NO-DIG DOWN UNDER MELBOURNE 2019
Engaging beneath the surface

Utility Location Skill Development
An Eyeglass into New Zealand

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ABSTRACT:

Many of us that have been involved on the ground floor of Underground Utility Location, Damage Prevention, Asset Management, and Subsurface Geospatial Survey and Mapping, anywhere around the world, can hopefully all agree on this one fact:

*We need to come together as a global industry/community, to encourage the evolution of skill development pathways for anyone working in and around Utilities Infrastructure.

Within this document I would like to share what a few of us have been doing in this space over the last decade within NZ. From carrying out the work, noting the issues, researching methodologies, compiling course material, designing and delivering training, connecting and teaming up with others to aid in the knowledge pool, to finally sharing a summary of learning lessons and recommendations derived from this time.

Trying to aid in developing an area that is underdeveloped is hard. Trying to do this for an area that didn't know it existed, has been exhausting and yet rewarding at the same time.

There are a growing number of people and practitioners who are optimistic about the future in skill development, and who also understand the challenges our industry faces. We hope that if the thought balance between unified purpose, training and education, mentoring, diversification of thought, logic, emerging technology, industry integration, and future focus sustainability is applied from the outset, then our industry sector can be developed well, with strategic intent, one connecting pathway to another.

Following is a brief account from 2007 – 2019.

1. Background

In my governance, executive, onsite, and industry advisory roles today, I am privy to visiting various industry sectors locally and internationally, and in 2019, I see most industries suffering from virtually the same issues. One of the primary concerns raised in many industry sectors is a lack of structured industry education and skill development pathways. We see evidence of this in skill-shortage numbers released by varying industry bodies in annual reports; underdeveloped training avenues within industry sectors such as Contracting, NDT Inspection, Geospatial Survey, Civil and Environmental Monitoring; and a general lack of apprenticeship, mentorship, and ongoing development programmes which build upon skill level and aid in monitoring practitioner progress.

It stands to reason that in newly established sub-sectors like Utility Location, skill development has been driven by people learning and teaching in the same breath. It is not recommended practice, but industry itself was founded on the same principle of 'we're doing it now, teaching it in a minute…wow more people are doing it, guess we better put structure in place', if not less. However, now is the time to tidy things up as we see a need for a system of training and skill development that responds faster to global and national trends, so we can get people with the right skills onto our sites much faster. All to serve an important part of the Utility Infrastructure Asset Management space: Utility Detection, Location, and Geospatial Survey and Mapping.

Let's begin with full transparency; In 2007 I started selling cable locators.
My knowledge base consisted of the instrument's specification sheet, the manufacturers marketing materials, and of course the user manuals. By reading the user manuals I worked out some of the functions for varying models but had no idea how to apply the system to locate underground utilities in a structured systematic approach. After researching and speaking with other resellers and practitioners in this space at the time, the realisation that most of us were all in the same boat, was surprising, and yet, understandable. The reason why I share this is because a lot of people who have found themselves in Utility Location walk into this industry with a minor awareness of the underground asset space in its entirety. Many of us just stumbled in and made it work the best we could with the time and resources we had. There was no industry body that could provide support, recruitment initiatives, skill development pathways, standards, certification or any type of development, let alone ongoing advancement opportunities. Connection to industry would've been so helpful. Thankfully, times have evolved since then.

During the first 2 years of selling the systems I spent a lot of time on site. As anyone in our line of work can attest too, when you are privy to seeing the work being performed you are also made aware of the issues. One of the largest concerns was the genuine lack of skill and know-how in utilising the technology properly. From strike to strike I and others in our space, bore witness to the effects of an industry that needed to take form.

It was during this period I also picked up a GPR (Ground Penetrating Radar) and started pushing it around. It was fairly apparent that reading a manual, talking to people who themselves were deep in learning, and clicking, shaping, marking, and hoping, just didn't cut it. GPR by nature is non-intuitive to the novice, you can be a phd, a master, and/or hold several degrees – interpreting hyperbolic readings, signal fracture, and material analysis is something that needs to be taught, applied, and reflected upon.

It was also quite prevalent that there was a major lack of general location practitioners in the industry and I found myself starting to perform a few locates during this time – primarily because companies had been receiving instruction from me by way of product training, and wanted someone to come out and mark the ground. There was zero mapping and survey methodologies back then, just clearance work and mark-outs utilising passive frequencies, induction, and my good ole faithful sigma clamp.

