 reports on a survey of 132 geospatial organisations to explore the extent to which new and potential entrants to the geospatial industry are meeting demands of employers and are supported in their needs to upskill. Section 5 summarises 8 interviews with tertiary geospatial educators in New Zealand regarding the skills demanded by employers and their current and potential links with industry. In Section 6, the results of the two surveys and interviews are discussed. A number of key recommendations are made in Section 7. Possible future research is identified in Section 8 and Section 9 concludes.

2. Geospatial support landscape in New Zealand

In this section, we briefly review the current landscape of skill development opportunities.

Secondary education

Geospatial skills are not commonly taught in New Zealand secondary schools. Geospatial standards, where offered, are part of the Geography curriculum in the NCEA (National Certification of Educational Achievement). Three NCEA standards in New Zealand deal with spatial analysis. The three standards from level 1 (year 11, form 5) to 3 (year 13, form 7) were introduced in 2011. As

indicated in Table 1, the number of students taking each of the standards are increasing. The nature of secondary education in New Zealand requires secondary teachers to choose what standards their students will study and how those standards are achieved. It is likely that training and resourcing for geospatial skills, which require the use of computing resources and the teacher's familiarity with the software, form a barrier to the wider adoption of these standards.

Table 1: Number of students taking level 1-3 NCEA spatial analysis standards from 2011-2013. Source: New Zealand Qualifications Authority

	2011	2012	2013
Level 1	1,395	1,882	2,016
Level 2	14	360	505
Level 3	0	5	176

Tertiary education

Introductory GIS, remote sensing and other geospatial courses are offered at undergraduate level in most universities in New Zealand. These geospatial courses primarily form a component of other specialisations, e.g. Geography or Earth Sciences, rather than a core qualification. Surveying is the exception. Named qualifications in geospatial (e.g. GIS) predominantly exist at postgraduate level. The focus on postgraduate geospatial education is in keeping with offerings in other countries, e.g. the UK and the USA. A comprehensive list of courses including contact details is available in Appendix 2.

As the industry develops, expectations of formal geospatial qualifications are likely to increase. A drawback to this postgraduate emphasis is the delay in which professionals with the appropriate skills will enter the workforce (an additional one to two years after their primary degree). However, entry into the geospatial industry following a postgraduate qualification means that the generic skills, e.g. team work and communication skills, as well as domain specific knowledge, e.g. ecology or geology, can be of benefit to the young professional and the industry. Further, all new entrants to the industry do not require a postgraduate qualification to gain employment.

Benefits of formal tertiary education courses or programmes over other skill development options, such as software training, include the formal assessment of the student's knowledge and the inclusion of theory as well as hands on experience (Whyatt *et al.* 2011). Education courses have a wide remit and ideally should cover concepts and critical thinking skills rather than simply tools or techniques (Bearman *et al.* 2016). Universities and other tertiary institutions place considerable

importance on graduate attributes, e.g. "work both independently and collaboratively with others"[1]. These attributes are intended to be developed throughout the student's programme of study and comprise of generic skills (e.g. written communication) or may vary by discipline.

Vendor and professional training courses and the role of professional organisations

Software training courses are commonly provided by software vendors in New Zealand, such as Eagle Technology (Esri) or Critchlow (MapInfo). These courses are generally short term (e.g. 1-2 days), and focused on specific software techniques. The courses provide an important role in the support landscape by allowing professionals to upskill in specific areas. For example, professionals may use these courses to update their skills with a new version of the software or expand their knowledge of servers. While commonly these courses are not formally assessed, certification in the use of the specific software is possible (e.g. Esri Technical Certification).

In 2013, the New Zealand Institute of Surveyors (NZIS) expanded its remit to specifically include other geospatial professionals. NZIS host a number of continuing professional development (CPD) courses throughout the year (e.g. customer service excellence and negotiating skills). The courses cover the development of generic skills as well as training in software and geospatial processes. NZIS provide certification in New Zealand for surveyors and CPD is a requirement of continued certification. While other professional certification is available in New Zealand (e.g. CGeog (GIS) [2]), they are uncommon.

Conferences and industry events

Industry conferences in New Zealand are hosted annually in software specific communities (e.g. the 'New Zealand Esri User Conference'[3] and the 'New Zealand Intergraph User Conference'). These software communities also host a number of regional meetings. Software neutral conferences are hosted by a range of organisations which target different aspects of the professional community. A national Māori GIS conference ('Place') focuses on issues of relevance to Māori, while biennial conferences on GIS research (NZGRC, formerly SIRC) and Cartography (Geocart) have a greater academic focus. ALGIM (Association of Local Government Information Managers) host an annual conference with a primary focus on ICT use local government with a strong GIS component. ALGIM also host an annual GIS Symposium. NZIS host an annual conference with a spatial stream. Further professional events are provided by Women in Spatial (WIS, under NZIS), Emerging Spatial

[1] http://www.victoria.ac.nz/learning-teaching/learning-partnerships/graduate-profile
[2] http://www.rgs.org/OurWork/CharteredGeographer/Application+criteria.htm
[3] The ESRI User Group organises the regional meetings while the annual conference is organised primarily by Eagle Technology.

Professionals (ESP)[4], NZIS and vendors. These events can take the form of seminars, public talks and networking events (e.g. fieldtrips or evening drinks). The benefit of these events can be less tangible compared with other skill development opportunities. These events provide professionals with the opportunity to network and learn of new software developments as well as applications and processes in other organisations. Further benefits are described by YGPs in section 3.

3. YGPs' perceptions and experience

Young Geospatial Professionals (YGPs) were surveyed to ascertain their perceptions of support available to them in the geospatial industry. This section of the report first describes the characteristics of the YGPs surveyed. Next, the importance of entry pathways, such as internships and graduate positions, are described. In the following section, the expectations YGPs had of their current roles compared to their current experience is assessed. In the final section of this phase of research, the support offered to YGPs is described. Information on the methodology used to survey the YGPs is in Appendix 3.

One hundred and one YGPs completed an online survey[5]. Most YGP respondents worked in the geospatial industry for between 2-5 years (44%). As expected, the respondent's age affected the length of time they had worked in the industry, with older respondents working the longest. However, respondents in the 30-34 range also included new entrants. This delayed entry to the industry points to discovery of the industry by older entrants after a first entry to the workforce in a different sector. For this reason, it is important to conceptualise new entrants as both straight from education and second career. Alternative entry pathways for second career professionals may also need to be considered.

The respondents were 53 male, 47 female and 1 unspecified. Most respondents were New Zealand citizens (78), 14 respondents were permanent residents and 7 were employed on working visas. Thirteen respondents had moved to New Zealand to take up a position in the geospatial industry, 8 within the last 3 years. Only one New Zealand citizen moved to New Zealand for a job in the geospatial industry.

Respondents could select more than one ethnicity. Most respondents were New Zealand European[6] (66). Māori comprise approximately 15% of the New Zealand population and only comprised of

[4] The Emerging Spatial Professionals (ESP) group was formed around the conclusion of the data collection for this project and consequently was not mentioned by respondents as a source of possible support.
[5] The numbers replying to each question may change as some questions were not relevant to all participants and not all participants answered all relevant questions.
[6] One respondent identified as a New Zealander and not as New Zealand European or Māori and consequently could not be used in ethnicity comparisons against national statistics.

6.4% of the New Zealand citizens within the respondents and 5% of the total respondents. It would seem from this sample, that Māori are underrepresented in the geospatial industry[7]. Most respondents were full time employees. Only 16 were part time (13) or in temporary or contract positions (3) and none were self-employed.

Most of the respondents identified as a Geospatial Professional (83.2%) even when other professional identities were selected. When asked to select a single identity, Geospatial Professional was chosen by 48.5% of respondents followed by Spatial Professional (9.9%), Other (6.9%) and Geographer (5.9%). It is interesting to note that GIS was only identified twice despite education courses predominantly containing GIS in their titles (Appendix 2).

Postgraduate qualifications are the most common level of qualification with 59 respondents holding an honours, postgraduate diploma or certificate, masters or doctorate (Figure 1). Bachelor's degree was the single most common educational qualification (35 respondents). Fourteen respondents did not have a geospatial qualification. 26 respondents have a geospatial bachelor's degree. As the possibility of taking a geospatial bachelor's degree in New Zealand is limited, respondents may have interpreted this question to mean a relevant spatial discipline (e.g. Geography) as well as more specialised geospatial qualifications (e.g. surveying and minor in GIS). Thirty-nine respondents had a postgraduate geospatial qualification, again making a postgraduate geospatial qualification the most common. A further 21 respondents had taken specific geospatial education courses at tertiary level or a graduate certificate or diploma.

[7] However, as a single census of YGPs was not available and data collection was conducted through particular spaces within the geospatial community, these figures may under represent Māori participation.

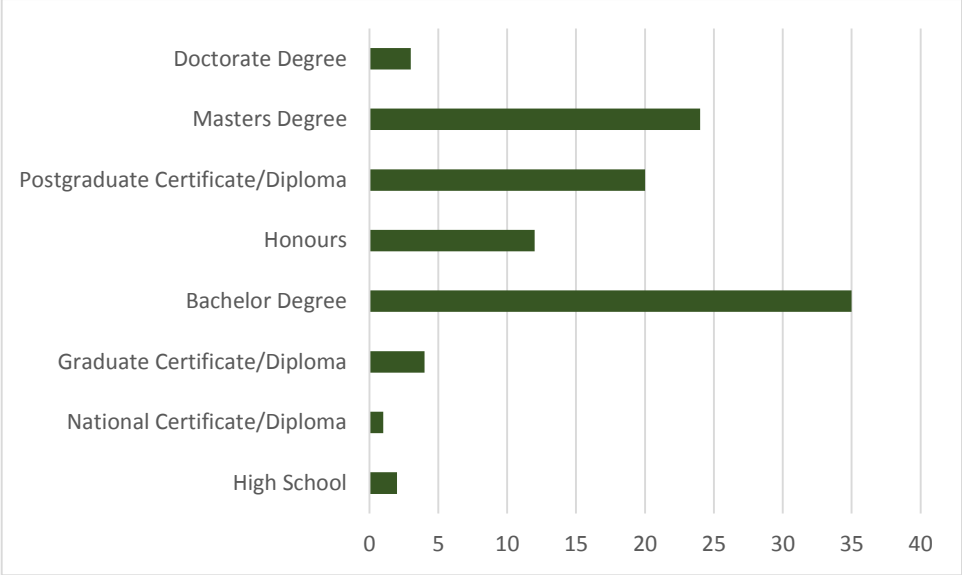

Figure 1: Highest qualification held by young geospatial professionals[8]

What is the importance of entry pathways for YGPs?

Internships, research scholarships, summer employment, part time roles and graduate development programmes can provide a clear entry pathway into the geospatial industry for current students and recent graduates. These pathways may also be suitable for second career entrants. In this section, the benefits and experience of these entry pathways are explored.

Just over half of the respondents (51) followed an entry pathway into the industry. An internship which was either paid or unpaid and supported by a university or educational institution was the most common pathway (Figure 2). Most commonly respondents only took a single supported entry pathway to the industry but some respondents (25%) took advantage of more than 1 pathway. Internships and similar entry pathways were most commonly of 1-3 month duration.

[8] All graphs in this document use absolute numbers rather than percentages. The number of organisations and YGPs answering each question differed and consequently, percentages may have hidden the importance of the absolute values in forming comparisons. As the number of YGP respondents was 101, interpretation will not differ in most cases as when rounded the values are the same.

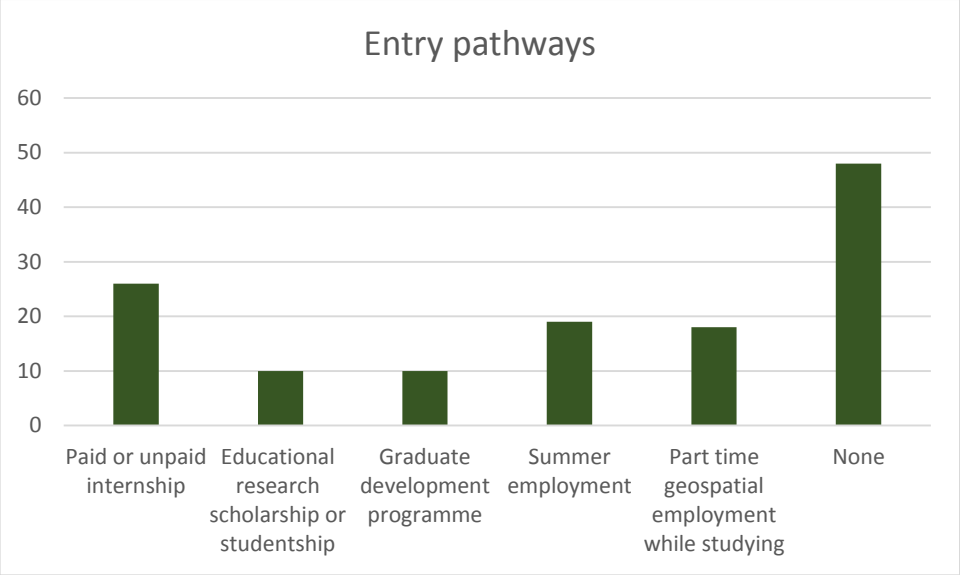

Figure 2: Entry pathways into the geospatial industry for YGPs

Of the 50 respondents who answered the question, half were offered a position at the end of their internship, scholarship or similar role. Of these 25, 11 are currently employed in the offered position. If the respondent was not employed in the offered role, they had moved on from the role offered through promotion, or subsequently changing position or company (6), overseas internship (2), contract position offered (3), and competing offer at another company (2). It is interesting to note that one respondent although employed at a different company "*was recruited by a former manager*" (YGP).