As I was performing this very basic survey and logbook work, some of the guys onsite asked me how I was conducting my surveys and so I started to jot down my site procedures. Not long after, I researched other relevant onsite procedures, recompiled, and then restructured the notes into a living Standard Operating Procedure document. Which back then consisted of a half page of bullet points; a far cry from today's basic methodology 8 page SOP document.

It didn't take much for myself and my colleagues to realise that we needed training to aid in bringing ourselves up to speed with best practice applications and methodologies for locating. So, we went into research mode. From manufacturers manuals, specifications and case studies, to contacting industry bodies (what we could find at that time), to locators working in the industry based in the United Kingdom, Germany, Switzerland, Italy, United States, Canada, China, Japan, South Africa, Australia, and New Zealand – we contacted a substantial amount of people and had a lot of discussions to see what information and training existed. What surprised me the most was that although some people had been involved in the industry for a while back then, there wasn't any real uniformed, structured approach to general skill development within the industry sector, other than those who were conducting training courses that only covered various *parts* of a Utility Locators role. Moreover, the people I spoke too were in unanimous agreement that there was no industry sector to speak of, everything seemed to be 'in development'. On this side of the world it was just a bunch of passionate people doing the best they could with what they had. Most had varying opinions not only on the industry itself being an industry, but the jury was also out on how to train, who trains, and what to train. I must say, although we are getting better, that defragmented feeling remains the same today in 2019. This is why I have decided to come forward and share my side of things, with a hope that those who are much further advanced including those who are a little behind, can connect, so we can *all* move forward with a shared and unified skill development approach for the Utility Infrastructure industry sector in general. Locating is one area, there is much more to do in this space. However, we must start from the start.

After much discussion and a more enlightened understanding of the chessboard, I decided it was time to get on a plane and do some travelling to go meet the people I had been talking too. Back then I just didn't realise that I would be committing the next 9 years to multiple plane rides, road trips, trade and industry certificates, survey work, writings, trainings, and presentations in and around underground assets, damage prevention, mapping, survey, civil construction, engineering, and ndt spaces.

2. Skill Development Applied Learning and Creation

I started upskilling myself by going to visit various manufacturers around the world. For me, this was the easy part of my development journey, because as a reseller it was an accessible and cost-effective investment for our company. The more we knew, the better we sold.

The problem with this sort of training is that it is purely product based, with little to no mention of methodology, theoretical, and practical applications. These areas at the time were rarely ever covered. Most importantly, sales driven trainings tend to gloss over certain limitations of a system. Sometimes because they don't know, but also perhaps they just don't want you to know. I understand the thought process, but as I now see the bigger picture, I just don't agree with it.

The good thing about getting trained by a manufacturer or supplier, who knows their stuff, is that a practitioner will receive a comprehensive product, functionality, and maintenance tutelage. In fact, out of all the trainings that I have attended in this space, the best *product* trainings often came from the manufacturer or professional solutions supplier due to their full function knowledge. This is one of the modules noted in the Foundation Learning Pathway (FLP) outlined in the recommendation section of this document: Product, System, Functionality, Maintenance, Certification

I believe manufacturers and solutions suppliers need to work in with industry, as they have an important part to play, not only in supply, but also in research and development which aids in improving the Utility Locators toolbelt and creating more effective systems to improve operational efficiencies. Technology is a massive plus to the return on investment thought process. However, and I cannot stress this enough (having come from a supply background); Suppliers should *not* have the authority to dictate industry direction or standards to an industry body. In the same breath, industry needs to keep up to date with innovative technology, because if we do not, we will either become ineffective, out-dated, or obsolete. Especially as technology, now more than ever, is enabling diversification and cross pollination of onsite application, practitioners, and industry sectors.
Technologists have a big part to play within our industry sectors, and good conflict of interest governance in our industry bodies should adequately handle any thwarting influence from the supply stream to the wider sector.

Next I began attending classroom based academic courses on frequency, signal, material analysis, ultrasonics, radar and various other hard sciences and NDT inspection methods. These courses weren't advertised back then, a few of us had to research and locate them, and of course a couple of people within my growing network started sharing their experiences on the courses they were sitting. I must point out, that none of these courses were at all focussed on utility location. They were science-based offerings, pure and simple, with nothing offered in NZ. I sat two courses in the AU, another in Canada, one in Chicago, two online, and of course two theoretical and practical learning courses in the UK. This was the *beginning* of my theoretical science knowledge base. Really understanding how frequencies and signals worked within the ground, the importance of geophysical properties, wavelength analysis and signal fracture, data acquisition and general processing - integrated with product and functional knowledge of the technologies, signal strength and manipulation became a little clearer and thus another module within the FLP took shape: Theoretical Science and The Variables.

During and post theoretical learning, myself and a few others within our collective were actively surveying and engaging with the material and the technologies to see if the hard science checked out with onsite applications, functions, and requirements. Site requirement at that time was very different to now. There was a lack of Health and Safety, Standard Operating Procedures, Traffic Management, Methodology – you name it. It was at this time that a group of us from around the globe were discussing and began to list the applications that a Utility Location practitioner would be required to execute. I simplified these discussions into an Application Matrix, see Figure 1, which has since evolved. FLP**:** Scope of Works and Applications

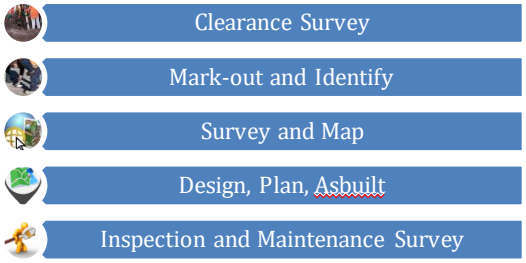

Figure 1 – Utility Location Application Matrix

A colleague of mine from the AU asked me which approach best suited each on-site application. I am not ashamed to admit that I was one of the people who lived out of the ABC XYZ of Locating PDF disseminated by Radiodetection back then. The matching locator frequencies and optional accessories to the job page was a huge help and a great foundational learning base, especially when one is really needing to move past the basics and into actively engaging in utilising various frequencies, accessories, and antenna to find and identify more things enabling a more thorough and systematic survey. But I found, as had others around me, that the more surveys we performed the more we became in touch with multiple methodologies. Methods that could be used for varying applications

utilising the same systems but using various functions in different configurations. As we tested and surveyed with various brands of technologies, we began to realise that the methodologies we currently had in place would need to adapt. Base methodology aside, finding and marking assets utilising more efficient technologies meant that flexibility to a more customised approach to a practitioner's scope of works was an important thought process to grasp. Case in point is automatic vs manual gain. First and foremost; I do not condone and promote automatic gain. For the sake of seeing if something is in the ground – maybe. For confirmation, range reduction, and pinpoint locating – never. Within accurate locate methodology, good trainers will teach how to utilise manual gain to pinpoint a locate (including the Peak *then* Null verification technique) if a practitioner is using an automatic gain system, the methodology, approach, locate level, and promised requirement for the job would need to change. Another changing face of locate training is the tracing vs accurate pinpoint locate debate (elaboration for another time). My point is, methodologies must be under consistent research and reform, it is therefore pertinent to ensure our industry bodies are consistently trying to evolve this space, hopefully with the help of globally shared information. FLP**:** Methodology and Approach – Infield Experience and Logging

It was at this time, around 2012/2013, that our training material started to evolve quite substantially which now included: Information collected from global trainings, manufacturers product and maintenance notes, inclusion of surveys and site experience, and of course, additions from various other practitioners I had met from around the globe and within our own backyard in NZ – our training content was developing well.
In addition to Methodology I started to include the SOP document we had been working on, which included H&S information from various sources such as WorkSafe, Local Government, NZ Transport Authority, and Contractors Excavation Procedures etc. This SOP has now been added to the Best Practice module below.

Next up was enrolment and completion of a number of NZQA (NZ Qualifications Authority) standard courses including designing, evaluating, delivering and moderating training assessment materials - to bring myself up to speed with the meaning of 'quality content and delivery'. This learning aided in levelling up the quality of our training deliverables, ensuring that we onboarded others to look over what we were doing so we wouldn't become biased to our own content. In other words, it stopped being about how many courses we could sell; and became more about focusing our efforts on delivering good quality trade training that aided the industry overall. It also made us accountable and aware of the importance of our role.
We made sure that we added suitable outcomes and evidence-based requirements for all of our utility location-based course cluster module offerings (which include CCTV, Gas Detection, Confined Space Entry, Leveling, Soil Testing). I look at our foundation level cable location course as it is today, and that one course alone (the beginning in a series) is now on Version 9.1. That should relay how we are have been trying to keep our content relevant to industry requirements and incoming standards.