It is likely that the entry pathways are of benefit to both young professional and employer. In the employer's case, they can assess the suitability of the candidate for more permanent or full time roles and in the professional's case, they build their network as well as geospatial work experience which is highly regarded by employers.

Respondents were asked about both geospatial and generic skill development over the course of their most recent entry pathway position. The most common answer where the skill was required is marked with an asterisk in Table 2 and Table 3. It is interesting to note that familiarity with geospatial software was a requirement for all the entry pathway positions, and skill development in this area was the strongest across the geospatial skills identified. Improvements in geospatial database familiarity were also strong. Least required were application development programming and field GIS skills. For each of the generic skills, most respondents identified that they had improved a little. Fewer respondents identified the generic skills as not being required. A notable exception is leadership which is expected given the short term and junior nature of most entry pathway positions. An entry pathway also offered respondents the opportunity to experience the

work environment (*"Get to know the work environment, responsibilities that goes with it (contrary to doing an assignment, a work task has real consequences and cannot be undertaken lightly)"* (YGP)).

Most respondents were unsure as to whether sufficient opportunities for entry pathway roles are available (42.6%). Thirty five respondents did not believe enough opportunities were present while 23 did. Respondents who did not undertake an entry pathway role were more unsure (65% in comparison to 21% of those who completed such a role). The respondents who did not follow an entry pathway may have been less motivated to seek opportunities in advance of more formal entrance to the geospatial industry. Consequently, their knowledge of available options might be more limited. Respondents who applied but were unsuccessful or did not take up the role were evenly split between the three options (yes, no, unsure).

Table 2: Geospatial skill improvement as result of entry pathway

	Significantly improved	Improved a little	About the same	Skill not required
Application development programming	3	9	**12***	27
End user programming	7	11	**13***	20
Familiarity with servers	9	**15***	7	20
Geospatial database familiarity	**21***	16	9	4
Cartographic skills	19	**22***	7	2
Spatial reasoning and problem solving	20	**22***	6	2
Geospatial software familiarity	**31***	16	3	**9***
Field GIS skills	8	6	0	25

Table 3: Generic skill improvement as result of entry pathway

	Significantly improved	Improved a little	About the same	Skill not required
Oral communication	17	**23***	10	2
Written communication	10	**21***	17	3
Team work	11	**24***	12	5
Ability to work independently	18	**20***	14	0
Problem solving	18	**26***	8	0
Project management	10	**17***	16	9
Leadership	5	**17***	**17***	13
Information Technology (IT)	13	**22***	12	5

Do YGPs' expectations of geospatial roles match reality?

The respondents were asked to rate the importance of different skills in being successfully hired to their current position. All of the skills were deemed to be important by most respondents while previous geospatial work experience and geospatial skills were essential to being successfully hired in the respondent's current role (Table 4). Geospatial qualifications had the highest number of respondents rating this as unimportant (10 respondents). Of these 10 respondents, only 2 had a postgraduate geospatial qualification. Other education qualifications were seen as more important (and fewer respondents ranked education qualifications as unimportant (2 respondents)). The value the respondents place on geospatial qualifications may reflect the nascent stage of geospatial qualifications in New Zealand (respondents were classified as young geospatial professionals if they were under 35 and many current geospatial qualifications are not established over 5 years) or it may reflect a greater emphasis on 'on the job training' by employers. If a high value is placed by employers on 'on the job' training, we would expect to see high levels of support offered to young geospatial professionals whether internally (e.g. mentoring) or support to access external resources (e.g. vendor courses or conferences).

Table 5 details the importance of different skills in the respondents' current role and compares these to their expectations. Most skills were as important as expected. IT skills, familiarity with servers, application development programming and end user programming were more important than expected for most respondents. While remote sensing and photogrammetry, field GIS skills, cartographic skills and written communication were deemed important for their current role by 19, 27, 74 and 10 respondents respectively, the importance of these skills was over estimated by 32%, 30%, 18% and 10% of respondents respectively prior to starting the role. Interestingly, IT skills were only deemed important by 74 respondents, potentially highlighting a separation of geospatial roles from IT in the workforce and the differentiation by professionals in the industry. Over 50% of respondents who selected project management (56%), familiarity with servers (71%), end user programming (81%) and application development programming (82%) needed further development in these skills for their current role.

Table 4: Importance of existing skills in gaining employment

	Essential to position	Important	Neither unimportant nor important	Unimportant	Not relevant to position
Previous work experience	36	**38***	11	8	8
Previous geospatial work experience	**42***	39	10	7	2

Qualifications	30	**54***	13	2	2
Geospatial qualifications	30	**34***	25	10	2
Geospatial skills	**53***	30	13	3	1
Generic skills	34	**60***	6	0	0
General IT skills	12	**59***	21	7	2

Table 5: Importance of skill in current role compared with expectations. Ordered by number of respondents who selected that skill as important for their current position. Columns may not sum to the number of respondents who selected this skill as important as some respondents did not answer all questions.

	Important in role	More important	As expected	Less important	Further development intended
Ability to work independently	96	15	**78***	1	9
Geospatial software familiarity	93	18	**70***	5	30
Problem solving	93	32	**59***	2	22
Geospatial database familiarity	91	36	**51***	4	41
Team work	91	13	**76***	2	11
Spatial reasoning and spatial problem solving	87	23	**59***	5	39
Written communication	87	15	**63***	9	19
Oral communication	82	19	**56***	6	29
Cartographic skills	74	14	**47***	13	16
IT skills	74	**35***	35	4	29
Project management	63	23	**37***	3	35
Familiarity with servers	55	**33***	19	3	39
End user programming	43	**22***	17	3	35
Leadership	42	15	**26***	1	21
Application development programming	28	**15***	12	1	23
Field GIS skills	27	2	**17***	8	6
Remote sensing and photogrammetry	19	2	**11***	6	5

The most common number of skills the candidates needed to develop was 3 (24 respondents) (Figure 3). Six respondents said they needed to further develop more than 10 skills. Rather than simply highlighting a lack of skills, continued professional development is expected in response to changing industry needs and software.

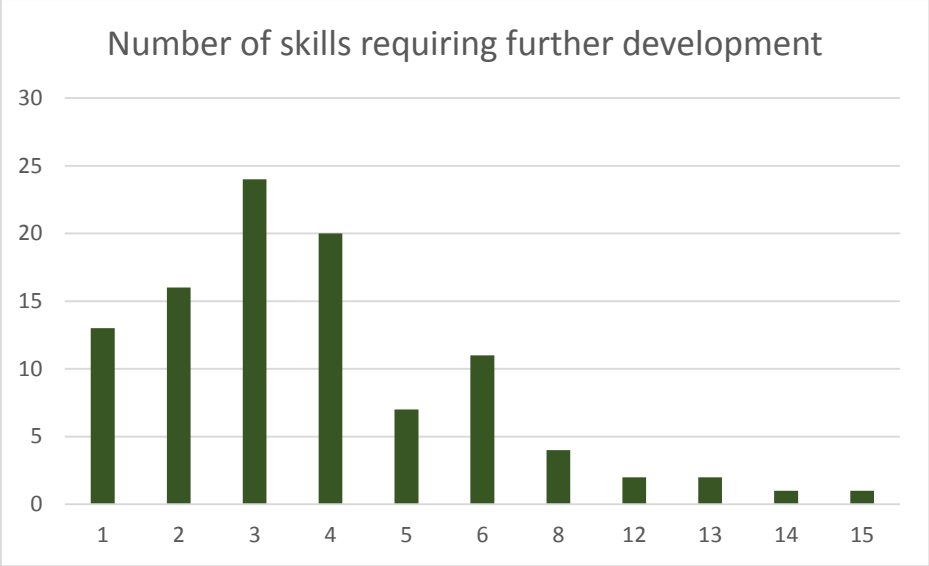

Figure 3: Number of skills YGPs identified as requiring further development

Table 6: Reasons YGPs gave as to why further skill development was needed. The two responses indicated by ^ were created from respondent unstructured answers and recoded.

I am new in my current position and will develop these skills with time in my role	41
These skills were not offered as courses at my education institution(s)	32
There were not sufficient opportunities to develop these skills at my education institution(s), e.g. leadership, communication	32
I did not take the relevant courses offered at my education institution(s)	21
Always more to learn^	17
My employer does not provide support to develop these skills	15
I have yet to investigate my options	15
Focus on other development or changing role requirements^	6
I was unable to take advantage of opportunities provided by my employer to develop these skills	3
Other	2

The most common reason a respondent needed to further develop their skills for their current role was being new in the role (Table 6). The next three most common answers related to the skills and courses offered at the respondent's education institution in 32 instances the skills were not offered and sufficient opportunities to develop were not available. In 21 cases, the respondent did not choose the relevant courses available. Where courses and skills were provided by the education institution, the respondent may not have been aware of the available options (e.g. "*Lack of advice. The university did not stress the importance of computer programming as part of GIS education*" (YGP)). Interestingly, 'always more to learn' was created from respondent clarification when the 'other' option was selected. Many of these answers reflected the fast changing nature of the industry ("*The industry is constantly changing, so you need to keep up with the technology. There are not always courses to teach these skills*" (YGP)).

What part does support play in YGP roles?

Upskilling opportunities are important for YGPs to gain the skills necessary for current and future roles. Most respondents had been offered support. In house training was the most common form of support participated in by respondents (91 respondents), followed by attendance at industry events and conferences (81 each) and external training or education (78) (Figure 4).
Eight respondents did not receive any level of funded support over the last 3 years.

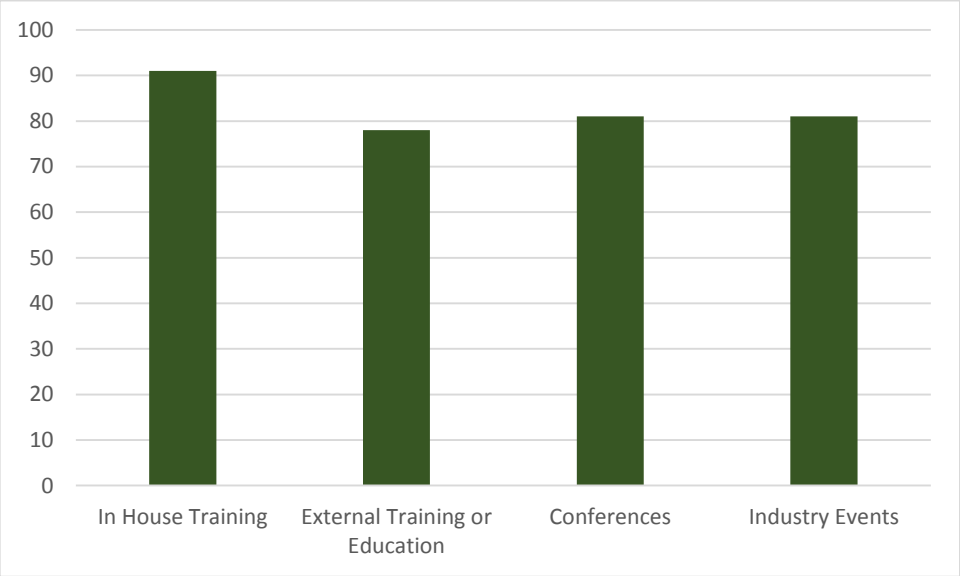

Figure 4: support provided to YGPs by their organisations

Mentoring with senior staff other than managers was the most common form of in house training support (Figure 5). Both internally and externally created resources were also commonly employed. Courses provided by vendors were less common. Internal support may be, at least partially, equated to 'on the job' training and is seen as a core component of continued professional development for YGPs.

Figure 5: In house training available to YGPs

Vendor courses were the most common form of external training or education (61 respondents), followed by education courses (27), non-geospatial IT courses (22) and courses run by a professional organisation (17) (Figure 6). Courses at an educational institution are normally a more significant time and resource investment and may not directly correspond to the software or other immediate needs of an organisation.

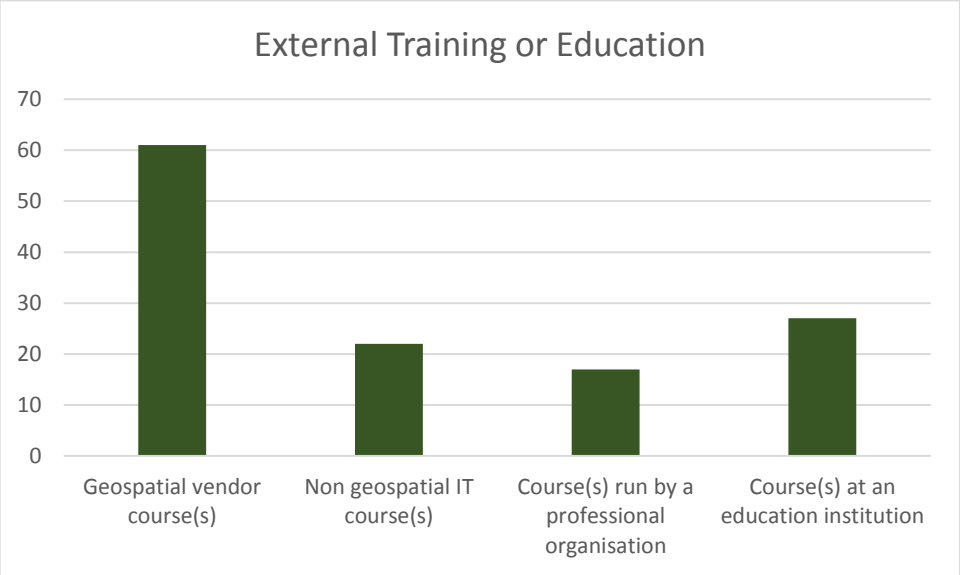

Figure 6: External training or education accessed by YGPs

Most respondents had attended a conference (81), but attendance at industry events was less common (Figure 7). Given the cost of attending conferences, local industry events may be a cost effective, upskilling and networking option. However, attendance at these events may be limited by availability or a lack of recognition of benefit by employers.

Only a third of respondents had presented at a conference. Benefits of presenting (such as greater visibility for the organisation and the professional or cheaper conference registration) may not be recognised by the organisations or the professionals themselves or seen to overcome the challenges of public speaking.

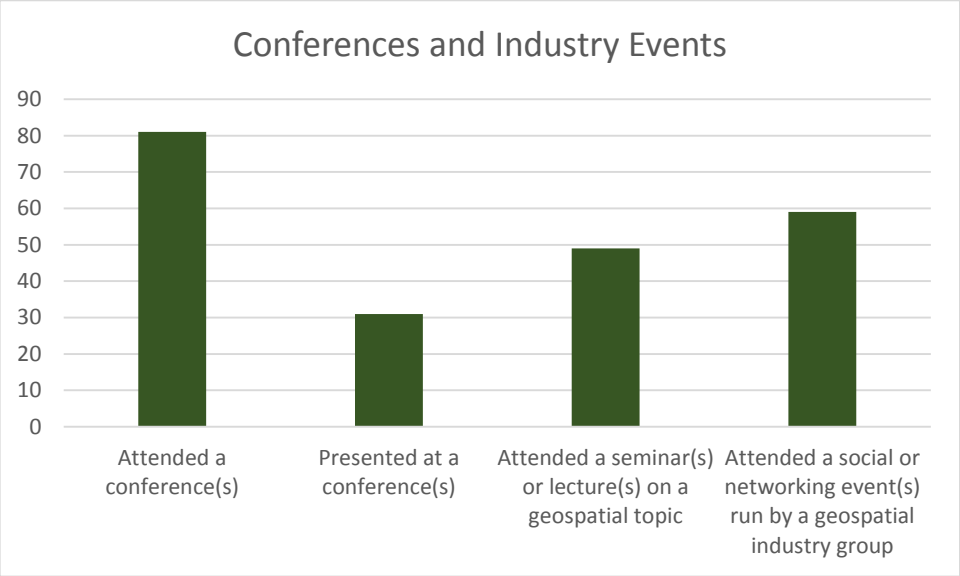

Figure 7: Conference and industry events attended by YGPs

If a respondent undertook an education course while in employment in the past three years, the employer was most likely to provide full fee payment (25). Time in lieu for study was not as common (7). Given that education courses normally require significant study outside of class times (e.g. a second year GIS course[9] can include 2 hours of lectures and a further 2 hours of labs a week for 12 weeks in addition to an expectation of a further 100 hours of independent study to complete assignments etc.), lack of time in lieu may make this option less attractive to YGPs.

Employers were more likely to fully fund a vendor course and only 1 respondent out of 58 received partially funded attendance. Full funding was commonly available for conference attendance (75 of 82 respondents) and industry events (45 respondents and a further 13 respondents received time in lieu where there were no associated costs to attending the event). Further development options provided by employers included: internships or summer student roles, providing information about networking opportunities, leadership training, Esri certification funding, and leave without pay for a volunteering opportunity.

All respondents thought that upskilling opportunities were important to them as individuals (Figure 8). Staying current and learning about the latest technologies and trends (98) was the most

[9] Course in this instance refers to a single subject or paper rather than a programme of study, e.g. an introductory GIS course as part of a wider Geography degree.

common answer provided, followed by learning about best practise or other ways of doing things (93) and networking (91). Apart from certification credits[10], hearing about jobs was least mentioned. Fears employers may have about staff actively networking their way into alternative roles would appear to be unfounded. However, staff who highlight their effectiveness at such events may be actively approached by alternative employers. The reward aspect of such support opportunities is underscored by the 'socialising', 'having fun', and 'getting out of the office' responses. Participation may be an effective means of rewarding staff in a manner that also coincides with more direct benefits to the organisation, such as employee upskilling.

Similar to individual benefits, networking, sharing ideas, company visibility, learning about different ways of doing things and best practise, staying current and learning about the latest developments and what was happening in the industry were all identified as benefits to the organisation. The benefit of more confident and skilled staff was recognised by a number of respondents (e.g. "*Providing time and support to training and development opportunities benefits the employer as the ideas, improvements and skills learnt will enable the employee to be more efficient, productive in their job and provide opportunity for process improvement and new ideas*." (YGP)). In addition, respondents placed a significant emphasis on collaboration on projects or for problem solving based on networks developed at these events. The benefit in motivating, engaging, retaining and rewarding staff was also identified as a key benefit by respondents (11). Recruitment opportunities of new employees for the organisation were only identified by a single respondent.

[10] Certification credits as a response was recoded from the other answers provided and so is likely to understate the numbers of respondents who would have chosen this answer if it were listed.

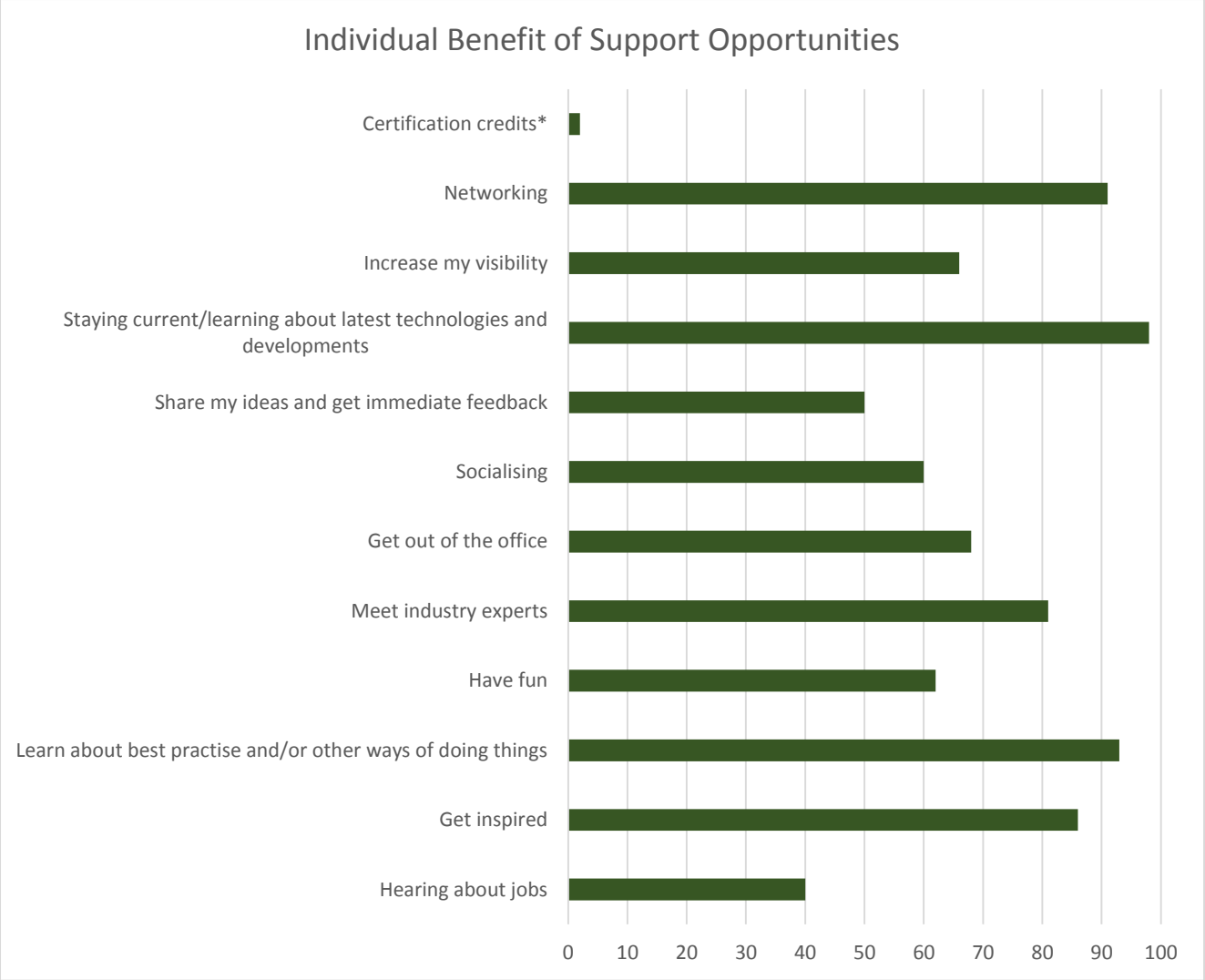

Figure 8: The benefit of support opportunities to YGPs. Certification credits was recoded from the 'other' answers provided.

Most respondents (62.4%) believe sufficient current skill development opportunities exist in New Zealand, while 25 are unsure and 13 do not agree (Figure 9). Respondents who believe there are insufficient opportunities to develop these skills are more likely to be actively developing most or some of these skills (92% of respondents with this answer) in comparison to respondents who are not sure (64%) or believe there are enough opportunities (76%).

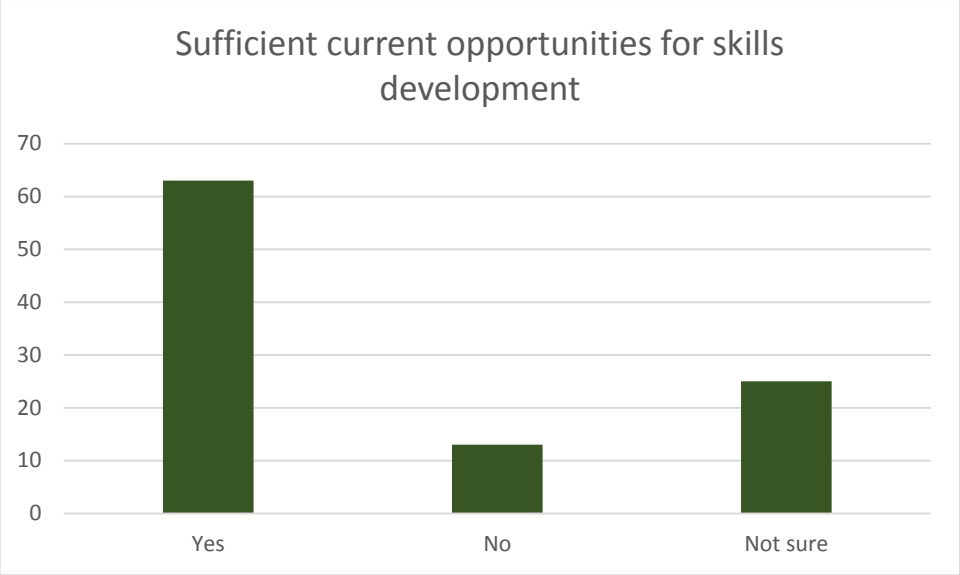

Figure 9: Are sufficient current opportunities provided for skills development?

To ensure that the geospatial industry can grow appropriate senior geospatial professionals who can perform more senior geospatial roles, the support needed by YGPs is likely to change the longer they work within the industry. Respondents with a longer length of time in their current role and in the geospatial industry may be more likely to need management or leadership skills (e.g. "*With [the] years, I tend to do more management and less geospatial work*." (YGP)).

To fill the largest skills shortage for experienced and qualified geospatial professionals, the geospatial industry must first attract and then retain professionals. Most respondents (58) see themselves in a geospatial position in 10 years' time. However, a high number of respondents do not envisage a future within the industry. Worryingly, women were less likely to see themselves in the industry over the same time period (38% compared with 60% of men, a statistically significant p value of 0.047*). The difference between male and female responses is troubling. Losing female professionals who are gaining experience of the New Zealand industry calls for the examination of factors behind this result. Women, consequently, may need greater support to ensure they see the geospatial industry as a longer term career.

4. Geospatial Organisations

In the second research phase, geospatial organisations were surveyed about the level of support they offer to Young Geospatial Professionals (YGPs), the value placed on geospatial and generic skills, whether YGPs are meeting employer's expectations, and if entry pathways to the industry were offered. 132 organisations participated in a survey on geospatial organisations' perceptions of young geospatial professionals (the methodology is outlined in Appendix 3). Of these, not all organisations fulfilled the criteria for every question, e.g. only 70 respondents were directly involved

in the recruitment process for a recent hire. Where percentages are provided, the percentages refer to the proportion of the valid responses received for that question rather than the total number of participating organisations.