All of the aforementioned was well before NZ practitioners had knowledge of, or even started to understand the relevance of standards like; AS5488, PAS 128, ASCE 38-02, CSA S250, NTE INEN 2873. Some of us knew of them, but in all honestly, we were just not there yet. A couple of really good companies in NZ were not only practicing the standards, but in my view were doing better work than a lot of the other companies I had witnessed overseas. However, our concern was the wider industry, and the fact that we didn't and still don't have enough highly skilled professionals to do the work here in NZ and in the Pacific Islands. Furthermore, the divide between the really awesome companies and the practitioners at the other end, was and still is, much too wide for an industry body to jump straight to where we need to be. Our job in this climate is to educate, legislate, engage, and take the hand of our sector and walk it to the level we need it to operate on. That's the reality of where we are - foundational stepping-stones.

Even though standards have still not yet been set in NZ, we have started to train in Best Practice utilising the AU AS5488 combined with the UK PAS 128 standards. FLP**:** Best Practice and In-Field Monitoring

During 2013, I started conducting a lot more training, whilst still conducting surveys, giving presentations, and running my businesses.
In the beginning the trainings went from 1 day to 2 days, then 1 week to 2 weeks. They then came back down to 3 days, as companies just could not give up their people for a copious amount of time, due to financially viability and time vs labour. Today, we have Module, Individual, and Combi courses, which are our most popular. We have designed, built, and partnered with others for training facilities including classrooms and practical areas. We also train onsite and I myself still travel quite frequently to conduct various trainings in this particular area.

An increasing request we are receiving today from those who are actively locating, is that practitioners want to be able to easily visualize, analyse, edit, and disseminate on-site data as effortlessly as possible.
Currently we concentrate on Report Generation for Excavation Permits/JSA's, overlay of interpreted data into varying formats, overlay of general fiducial markers into various formats, and of course various Post Processed geo-referenced deliverables. FLP**:** Data, Deliverables, and Report Generation

One reflection I believe most trainers share is that we learn from those we educate just as much as they hopefully learn from us. It is vital that trainers and educators allow trainees to share their stories in class and onsite. It gives them a voice, but it also allows trainers and assessors to keep up to date with relevant onsite issues and learn from the information being shared. I use these experiences to also hone my delivery and customise/adjust our courses to suit varying levels of applications, people, and requirements. This practice is especially good when training in locating principles in remote overseas areas such as: Fiji, Samoa, Cook Islands, Kiribati, and Papua New Guinea. I have a lot of stories regarding these territories, including cultural observations, that have been presented in the past as industry training case studies. I am only happy to share my findings here.

One of the largest concerns I have is ongoing skill development. A 3 day to 1week course jam packed with information, is going to be a waste of time if the practitioner is not going out onsite and utilising the learning and/or does not have an information recall facility. A few of us have been looking at ongoing skill development pathways so that practitioners can continue to build upon their skills, have access to an easy online system that records efforts, and one in which applies industry sector points to profiles – which ultimately heightens level of practice. From training apps loaded on mobiles for easy recall and record, to working with internal training managers and registers, to a cloud-based delivery system: sign-off, logbook, record - choices are limitless with today's information technology offerings. Getting the technology architecture right for this will be key and will also allow practitioners to look at their own individual skills matrix and identify next-step learnings.

It may pay to be wise in this space and set up a committee to discuss what is the best way forward for the industry overall taking into consideration other areas of interest within the entirety of the Utility Infrastructure Asset Management portfolio. E.g. Plumbers who fix our pipes, need to listen to leaks. System and Job dependent, the best way to do this is to find the pipe first. Therefore, our utility locators are now diversifying into other areas like Leak Detection and CCTV Pipe Inspection. Not to mention other Health and Safety requirements now asked of our Locators e.g. Gas Detection for confined space entry (GD), Traffic Safety Management (TSM), Excavation and Permits, and various other now deemed compulsive interconnected training tickets our professional locators must have. I also believe that customised training in Circuits, Signals, Geophysics, and Cable, Pipe Make-up and Installation will aid in taking our practitioners skills from basic to fairly high in a shorter amount of time than what we are currently experiencing. Partnering and receiving training from utility owners on their network is a key requirement (I have included this within the cluster skill modules in the recommendation section).

Connective Pathway or Cluster Skill Development enables diversification within the industry sector itself, furthermore, this thought process encourages connection with other industry bodies, to share information and connect development pathways. If our practitioners want to move onto Civil Contracting, fine. If the Civil Contracting practitioners want to come over and try their hands at Utility Location, Inspection, Analysis, Monitoring, and/or Maintenance – come on over.