Of the 132 organisations in phase 2, 91 (69%) had recruited or attempted to recruit in the past three years. 356 positions were recruited or attempted to recruit with a mean of 3.91 positions across the 91 organisations. Of these 356 positions, 157 (44%) were at entry level. For the most recent recruitment process and where the respondent was involved, most positions attracted candidates from within New Zealand (94%) followed by international applicants (57%) and applicants from the Asia Pacific region (43%)[11]. Approximately, 283 YGPs were employed by the 132 organisations surveyed and of these, 43 did not employ a YGP. The largest number of YGPs employed by a single organisation was 25.

Do employers value geospatial skills, qualifications and experience?

YGPs are being considered and hired in a large number of geospatial vacancies. When the respondent was involved in the recruitment for the most recent position, a YGP was considered for the role in 62 cases (89%). A YGP was successful in 44 of 56[12] positions in which they were considered. The reasons a YGP was not considered or was unsuccessful were similar; a stronger candidate was awarded the position (4 – in these 4 cases no other reason was cited), a YGP did not apply (4), training would divert resources from elsewhere in the organisation (2), or the YGP was lacking necessary skills (geospatial skills (6), generic skills (5), work experience (7), educational qualifications (1), management experience (1)). Educational qualifications or management experience were not listed as an issue for the YGP's lack of success in gaining a position once they were considered. The small number of YGP candidates who were overlooked in favour of a stronger candidate indicate that geospatial professionals seeking employment are not in over supply and the skills shortage identified in de Róiste (2014) is still likely to exist.

The respondents were asked to identify which skills or characteristics were most relevant for the most recent position where a YGP was considered. These characteristics were split between qualifications, work experience, geospatial experience and generic skills (see Table 7). Generic skills are often aligned with graduate attributes promoted by universities (Barrie 2006) and relate to transferable skills such as written and oral communication, teamwork, and leadership. Values fit with the organisation was the most highly rated by employers followed by geospatial and generic

[11] These numbers do not add to 100% as most positions attracted candidates from multiple categories.
[12] Please note: this is less than the 61 respondents that answered this section. The 7 missing respondents may simply have failed to answer this question or the recruitment process was not successful which was not provided as an option.

skills. The reasons given as to why YGPs were not offered or considered for a geospatial role broadly fit with the importance of skills listed in Table 7.

Table 7: Importance of skills and characteristics[13] for positions where a Young Geospatial Professional was considered. Entries marked with an asterisk (*) denote the highest response for that skill or characteristic. Table is ordered by median answer.

	Extremely important	Important	Neither important nor unimportant	Unimportant	Extremely unimportant
Values fit with organisation	**33***	26	3	0	0
Geospatial skills	15	**44***	4	0	0
Generic skills (e.g. written and oral communication)	16	**39***	7	0	0
Previous geospatial work experience	12	**44***	5	0	0
General IT skills	9	**35***	16	2	0
Geospatial qualifications	5	**40***	17	0	0
Educational qualifications	7	**33***	20	1	0
Previous work experience	3	**39***	15	5	0

Despite the ranking of generic skills below geospatial skills, four generic skills (in order: problem solving, team work, the ability to work independently and oral communication) were ranked more important than any geospatial skill when respondents were asked to rate the importance of a specified list of geospatial and generic skills. Spatial reasoning/problem solving was rated the highest geospatial skill followed by familiarity with at least one geospatial software. All of the generic skills were listed higher than familiarity with servers, application development programming, and remote sensing and photogrammetry. Largely, leadership and project management were not expected or considered important for roles where YGPs were considered.

Recruitment methods were also surveyed and candidates were rarely asked to provide evidence of their geospatial skills (e.g. portfolio or a programming or geospatial skills test). While geospatial qualifications were ranked below geospatial skills and previous geospatial work experience in Table 7, it is likely that geospatial qualifications are taken as an indicator of the candidate's ability in the absence of other testing or work experience. *"Geospatial skills are present, formal degree or*

[13] Other elements identified as important or extremely important were personality or attitude (2), willingness to learn (1) and, flexibility (1).

certification is testimony for this" (geospatial organisation). However, formal documentation of these qualifications were rarely requested.

Are YGPs meeting employer's expectations?

Sixty seven of the organisations surveyed (77% of respondents who answered this question) hired a YGP in the last 3 years. In general, YGPs are meeting employers' expectations (Table 8). A number YGPs are also exceeding employers' expectations, particularly in their familiarity with at least one geospatial software. Taking both the number of roles in which the skills are required and the number of YGPs not meeting or only somewhat meeting expectations, geospatial databases and cartography are of particular note. While required for fewer roles, familiarity with servers is also an area where a number of YGPs do not met the role requirements.

Care must be taken in extrapolating negative results to all YGPs. Most YGPs are meeting requirements and the results may not represent a lack of training, education or other skill development opportunities in these areas. However, from Table 10 (in Appendix 2) skill development in servers was not provided as a course option at any of the universities listed. Additionally, while databases are listed as part of GISC 405 in the MGIS programme, this inclusion is at most a sub-set of the course. Presently servers and geospatial database training is most likely to be provided by vendor courses. Cartography, conversely, is provided as part of the MGIS programme (across three universities) and at the University of Otago. As a result, it is surprising to see that a large proportion of YGPs are under performing in this area. This underperformance may reflect the recent creation of these postgraduate qualifications in conjunction with the wide range of ages (under 35) falling under the definition of YGP.

YGPs were more likely to exceed employers' expectations of the generic skills compared to geospatial skills (Table 9). YGPs were also slightly more likely to only 'somewhat' meet the generic skill requirement of the role (17% of YGPs compared to 18% but the difference is not statistically significant). A high number of YGPs exceeded team work and ability to work independently requirements for their role. A high number of YGPs exceeded at oral communication, and conversely a high number who did not fully meet the skill requirement, though this skill is required in a high number of roles. Of additional note are the expectations around leadership. While leadership was not required by the majority of roles, it had the highest proportion of YGPs not fully meeting this requirement.

Table 8: Did YGPs meet employer's geospatial skill expectations for the role in which they were hired? The number of roles in which the skill was required differs. An asterisk (*) denotes the highest response category where the skill was required. Due to a survey software malfunction some of the respondents' answers were not appropriately recorded, this issue affected between 0 and 6 responses per skill (average 1.9 responses) and these responses were excluded. Skills are ordered by the number of roles in which they were required.

	Exceed	Met	Somewhat met	Not met	Not required	Number of roles where skill was required
Overall geospatial skills	7	**38***	7	0	1	52
Familiarity with at least one geospatial software	9	**35***	5	1	1	50
Spatial reasoning & spatial problem solving	7	**35***	7	1	1	50
Geospatial databases	4	**32***	10	3	2	49
Spatial analysis	4	**39***	5	1	1	49
Cartography	5	**28***	9	2	8	44
End user programming	4	**16***	3	0	25	23
Familiarity with servers	0	**12***	9	2	25	23
Field GIS & surveying skills	3	**16***	3	0	29	22
Application development programming	5	**12***	3	0	26	20
Remote sensing & photogrammetry	0	**13***	3	0	35	16

Table 9: Did YGPs meet employer's generic skill expectations for the role in which they were hired? The number of roles in which the skill was required differs. An asterisk (*) denotes the highest response category where the skill was required. Due to a survey software malfunction some of the respondents' answers were not appropriately recorded, this issue affected between 0 and 6 responses per skill (average 2 responses) and these responses were excluded. Skills are ordered by the number of roles in which they were required.

	Exceed	Met	Somewhat Met	Not Met	Not Required	Number of roles where skill was required
Oral communication	15	**27***	10	1	0	53
Written communication	13	**33***	5	1	0	52
Problem solving	16	**27***	8	1	0	52
Overall generic skills	7	**36***	6	1	1	50
Team work	20	**24***	5	0	0	49
IT skills	8	**31***	9	0	4	48
Ability to work independently	**21***	19	5	2	0	47
Project management	2	**15***	8	2	22	27
Leadership	3	**13***	10	1	22	27

YGP expectations were explored in Section 3 and some skills were more or less important than expected for the YGP's current role. YGP expectations may misalign with some of the requirements of the roles available in the industry. *"A constant theme, which hasn't changed from my day, is that every student comes out wanting to do Remote Sensing however there is a very limited commercial market for this. All our recent graduates have express[ed] wanting to do Remote Sensing and most of those interviewed also bring it up. Looks like the Universities of NZ may need to change their focus to meet commercial realities in NZ"* (geospatial organisation). However, this possible misalignment was not widespread in the comments provided by employers.

Employers are aware that in hiring a YGP they may need further training and support. Most respondents agree that further geospatial and generic skill training is required for their most recent YGP hire (Figure 10 & Figure 11). YGPs are more likely to need geospatial skill training rather than generic skills despite similar numbers of YGPs meeting both sets of requirements.

"The role is generally seen as a junior, entry level position, so we are aware that further geospatial training could be required. When recruiting for this role in the past, we have always tried to employ

people straight out of training and as a first geospatial job. Most last about 12 - 18 months before they feel they have enough knowledge to move on." (geospatial organisation).

"We hire graduates knowing we will need to invest in them to fulfil their role and are aware of this during the hiring process, looking for someone with the right basic skillset but more importantly fit into the team" (geospatial organisation).

The requirement for further skill development may not simply sit with the YGP as a number of geospatial organisations suggested that continued professional development for all staff was important (*"There is always something new to learn for the curious and motivated person"* (geospatial organisation)).

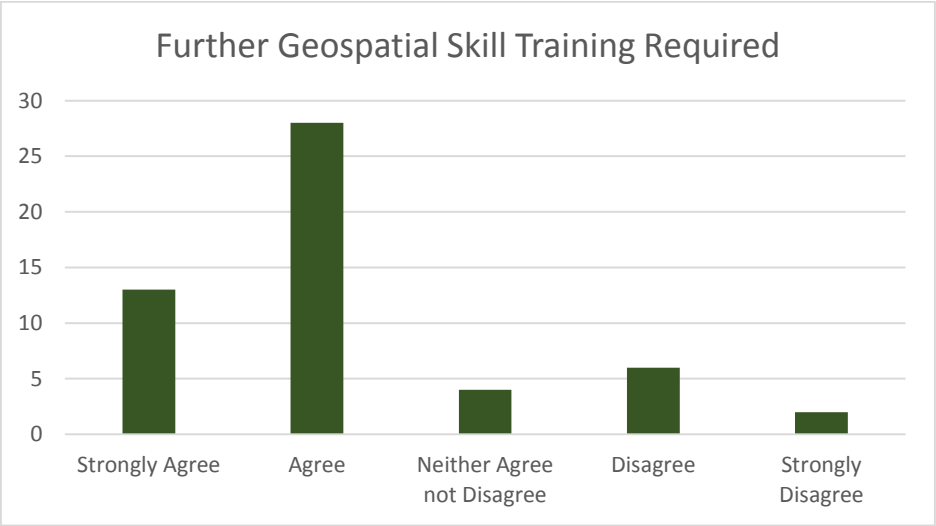

Figure 10: Further geospatial skill training required (most recent YGP hire)

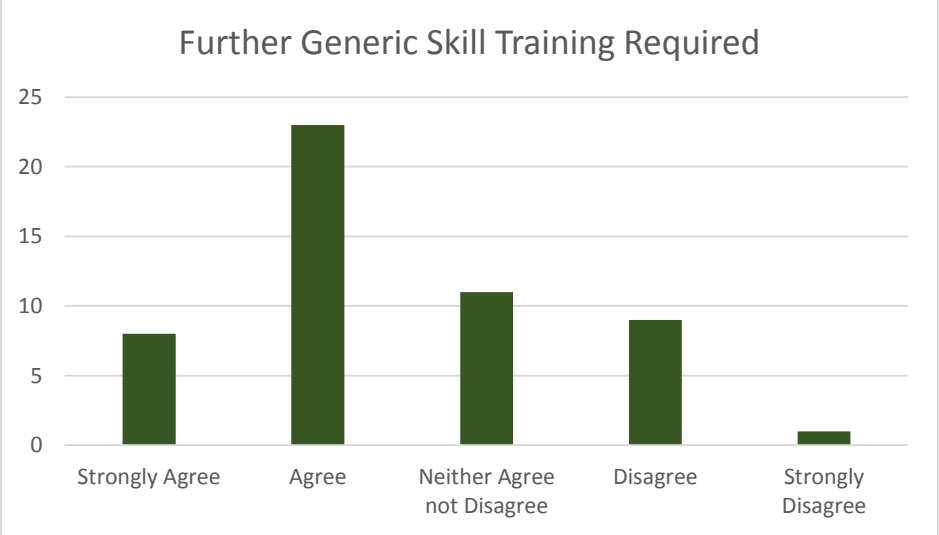

Figure 11: Further generic skill training required (most recent YGP hire)

What skill development support is provided for YGPs?

While there was a wide spread recognition of the need for additional YGP training, a greater level of support was not offered by most organisations (Figure 12). Perhaps this lack of additional support is due to a recognition that all geospatial positions require skill development (e.g. "[support is] *absolutely role related and thus irrelevant to lengths of tenure."* (geospatial organisation)). However, given many YGPs will lack experience of the geospatial working environment, additional support for these young professionals may have a higher return on investment.

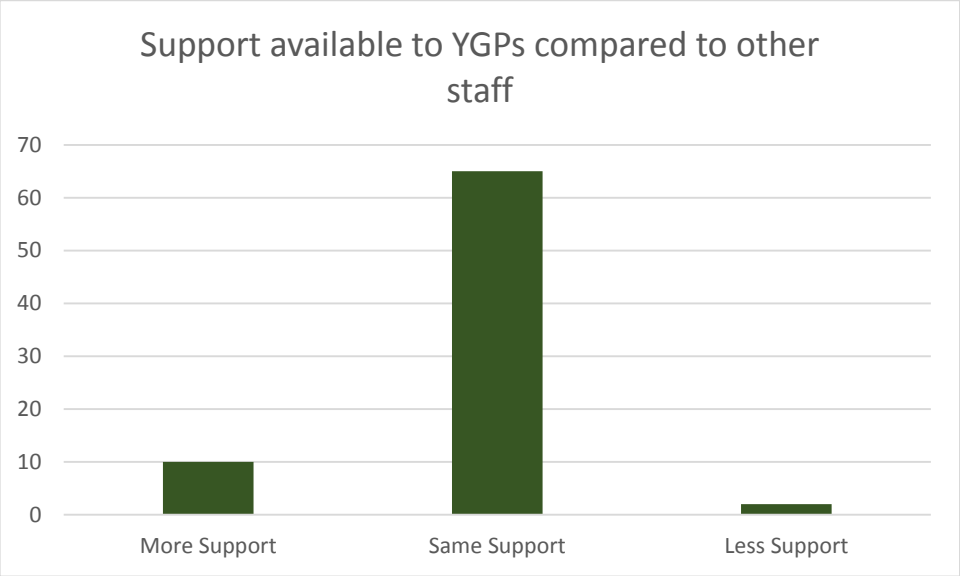

Figure 12: Support available to YGPs compared to other staff

In house support was the most common support offered to YGPs followed by conferences (Figure 13). Figure 14 details the types of internal support provided to YGPs. Mentoring with senior staff other than managers is mostly commonly cited. Training in mentoring for more senior staff may be a valuable addition to the support landscape in New Zealand. Such training is provided in house by some larger organisations, such as Auckland Council, but in the absence of these initiatives, professional organisations may be best placed to provide this support, such as the NZIS who already provide generic skill development courses.

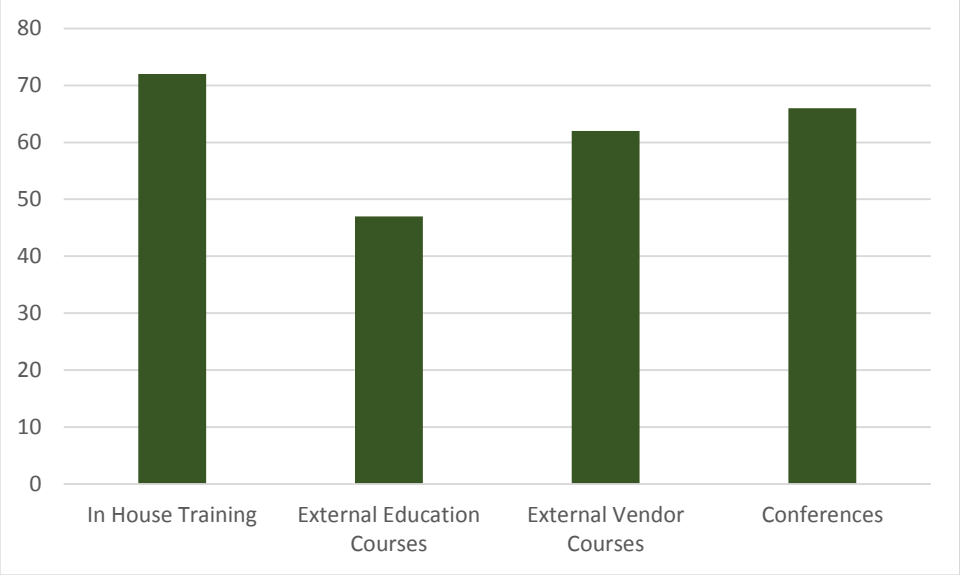

Figure 13: Support offered to YGPs

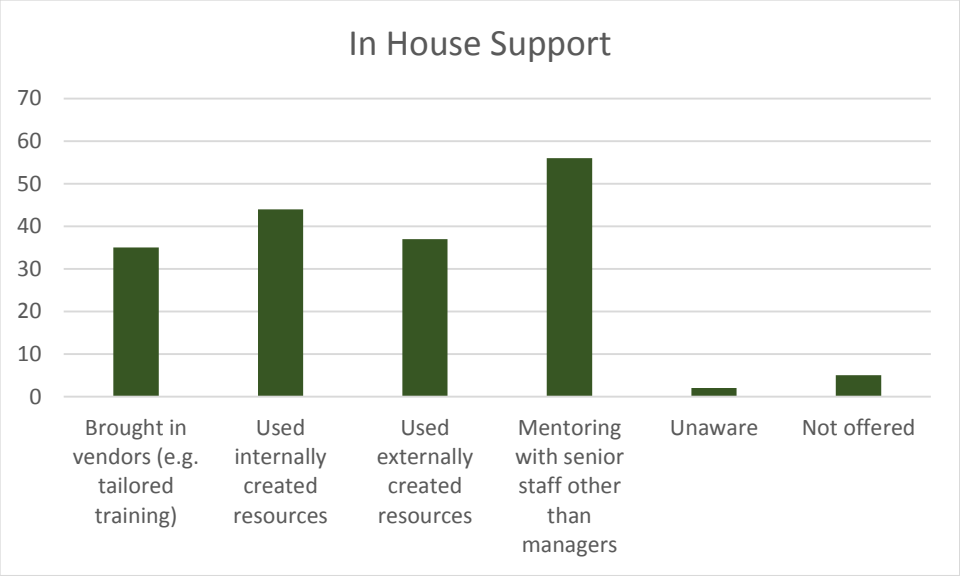

Figure 14: In house support offered to YGPs in the preceding 3 years

The type of support offered in undertaking external skill development (e.g. courses and conferences) are detailed in Figure 15, Figure 16, and Figure 17. Full conference funding is the most common support provided across all support options (including internal support). Vendor courses and conference attendance were most commonly fully funded while education courses did not attract the same level of support. Education courses are likely to require a greater time investment (in terms of contact time, study time and duration of course) than conferences or vendor courses though costs are likely to be similar or less than vendor courses. The benefit of vendor courses and conferences appear to be recognised by industry but the benefit or otherwise of education programmes and courses is less commonly appreciated. Further investigation is warranted into the

usefulness of and barriers to such industry-education links for YGPs. For example, universities commonly place importance on the development of generic skills in addition to domain or discipline specific skills in contrast to conferences and vendor courses.

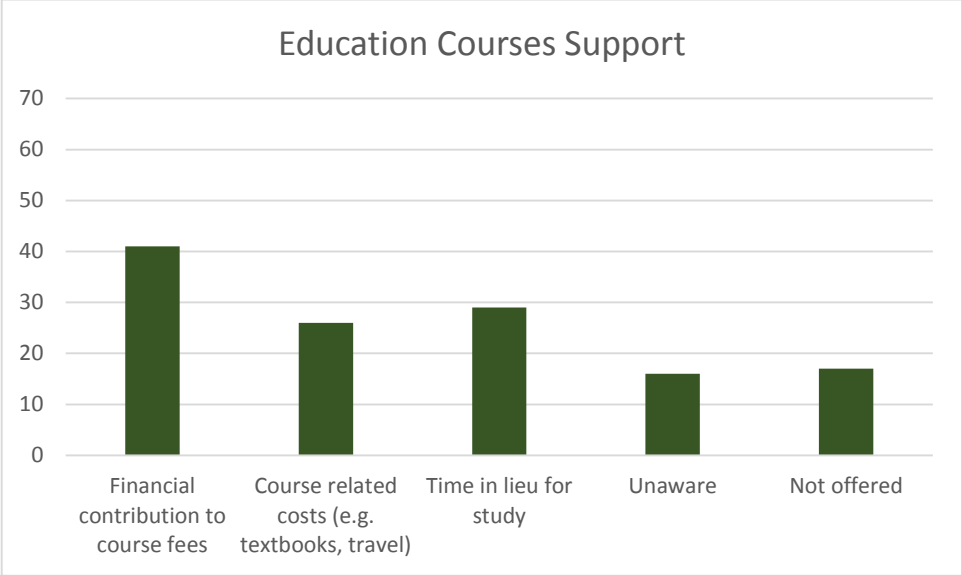

Figure 15: Support for education courses offered to YGPs in the preceding 3 years

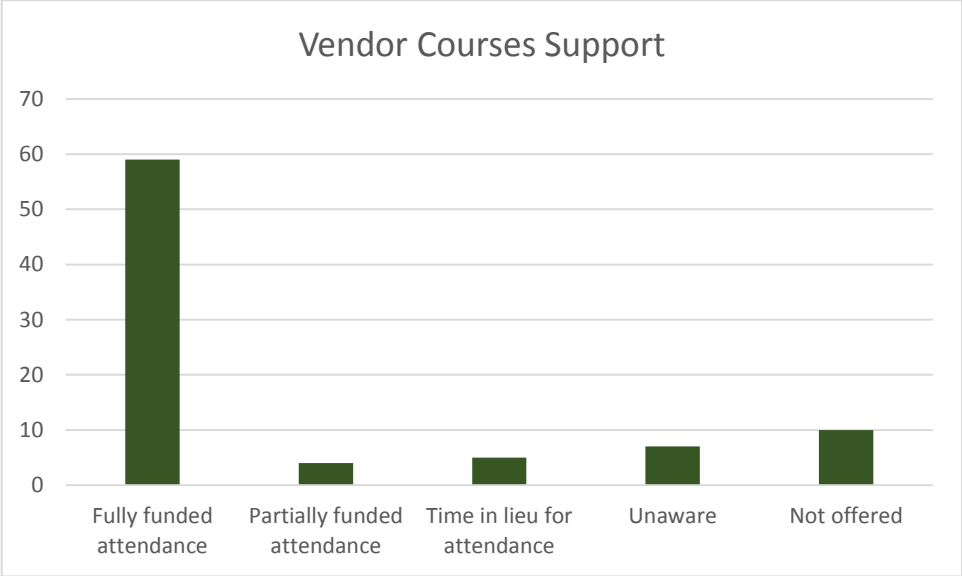

Figure 16: Support for vendor courses offered to YGPs in the preceding 3 years

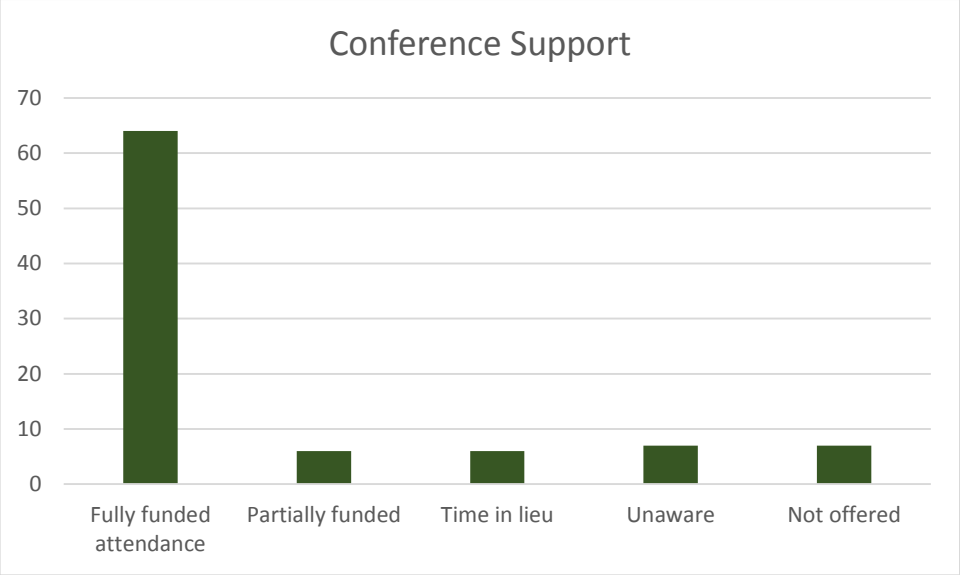

Figure 17: Support for conferences offered to YGPs in the preceding 3 years

Most respondents believed that sufficient geospatial training and education support was available (Figure 18). However, a high number of respondents were unsure.