3. Reflections and Recommendations

Learning Lessons

I was asked at a seminar earlier on this year what are the 3 things I would change if I could do this time all over again. The first thing I said was 'I would've been bolder in asking more questions whilst admitting that my own cup was empty'. So many of us act like we have all the answers, if we just sat back and listened for a moment the parts of the puzzle we are trying to put together tend to reveal themselves – with a bit of pulling, prodding and of course, team work.

The second thing I'd change is the knowledge pipeline order I chose when I was conducting my initial research. As I was in a technologist headspace I went down the supply knowledge route first. Knowing what I know now, I'd get on the phone to the already established international industry bodies of that time. Even though they were still thrashing around in their own spaces, they were much more advanced than we were a decade ago. Come to think of it, we didn't even know we existed back then – some are still not aware of us today, we are working on it however.

And finally (by the way, there are more than 3 things I would change) I would consult with education, training and development specialists sooner. I was already 3 years in when I decided to complete education papers, and consult with polytechnics, universities, and industry training organisations. Our group and my own practice would've been much further along had we gone down this avenue faster.

Alas, this is why we take the time to reflect – to learn. It is my hope that others gain something from this journey, if anything but to ensure a smoother ride. Please do not judge too harshly, I am a perfect embodiment of imperfection.

Following are my recommendations of a possible industry learning pathway for not only locators but those dealing in and around services in general.

Recommendations

1. Skill development and structure needs to be industry led.
   We need to direct practitioners through to the industry body first and foremost. Sector guidance will aid in ensuring that our practitioners are doing what needs to be done.
   Purpose + Strategy = An Education, Training, and Development Framework modelled around purpose to aid in achieving strategic intent.

2. A full training and development structure is essential to ensure adequate ongoing practitioner education. A good structure should be underpinned by the following quality assurance principles:

   - Focused on outcomes
   - Strategically aligned and needs-based
   - High Trust: people, process, technology
   - Fostering accountability
   - Flexible to integration

- Adaptable to change, innovation, and disruption
- Ongoing improvement
- Inclusive to diverse practitioners
- Competency, evaluative, and evidence based
- Digital record keeping, easy recall and dissemination
- Improve resilience – sustainable, business, economy

3. Industry sectors should allow involvement and integration with other sectors, which will encourage expansion and diversification into the greater Utility Infrastructure portfolio and beyond. This also fosters partnering with other industry bodies in relation to our own.

4. *Foundation* training should be competency-based, which will evolve as practitioners complete training modules and continue to move forward into more advanced trainings which require more stringent/advanced assessment and moderation processes - ultimately leading to certification. (Training and Education organisations must ensure that programmes of study or industry training are sufficiently flexible to address a range of needs).

   Below I introduce the foundation learning modules: UL we currently have in place, sans the Locator Certification Preparation, which is yet to be introduced into NZ and the other territories we work in.

Figure 2 – Foundation Learning Pathway (FLP): Utility Location Modules

5. National industry bodies from round the globe need to connect and work together to endeavor to foster an inclusive industry community culture, one in which shares information and experiences, to enhance the value of the industry sector to the wider economy. Seeing it work for others, my suggestion is to have a Global Industry Group who facilitates general discussion for the industry, by the industry.

6. A Continuing Professional Development (CPD) point system should be undertaken to ensure registered practitioners remain up to date with the latest knowledge, research, science, technology, and methodologies to ensure safe, efficient, and effective practice onsite. However, as learned from dealing with other industry bodies, I highly recommend this be customised accordingly. Building CPD into the overall professional

development pathway and module learnings via allocation of points to each area is a practice utilised within many associations and institutes and is seen to be a very easy model to work with.

7. Cadet Schemes, Apprenticeships, Industry Trainings including Refresher Initiatives, Leadership and Mentor programmes; or a National Qualifications framework (although NZ Qualification Framework guidelines reflect that the role of industry training organisations is different from that of education providers in this area), are key to industry growth, cultivation, and longevity.

   Our industry is working in and around vital assets, once a suitable structure is put in place by the industry body, funding for these schemes and programmes can be acquired through both Independent and Central Government agencies.
   Furthermore, as per the NZ Industry Training and Apprenticeships Act 1992, an industry body can prepare a proposed plan in accordance with section 159X of the Education Act 1989 and submit for approval under section 159YA of that Act. I highly recommend all industry bodies look into this regarding your own countries legislation in this space.

8. Ensure learning development pathways are set-up and structured accordingly to support industry employment, quality assurance principles, and recruitment initiatives.