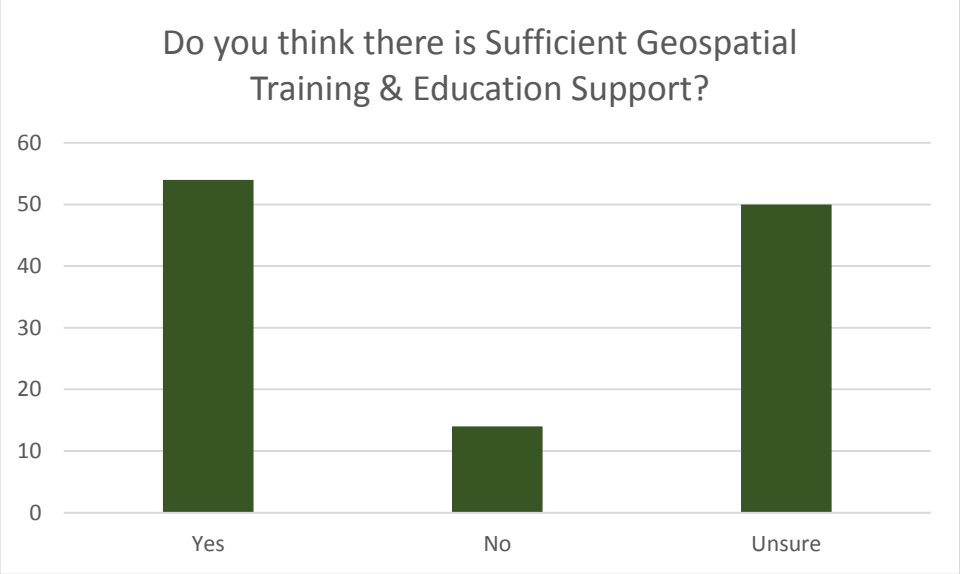

Figure 18: Do geospatial organisations believe sufficient geospatial training and education support is available for YGPs?

What pathways to the geospatial industry are supported by employers?

Most organisations do not offer an entry pathway for new entrants to the geospatial industry (Figure 19). Commonly, organisations only provided a single entry pathway (53.8% of those providing a pathway) and only two organisations offered all four. Where provided, graduate development programmes (e.g. short or fixed term contracts for recent graduates) and paid internships were the most common pathway. The small number of scholarships or studentships fits with the lack of support for formal education courses and programmes. This lack highlights a potential disconnect

between education institutions and geospatial industries. For example, funded masters projects could be of benefit to students and the geospatial organisations funding the research project. Such projects require the support of the educational institutions and geospatial organisations, as well as strong industry-education linkages.

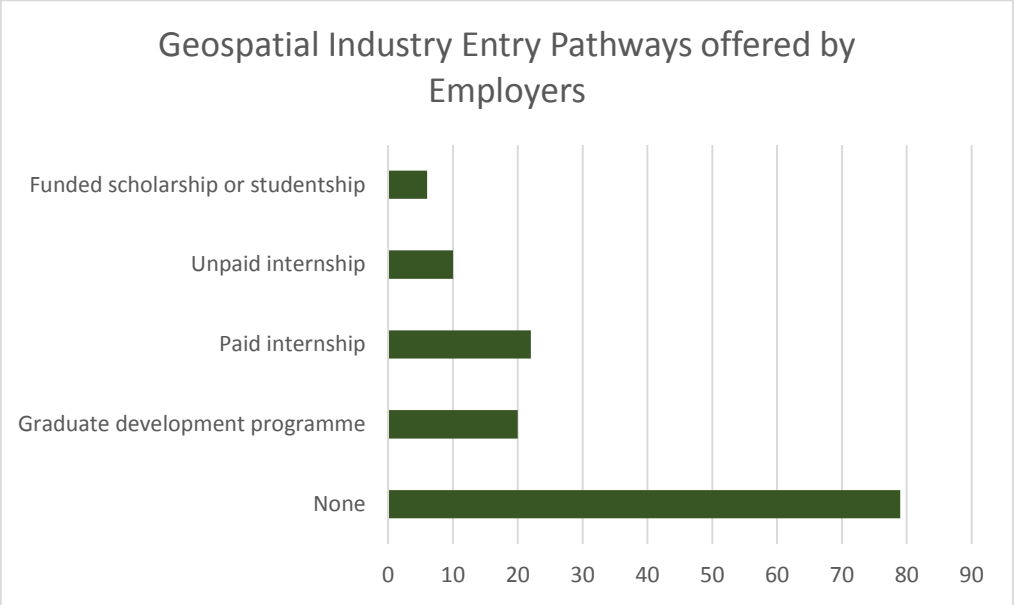

Figure 19: Entry Pathways to the Geospatial Industry provided by Employers

5. Educators' perceptions

The number of graduates leaving universities with geospatial qualifications has grown significantly. Educators are playing a greater role in attracting and preparing Young Geospatial Professionals (YGPs) for the geospatial industry. Eight geospatial educators (GE) were interviewed about the skills required by the geospatial industry, their perceptions of employer's needs, and education-industry links. In addition to teaching, most educators are expected to undertake research, postgraduate supervision, administrative roles (e.g. university committees), and professional services (e.g. journal reviewing). As for the previous two phases of this research, the results are reported independently and comparisons are reserved for discussion in section 6 of this report. An overview of the methodology used is in Appendix 3.

Expected skills

Course content and educators' knowledge of the skills requirements of the geospatial industry guides the skill development of many potential entrants to the geospatial industry. GEs were asked to identify the skills valued by geospatial employers. GEs saw the following skills as important to employers: programming (7, task automation, web and application development), GIS software competency (5), spatial analysis (2), use of open source or free software (1), transferable or generic

skills (2), written and oral communication (2), willingness/ability to learn (4), motivation (1), teamwork (2), ability to work independently (1), critical use of GIS (1), data management (1), familiarity with servers (1), work experience (1), and good grades (1). Of these valuable skills, the geospatial educators were also asked what they believed was the first thing employers looked for on a CV. The GEs identified GIS software competency (5), programming or ability to automate tasks (3), transferable or generic skills (2), willingness to learn and motivation (1), and spatial analysis (1). However, some GEs also recognised that different geospatial positions required different skillsets (e.g. "*That's a tricky one because it probably depends on the type of job employers are offering*" (GE4)). However, as Whyatt et al. (2011, p237) warn "the dynamism of the GIS labour market" means the skills demanded by industry change.

While GE expect students should be be familiar with the relevant tools and software for the geospatial industry, the GEs had differing perceptions of employers expectations of familiarity. On one hand, employers were seen as wanting "*a turnkey person that already has the GIS skills, ArcMap or Esri skills that they can immediately use. They wouldn't want to train people*" (GE7). While on the other hand, some GE believed employers were willing to train employees who were willing to learn. "*In terms of GIS … to the employers themselves, it's probably not vital that they know every single thing because someone can be willing to learn or they can adapt and if they're working in a team, you can bring a junior person in that's got a team of experts around them, then the personality of the person is just about more important than just the skills*." (GE4).

While geospatial courses are a key entry point to the geospatial industry, GIS can also be an advantageous supporting skill for another profession (e.g. marine scientist or conservation biologist). For example, "*with Environmental Management, Planning or Landscape Architecture, they might look at someone's CV and see the GIS skills and … that gives* [the students] *an advantage*" (GE1). In tertiary institutions with only one geospatial course, entry to the geospatial industry is less obvious and educators' primary focus may be the skills required by these complementary disciplines.

Most educators do not privilege generic skills in their courses. GIS courses at undergraduate are normally part of larger degree programmes, most of which are not in the geospatial sciences (e.g. geography rather than surveying). As undergraduate geospatial courses were a small component of a graduate's degree, the secondary emphasis on generic skills meant that most GEs had an expectation that these skills are in the main developed elsewhere in the students' education (e.g. other courses on the degree). Further, Leveson (2000) highlights potential issues with thye language around these skills in understanding industry and education differences. Employers may be placing a higher importance on generic skills in GIS roles (Hong 2015).

Links with industry

All 8 education participants had existing links with industry and recognised the importance of these links (e.g. "*I think this is one of those industries where everybody benefits if there is a really strong link with the industry*" (GE1)). Guest lectures, internships and other industry links provide students with "*real world experience, a real world perspective*" (GE2) and can result in employment opportunities ("*perhaps lead into something like an internship or summer studentship*" (GE4)). For educators, these links ensure that they can "*check in and make sure that what* [they're] *teaching is actually relevant*" (GE5). Educators cited access to students for roles in their organisation as well as undertaking industry relevant research as benefits to links for industry.

Predominantly, education-industry links were seen as a means of providing real world examples to students via guest lectures, case studies or data, involvement in the geospatial community through attendance at industry events and facilitating community events or organisations, easing entry to the geospatial industry for potential new entrants, and research collaboration. One participant mentioned the use of education courses by organisations to upskill recent hires.

Guest lectures were the most common link mentioned by participants. Six of the 8 participants hosted speakers from industry on their geospatial courses. The remaining two education participants were limited in their ability to include industry guest lectures due to the limited number of GIS courses at their institution ("[one course] *is almost too short… to cover everything… and the paper does cover a lot of scope*." (GE4)) or the distance delivery of the course. Guest lectures predominantly emphasized what the guest lecturer did in the geospatial industry and how they came to be employed in their role (e.g. "*if you're interested in going into GIS as a job, these are the kinds of things you might get involved with*" (GE1)). Guest lectures covered "*the technical side or* [provided] *context*" (GE3) to students. One participant mentioned the benefit of a list of potential guest lectures ("*A pool or list of people who are willing to come in and chat, what their job area is and what they do would be really helpful*" (GE2)). Inclusion of guest lectures in all courses was limited by the potential costs ("*institutions don't necessarily have the money to pay a guest speaker*" (GE4)).

Networking was identified as a means to feed current applications into course material and some participants stressed the importance of using 'real' data and examples in their courses. Within course curriculum, industry links can inform curriculum development (e.g. the inclusion or prominence given to certain skills or content) and the inclusion of real world examples. Informal and formal networking were important to GEs as a means of assessing the suitability of their courses to industry needs (e.g. "*means I can rejig the courses as needed to make sure they're responsive*"

(GE1)). Many GEs attend local industry events but national events, such as the Esri user conference, were not mentioned. A number of GEs are involved in geospatial industry committees, such as the Esri user group and local GIS groups, and some education institutes have hosted geospatial conferences and talks aimed at both the academic sector and industry.

Links with industry were also seen as a means of aiding future student employment. One participant identified the importance of student presentations at local geospatial events for the students' future employment. More substantial bridges or entry pathways to the geospatial industry were not commonly provided. Only two institutions surveyed provided GIS based internships for their postgraduate students, while a third institution had a generic internship option students could take but was not directly associated with the geospatial industry.

Funded scholarships and sponsorship of research was also mentioned by a number of GEs. Industry organisations have provided funded and unfunded student projects at PhD, Masters and undergraduate level, although PhD scholarships were less frequent. A number of institutions also run summer research scholarships which are often co-funded between the education institution and an external organisation.

Surprisingly, in a sector with a high skills shortage, consultancy was not mentioned by any of the participants as a means of industry insight or links.

All 8 education participants were interested in developing further links with industry and agreed that both industry and their educational institutions would be interested in greater links. Further links ranged from low engagement options, such as ensuring the relevance of course content ("*give me some reassurance that I've got an understanding of where the industry is at and what it needs*" (GE1)) or as a means of matching students to employers to greater industry links in the selection and funding of research projects at both undergraduate and postgraduate stages (4 education participants).

Differing motivations and timelines mean that greater links are not without barriers. For example, industry, education institutes and the individual GEs may have different focuses, motivations and timelines. Two GEs specified a potential limit on the scope for engagement with a greater willingness for industry to give guest lectures rather than other modes of involvement (e.g. a "*limited appetite for research engagement*" (GE5)). Some professionals within the industry may have a narrow expectation of the role of an academic and may "*think that academia are there to provide [software] training for students"* whereas there is a heavy emphasis on *"publications, and for*

better or worse teaching is seen as a secondary activity and isn't as highly valued as perhaps it should be" (GE5).

"*The academics goals and the way we get brownie points or get promoted is based on how much research we do and how much funding we get. Industry, they get their brownie points and promotions by how much money they make. Sometimes it's hard to find the connection where we have quite different motivations and we're working to different timelines. But universities are always working to encourage it.*" (GE2).

Overcoming these barriers will require engagement between industry and educators and an understanding of the context in which both parties operate.

6. Discussion

The geospatial skills shortage applies to both new and more experienced roles in the geospatial industry. However, the largest skills gap was for both qualified and experienced professionals. A skills shortage can be caused by a lack of relevantly trained people or by an inability to retain trained professionals. By exploring the support landscape in New Zealand, this report identifies potential gaps in provision and areas for improvement.

Three types of support are required by Young Geospatial Professionals (YGPs). First, to attract new entrants to the geospatial industry, potential entrants must know of the industry and the relevant skill requirements. Second, to enter the industry, potential professionals must develop relevant skills and expertise. Third, once employed, YGPs need to develop relevant expertise to progress within the industry to fill more senior positions and it becomes important to retain skilled and increasingly experienced YGPs.

Stage 1: Attracting new entrants

While the number of students at secondary school studying NCEA standards are growing, a number of potential barriers exist to wider adoption of these standards, e.g. resources and teacher support. Further, the effectiveness of these standards in attracting new entrants to the industry has not been explored. An exploration of these barriers was beyond the scope of this report.

A greater visibility of the geospatial industry at secondary school level (e.g. guest lectures and open days) could increase the number of new entrants to the industry. Existing organisations may be an appropriate avenue, such as Future in Tech who organise guest talks to school children by industry professionals within the technology, engineering and science based industries, including the geospatial industry.

Stage 2: Initial skill development

Increasingly, new entrants to the geospatial industry are developing relevant skills through formal education pathways and over 50% of YGPs have a postgraduate degree. As the industry develops, these formal pathways are likely to become more standard. At present, most geospatial courses are taught at postgraduate level. A large number of educational programmes and courses for geospatial skills are likely to mean that new entrants will have specialised geospatial postgraduate qualifications. Effective links between industry and education will mean that potential entrants to the industry are supported in the development of relevant skills. These links can take a number of forms: Guest lectures, Curriculum development, Real world examples, Entry pathways (such as internship placements) and Research funding.

To fill more junior roles within the geospatial industry, enough new entrants must be attracted with the relevant skills. While geospatial courses (e.g. Introduction to Geographic Information Science) are popular with students, not all students taking these courses will identify the geospatial industry as their career destination. Geospatial skills are increasingly demanded as an additional skillset by other careers and many students on introductory courses will not specialise in the geospatial domain, e.g. they may become a conservation biologist who uses GIS to map endangered species. The broad reach of geospatial skills is to be commended but students also need to be made aware of potential career paths within the industry.

Guest lectures allow students to see the application of the geospatial skills they develop within potential careers in the geospatial industry. A guest lecturer pool would also be of benefit to new educators who have yet to build industry linkages from which guest lectures are drawn.

Educators rely on their personal links with industry professionals to ascertain the relevance of their curriculum for the New Zealand geospatial industry. Curriculum development is also likely to be informed by international practise and current research trends. Networking with industry professionals by educators is important to ensure that educators' awareness is up to date and appropriate to a wide range of geospatial roles. For example, remote sensing might be the primary task in one role and not relevant for another role within the geospatial industry. Currently, educators operate within an environment which does not strongly support interaction with industry, e.g. funding for national conferences and events are often more difficult to attain in comparison to overseas academic conferences within the current university funding model. Attendance at national and local industry events provide important networking opportunities and may provide localised and relevant examples of real world applications which can then be conveyed to current students.

Educators' perception of the skills in demand by industry did not widely differ from the employers surveyed and most employers found that their most recent young geospatial professional hire met or exceeded expectations. This situation suggests that educators are aware of the needs of the geospatial industry and this knowledge is likely to inform their current curriculum. However, the need for remote sensing and photogrammetry, field GIS skills, cartographic skills and written communication were over estimated by between 10-32% of young geospatial professionals surveyed depending on the skill. This overestimation suggests some education institutions may place too heavy an emphasis on these skills.

Gaps in the current education provision appear to exist. In roles where project management, servers, and end use or application development programming were required, more than half of young geospatial professionals needed further skill development in these skills. However, these skills were not required in a large number of the roles into which YGPs were hired. The recent development of programming courses at postgraduate level may start to lower the need for programming skill development but no New Zealand programme currently offers courses on project management or servers as part of a geospatial programme. A small number of geospatial staff are employed at most New Zealand universities (i.e. 1 or 2 staff is most common), this situation will limit what education courses or links can be supported.

Most educators interviewed noted that industry supported research was infrequent. Research collaborations between education institutions and industry can be beneficial to both parties. Masters and PhD research can be an effective and low cost form of research and development for industry. However, improving this linkage between education and industry requires acknowledgement of the differing timescales and motivations between the two sectors. Industry needs may not fit with longer academic timelines, uncertain outcomes, robust and potentially more time consuming processes, and the need for academic publications. Development of industry relevant projects can be time consuming for academics and divert attention from other more institutionally recognised and rewarded activities, such as writing publications. Shorter term projects may be an initial means of exploring potential research opportunities, however, such projects also require a focus on academic publications and require the academic's time for supervision.

Entry pathways, such as internships or graduate development programmes, can be an important means of supporting YGP entry into the geospatial industry. While beyond the scope of this report, entry pathways are also likely to benefit second career entrants. Entry pathways are either supported by education institutions (e.g. internship courses or placements) or independently

provided by organisations within the geospatial industry. In the survey, YGPs recognised that entry pathways provided a means to improve both geospatial and generic skills, improve their understanding of the geospatial industry, network, and help recognise the value of generic skills in the work environment. However, the skills gained during an entry pathway will not fully prepare young professionals for a working role as short term role requirements are likely to differ from that of full time positions. Entry pathways often resulted in an employment offer as well as improved skills for the YGP and the employer was able to more deeply assess a candidate's suitability for more permanent or full time roles. Despite these benefits, few geospatial organisations provide entry pathways for YGPs and internship schemes provided by universities are uncommon. However, given half of the respondents followed an entry pathway, some organisations may offer a large number of opportunities or the YGPs themselves developed their own opportunities in consultation with a geospatial organisation.

The YGPs surveyed did not believe enough entry pathway opportunities were available. This belief was strongest among YGPs that followed an entry pathway so are most likely to be aware of the availability of opportunities. Given the appetite for greater education-industry links, joint efforts between education institutions and industry to increase entry pathways are likely to be met with success. Further, many of the YGPs were unaware of entry pathway opportunities.

Entry pathways may also be of particular benefit to Māori as YGPs with this cultural heritage are under-represented in the geospatial industry. Though the number of Māori students attracted to geospatial education courses is unknown, it is likely that the number of Māori students are also low. Entry pathways for Māori may need to operate at an earlier level, e.g. after secondary education or during undergraduate education, to ensure that the geospatial industry is identified as a possible future employer prior to decisions being made about education specialisations.

Employers value geospatial skills but only when they are supported by a broader range of generic or transferable skills. For example, problem solving was more highly valued than spatial problem solving. The value placed on both geospatial and generic skills is largely reflected in the perceptions of YGPs and educators. The limited number of geospatial courses, especially at undergraduate level, may mean the teaching of technical skills and geospatial concepts can crowd out the development of generic skills within these courses. Generic skills are not solely developed on geospatial courses and often form part of graduate attributes for both geospatial (e.g. surveying and GIS) and other programmes.

Stage 3: Continued skill development

The final stage of support for young geospatial professionals is in-employment support offered by their employers. Through the further development of their initial skillset, young geospatial professionals can be supported to gain the relevant experience to fill more senior and leadership roles in the industry. Complicating this approach, however, young geospatial professionals may have been hired into roles for which they are underqualified due to the skills shortage. In addition, the dynamic nature of the geospatial software and hardware environment may mean continued skill development to update previously gained skills are also important.

A majority of YGPs (62.4%) and geospatial organisations (50%)[14] believe that adequate support opportunities exist for YGPs in New Zealand. While the number of YGPs and organisations who believe the support opportunities are not available are similar, organisations are less certain than the YGPs about the availability of support. This generally positive perception suggests that support opportunities are appropriate in New Zealand. In contrast, the YGPs who believed support was not adequate were also more likely to be those YGPs actively developing geospatial skills. While the result was not statistically significant, these YGPs are more likely to have investigated what support opportunities are available and whether their employer will provide funding and/or time so the YGP can take advantage of those opportunities.

Support was provided by most organisations; a fact recognised by the YGPs surveyed. As geospatial qualifications become more frequent for new industry entrants, the importance of 'on the job' training and other skill development opportunities may be less needed by new entrants. As evident in both the YGP and geospatial organisation results, in house support is commonly provided by geospatial organisations and mentoring by senior staff plays an important role. Most YGPs have the opportunity to attend conferences or other industry events. Education, vendor or professional training courses are less commonly supported with education courses significantly less supported by geospatial employers.

Most employers and YGPs recognise that a recently hired YGP will need to develop skills and expertise for the role into which they were hired. This situation may point to gaps in the education provision within New Zealand as identified in the previous section (e.g. project management and servers) or the current lack of a geospatial education by most YGPs. However, it is also advisable for geospatial education to focus on concepts rather than specific software tools (Bearman *et al.* 2016). As evident from Table 8, not all roles require the same skills. Due to the fast paced nature of the industry, YGPs are likely to require experience in different tools by the time they reach more senior

[14] Most other responses were unsure.

positions. By focusing on key geospatial concepts, education programmes can provide a context for new developments which make these advancements easier to learn.

Continued professional skill development may require a greater emphasis on generic skills in comparison to geospatial skills. Initial skill development primarily focuses on geospatial rather than generic skills. As young geospatial professionals mature in their career, they may need to develop management and external engagement skills not previously required. However, the emphasis on support provided by employers for the development of geospatial skills in comparison to generic skills was not assessed.

The fast paced nature of the industry also means that all geospatial professionals are likely to need to continually update and grow their skillset. This continued need is reflected in the continued professional development (CPD) expectation for NZIS members. Geospatial organisations commonly do not provide additional support for YGPs over more established staff. YGPs are likely to be less familiar with the procedures around applying for funding for external support opportunities, including conference attendance, and the metrics by which such applications are evaluated. Consequently, YGPs may find accessing support more difficult. YGPs' less extensive grounding in the geospatial industry should also mean, with appropriate support, they and their employers may gain more from accessing support opportunities. At an industry level, greater support for YGPs should mean that senior geospatial professionals can emerge from the current pool of YGPs, thus filling the most critical geospatial skills shortages as identified in de Róiste (2012). Employer backing of support opportunities is appreciated by YGPs and may also aid in staff retention as those YGPs progress in their careers. Given that conference attendance can be expensive, especially if national or international travel is involved, local industry events may a cost effective means of upskilling and networking.

Young geospatial professionals, outside of surveying, do not have a clear professional identity. Since the withdrawal of the SSSI from New Zealand, the NZIS is the sole accrediting professional body for geospatial professionals operating in New Zealand. NZIS provides professional certification and encourages members to undertake continued professional education. However, membership of this institute has not been well taken up by non-surveying, geospatial professionals. The lack of uptake may mean that there is a limited benefit to professional certification at present or a lack of knowledge of the potential for such an avenue as a means to gain skills or recognition for developed skills. The perception and benefits of professional certification or perceived benefit of a defined professional body was not addressed in this report.

Employers were less likely to support YGPs in accessing education courses in comparison to other support options. Education courses commonly are more time intensive than other support options as students commonly need to attend lectures weekly and are required to complete detailed coursework. This potentially increased workload may account for employers' hesitation in supporting this option. However, education courses also provide employers with an indication of the quality of understanding or skill acquisition through the course grade. Educational courses and qualifications may increasingly be seen as entry criteria to the industry rather than as a means of YGPs upskilling once they have entered the industry. However, such courses could provide YGPs with upskilling opportunities unavailable elsewhere.

For particular skill development areas (e.g. programming), internal support and conferences or industry events may not be focused enough to provide targeted upskilling. This situation may explain why YGPs in the process of upskilling believe support opportunities are less available. It is likely that courses (tertiary and vendor) are better placed to provide an appropriate structure for the YGP to gain familiarity with an identified skill. Given that only 13 YGPs believed that support opportunities were not available and detailed reasons for this answer were not provided, interviews with this group could identify what barriers the YGPs face in accessing support. Barriers could include timing issues (i.e. courses not available when required) or geography (i.e. courses not available in local area).

In-employment skills development can be a key factor in developing national capability in this shortage area. However, retention also plays a key role in ensuring enough experience and qualified professionals are available for more senior roles within the industry. A skills shortage can be caused by a lack of new entrants to the industry, an inability to retain current employees or a combination of the two issues (OECD 2016). While most young geospatial professionals surveyed saw themselves in the industry in 10 years' time, a large proportion did not (approximately 40%) and women were significantly less likely to envisage a future in the industry. Losing skilled and experienced professionals is problematic and, in addition to supporting the development of necessary skills, funding for industry events and educational opportunities is a potential way to retain and reward staff.

7. Recommendations

Attracting new entrants

- Encourage and promote industry involvement in local secondary schools. Outreach resources (e.g. database of local speakers, possible lesson plans supported by such outreach)

would lower school and industry resource costs of hosting industry outreach by lowering preparation time.

Entry pathways

- Create a repository of entry pathway opportunities (e.g. internships, graduate development programmes, part time or short term opportunities) for students.
- Create a database of organisations interested in coordinating with an education institution to offer internship opportunities. Care needs to be taken that such opportunities, if unpaid, are based on skill development for the student rather than simply replacing paid labour opportunities.
- Engage with the geospatial industry to create further opportunities for entry pathways (e.g. graduate development programmes and part time roles for new entrants to the industry).
- Engage with industry to develop targeted entry pathways for Māori young geospatial professionals.

Supporting new entrants

- Provide information to potential geospatial professionals on the expectations of industry for both geospatial and generic skills.

Links with education institutions

- Support the discussion of geospatial curriculum development by hosting periodic workshops on the key issues facing the New Zealand geospatial industry.
- A national database of guest lecturers would be welcomed by educators, and especially useful for new educators who have not yet developed a professional network within the New Zealand geospatial industry.
- Educator's rates at industry events may facilitate academic interaction and attendance.
- Develop and host workshops to support industry and education research linkages. Shorter term projects, e.g. summer scholarships, may be an initial step in the development of industry and education research linkages.

Support opportunities

- Compile a repository of potential external support opportunities available across both geospatial and generic skills.
- Encourage employers to offer preferential support to new geospatial professionals and women in particular.

8. Possible future research

1. Explore the effectiveness of the standards in attracting new entrants and ameliorate current barriers to wider adoption of spatial analysis NCEA standards.
2. Explore the role of and potential benefits of professional certification or professional organisation membership in the geospatial industry.
3. Investigate the differences in experiences of both men and women in the geospatial industry, in particular the factors leading to lower numbers of women envisaging a future in the industry.
4. Identify specific gaps in support experienced by those YGPs actively seeking to develop their current skills. Explore the differences in support for geospatial and generic skills within the geospatial industry.
5. Identify barriers to accessing education courses as a support opportunity for young geospatial professionals.