9. Since identifying various learning pathways during our experiences in the training, education, and development space in NZ and the wider South Pacific area, it became quite apparent that a consolidated IDP needed to be compiled. The below figure best represents what we have come up with thus far.

   Solidify a living and adaptable Industry Development Pathway (IDP) document.

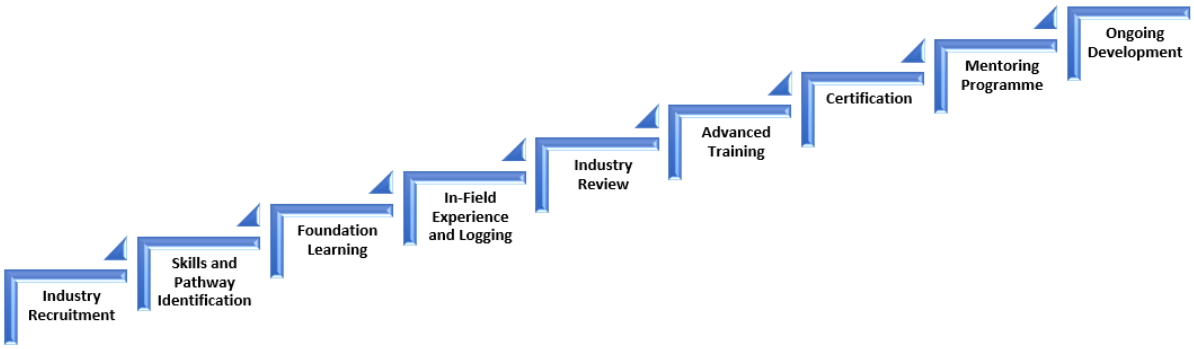

Figure 3 - Industry Development Pathway (IDP)

10. Develop Industry Body, Training, Supplier, and Field Experience partnerships to aid in cluster skill development pathway connection. I have a lot of ideas regarding this side of things after many and varying discussions with other industry bodies. Below is a brief explanation of the thinking in this area. However, when combined with other industry sector trainings, it expands very quickly. My recommendation at this stage is to just build upon advanced offerings by adding relevant modules to the mix. This should be looked at as a flexible space with room to move.

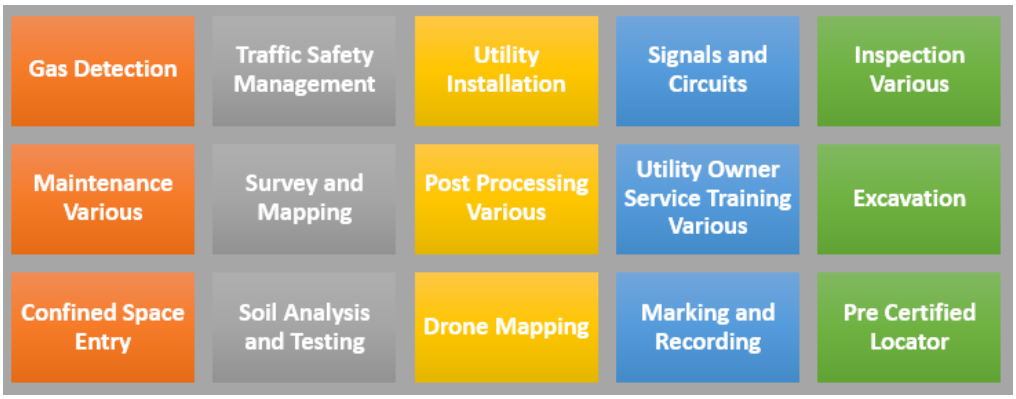

Figure 4 – e.g. Proposed Cluster Skill Modules

4. Conclusion

We in NZ as a group and as individuals do not have all the answers, but I believe we have value to add to the sector in general.

Sharing information on a global scale so we can all be of help to each other, is imperative. It would of course be up to each country as to how the information is consolidated, customised, and delivered to suit culture, but the primary knowledge base is what is most important. All failures, successes, combined experiences and war stories - all are relevant to the industry sector we work in, including the other connected spaces we also add value too.

I wholeheartedly encourage all industry bodies to chat, not just within our own sectors, but also with others. This is how industries become smart, adaptable, and evolve - they connect with each other, share information, compile, execute, and meet up to review monitored progress. This is what is known as Smart Industries thinking, an initiative a few of us have been talking about for quite some time now. Let's progress together.

Unite core purpose, connect our industry sectors, share information, educate each other, evolve and grow together.

#Educate2Elevate

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