9. Conclusions

The support landscape in New Zealand for young geospatial professionals is viewed positively by the majority of geospatial organisations and young geospatial professionals. This report identified three key stages of support: attracting new entrants to the industry, initial skill development and continued skill development. At each of these three stages, awareness of support opportunities could be improved as outlined in Section 7. Promoting awareness of opportunities for support (e.g. courses, and internship opportunities) should facilitate the development of in demand skills.

Through a series of interviews with geospatial educators, the importance of education-industry links in initial skill development for new entrants to the industry were detailed. A number of opportunities exist to improve these links and encourage new entrants into the industry as well as ensuring these new entrants have relevant skills. Collaboration with industry in the development of sustainable curriculum and research possibilities will help ensure that new entrants to the industry possess relevant skills.

A strong case can be made for preferential support for young geospatial professionals and Māori and women professionals, in particular. In 2012, de Róiste identified a geospatial skills shortage for New Zealand. While hiring young geospatial professionals was difficult, the largest unmet demand was for experienced professionals. To ensure that the New Zealand geospatial industry can fulfil future needs for both qualified and experienced geospatial professionals, the industry needs to both attract and retain staff. The geospatial industry does not appear to attract a proportional number of Māori

professionals and numbers are likely to be significantly below the proportion of the general population with Māori heritage. Whereas for women, the key issue is retention. Women already in geospatial employment are significantly less likely to see themselves remain in the geospatial industry. In addition, a substantial proportion of young male geospatial professionals also do not see themselves remaining in the industry. Preferential support may need to be offered to these groups to ensure that future industry needs for both experienced and qualified professionals are met.

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Appendix 1: Definitions

Geospatial

As defined in the geospatial skills shortage report for New Zealand (de Róiste 2012), the geospatial industry uses, collects, manages, analyses, presents, and disseminates data referenced to a spatial location on the Earth's surface. Addresses or other data with spatial locations can be used to better manage current resources or combined to reveal new patterns or information. Within this broad definition, the geospatial industry encompasses both private industry and government at local and national levels. The industry includes both consumers and providers of geospatial skills, services, data, software and hardware. A company's core business does not need to be geospatial for the company to make use of geospatial skills and expertise. As an example, geospatial software can be used to locate new premises for a business based on the characteristics and location of their current and potential customers or identify areas for flood mitigation by combining vegetation, slope, soil and other information.

Professional

In this report, we define a professional as an individual who has the skills and expertise to operate in a discipline with an acknowledged body of knowledge. Implicit in this definition is that a professional needs to cultivate a "blend of technical, business, analytical, and interpersonal competencies" (Gaudet 2003 p25). Often, a professional is expected to undertake ongoing and continued development in both generic and technical skills.

Young geospatial professional (YGP)

Young Geospatial Professional (YGP) as referenced in this report refers to an employee working in the geospatial industry aged 35 years and under. This broad definition is in line with SSSI[15], URISA[16], GITA (Geospatial Information and Technology Association)[17] and awards for geospatial professionals nationally (i.e. NZSEA) and internationally (Rachapudi Kamakshi gold medal for Young Geospatial Scientist[18]). Other organisations are more restrictive limiting on age as well as professional experience (e.g. ASPRS (American Society for Photogrammetry and Remote Sensing)[19] limits young

[15] http://www.sssi.org.au/index/commission/7.html 19/12/2014
[16] Urban and Regional Information Systems Association http://www.urisa.org/about-us/vanguard-cabinet/ 19/12/2014
[17] http://gisuser.com/2006/04/gita-2006-to-include-programming-for-young-professionals/?print=pdf 19/12/2014
[18] http://www.geospatialworld.net/News/View.aspx?id=25756_Article 19/12/2014
[19] http://www.asprs.org/About-Us/Young-Professionals-Council.html 19/12/2014

professionals to non-student professionals 10 years or less experience and who are 35 years old or younger).

Appendix 2: Geospatial courses

Table 10: Courses in Geospatial Sciences offered at third level institutions in New Zealand. This table excludes surveying courses offered at the University of Otago.

Institution	Course code	Course title	Coordinator	Contact
AUT	GISC 401	Foundations of Geographic Information Science	Dr Ioannis Delikostidis*	Dr Barbara Breen (barbara.breen@aut.ac.nz)
	GISC 402	Geographic Information Science Research	Dr Ioannis Delikostidis*	
	GISC 403	Cartography and Geovisualization	Dr Mairead de Róiste*	
	GISC 404	Geospatial Analysis	Dr Ioannis Delikostidis*	
	GISC 405	GIS Programming and Databases	Dr Barbara Breen	
	GISC 406	Remote Sensing for Earth Observation	Dr Wolfgang Rack*	
	GISC 411	Geographic Information Systems in Health	Dr Malcolm Campbell*	
	GISC 412	Spatial Algorithms and Programming for GIS	Dr Femke Reitsma*	
	GISC 413	Geomatic Data Acquisition Techniques	Kelvin Barnes*	
	GISC 415	GIS Internship	Dr Malcolm Campbell*	
	GISC 416	Conservation GIS	Dr Barbara Breen	

Bay of Plenty Polytechnic	GEOG 328#	Geographical Information Systems	Caroline Schweder	Caroline Schweder (caroline.schweder@boppoly.ac.nz)
Massey University	132.106	Introduction to GIS	Rachel Summers	Rachel Summers (S.R.Summers@massey.ac.nz)
	132.738	GIS Principles and Applications	Rachel Summers	
	132.740	GIS Programming and Practice	Rachel Summers	
	189.761	Applied Remote Sensing	Mike Tuohy	
	233.251	GIS and Remote Sensing	Mike Tuohy	
	233.301	Advanced Remote Sensing	Mike Tuohy	
	233.706	Environmental GIS	Mike Tuohy	
	233.707	Environmental Remote Sensing	Mike Tuohy	
Otago University	SURV 102**	Geospatial Science	Prof Christina Hulbe	Dr Tony Moore (tony.moore@otago.ac.nz)
	SURV 208	Introduction to Geographic Information Systems	Dr Tony Moore	
	SURV 309 (also available as SURV 509)	Introduction to Remote Sensing Technologies	Dr Pascal Sirguey	
	SURV 319 (also available as SURV 519)	Spatial Analysis and Programming	Dr Tony Moore	

	SURV 411 (also available as SURV 511)	Advanced Spatial Analysis and Modelling	Dr Pascal Sirguey	
	SURV 412 (also available as SURV 512)	Geovisualisation and Cartography	Dr Tony Moore	
	SURV 413 (also available as SURV 513)	Resource Mapping and Image Processing	Dr Pascal Sirguey	
Southern Institute of Technology	***Not always offered	Course offered under Bachelor of Environmental Management	Erine Van Niekerk	Erine Van Niekerk (erine.vanniekerk@sit.ac.nz)
Unitec	NSCI6715/6743	Geographic Information Systems	Dr Glenn Aguilar	Dr Glenn Aguilar (gaguilar@unitec.ac.nz)
	NSCI7736	Applied Geographic Information Systems	Dr Glenn Aguilar	
University of Auckland	GEOG 103/103G	Mapping our World (Digital Earth)	Carola Cullum	Dr Jay Gao (jg.gao@auckland.ac.nz)
	GEOG 210	Introduction to GIS and Spatial Thinking	Dr Murray Ford	
	GEOG 317	Remote Sensing and GIS	Dr Jay Gao	
	GEOG 318	GIS Principles and Practice	TBC	
	GEOG 771	Spatial Analysis and Geocomputation	TBC	
	GEOG 772	Advanced Raster Data Analysis	Dr Jay Gao	

University of Canterbury	GISC 401	Foundations of Geographic Information Science	Dr Ioannis Delikostidis	Dr Ioannis Delikostidis (Ioannis.delikostidis@canterbury.ac.nz)
	GISC 402	Geographic Information Science Research	Dr Ioannis Delikostidis	
	GISC 403	Cartography and Geovisualization	Dr Mairead de Róiste*	
	GISC 404	Geospatial Analysis	Dr Ioannis Delikostidis	
	GISC 405	GIS Programming and Databases	Dr Barbara Breen*	
	GISC 406	Remote Sensing for Earth Observation	Dr Wolfgang Rack	
	GISC 411	Geographic Information Systems in Health	Dr Malcolm Campbell	
	GISC 412	Spatial Algorithms and Programming for GIS	Dr Ioannis Delikostidis	
	GISC 413	Geomatic Data Acquisition Techniques	Kelvin Barnes	
	GISC 415	GIS Internship	Dr Malcolm Campbell	
	GISC 416	Conservation GIS	Dr Barbara Breen*	
University of Waikato	GEOG 328	Geographical Information Systems	Dr Lars Brabyn	Dr Lars Brabyn (larsb@waikato.ac.nz)
	GEOG 538	Automated Spatial Analysis using GIS	Dr Lars Brabyn	
	GEOG 548	Advanced GIS Modelling	Dr Lars Brabyn	

	GEOG 558	Applied GIS for Research and Planning	Dr Lars Brabyn	
	GEOG 568	Applications of Geographic Information Systems	A/Prof Lex Chalmers	
Victoria University of Wellington	GEOG 215	Introduction to Geographic Information Systems and Science	Dr Mairead de Róiste	Dr Mairead de Róiste (mairead.deroiste@vuw.ac.nz)
	GEOG 315	Advanced Geographic Information Systems and Science	Dr Mairead de Róiste	
	GEOG 415	Introduction to Geographic Information Science and its Applications	Dr Mairead de Róiste	
	GISC 401	Foundations of Geographic Information Science	Dr Ioannis Delikostidis *	
	GISC 402	Geographic Information Science Research	Dr Ioannis Delikostidis*	
	GISC 403	Cartography and Geovisualization	Dr Mairead de Róiste	
	GISC 404	Geospatial Analysis	Dr Ioannis Delikostidis*	
	GISC 405	GIS Programming and Databases	Dr Barbara Breen*	
	GISC 406	Remote Sensing for Earth Observation	Dr Wolfgang Rack*	

	GISC 411	Geographic Information Systems in Health	Dr Malcolm Campbell*	
	GISC 412	Spatial Algorithms and Programming for GIS	Dr Ioannis Delikostidis*	
	GISC 413	Geomatic Data Acquisition Techniques	Kelvin Barnes*	
	GISC 415	GIS Internship	Dr Malcolm Campbell*	
	GISC 416	Conservation GIS	Dr Barbara Breen*	
Waiariki Institute of Technology	Short course***	Introduction to GIS and GPS Level 4	Mark Cleland	Mark Cleland (mark.cleland@waiariki.ac.nz)

* denotes course is delivered via video conferencing and course coordinator is located at a different institution

** denotes that the course has a substantial GIS component but is not a GIS course

*** offered based on demand

This course delivered at Bay of Plenty Polytechnic under the umbrella of the University of Waikato

Appendix 3: Methodology

This study comprised of three phases. The methodology employed in each of these three phases is outlined below. The research framework as well as the questions asked in the surveys or interviews were approved by the Victoria University of Wellington Human Ethics committee.

Phase 1: Young Geospatial Professionals (YGPs)

A YGP questionnaire was sent to 144 potential respondents. 114 responses were received of these 101 were valid responses, 3 respondents were over 35, and 10 respondents did not complete the survey. All valid respondents were New Zealand based. The response rate was 70%. Dillman et al.'s (2014) tailored design method (TDM) was followed to promote a high response rate. The questionnaire covered the recruitment of young geospatial professionals, support and opportunities available to young geospatial professionals and characteristics about the organisation. The questionnaire was anonymous. Most respondents were aged 25-29 (48.5%). No respondent was under 20, although this was an option on the survey. This age range is likely to be indicative of the geospatial professionals in the industry. Participants were recruited through advertisement on relevant LinkedIn and Facebook industry groups, personal contacts, and through respondents to phase 2 (geospatial organisations).

Phase 2: Geospatial organisations.

In phase 2, 159 geospatial organisations were invited to participate in an online, anonymous questionnaire. As with phase 1, the TDM was followed to promote a high response rate. 159 organisations were contacted and 132 valid responses were returned; a response rate of 83%. The questionnaire comprised of 3 sections covering: Recruitment process of young geospatial professionals; Characteristics and attributes of desirable young geospatial professionals; and Support and opportunities available to young geospatial professionals. The respondent was most likely to be employed by an organisation with between 50-249 employees with 30 organisations with staff numbers under this and 46 with a larger number of staff. On average, organisations had 5.5 full time permanent geospatial staff working in the 120 organisations, another 2 geospatial positions where geospatial was the main but not the only workload (50-75% of workload), 0.3 temporary geospatial staff and 0.3 part time geospatial staff. This signifies an approximate workforce of 967 geospatial employees across the 120 organisations. In addition to these primarily geospatial positions, a further 5.5 staff on average had geospatial roles which formed a significant but not the main part of their workload.

Phase 3: Educational providers

Ten tertiary geospatial educators at different institutions in New Zealand were contacted by email and invited to participate in a semi-structured telephone interview. Interviews were carried out with 8 educators (including the author of this report[20]) by a research assistant. The interviews were transcribed and a copy of the transcript was sent to the educator to check and amend where appropriate. This report primarily draws on questions regarding industry involvement in the teaching programmes at these institutions and educators expectations of the skill demands of the industry. The geospatial courses provided in appendix 3 were compiled from these interviews as well as telephone conversations with administrative staff at the relevant institution.

[20] Quotes provided in the body of the report do not include that of the author.