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Working Towards Benefits and Economies of Scale in US Surveying/Geomatics Programs

N.W.J. Hazelton *

Coolgardie LLC,
2925 Wendys Way,
Anchorage, AK, 99517.

E-mail: nwjh@coolgardie-llc.com

Abstract

The model for surveying education that was adopted in the US, possibly by default, in the 1970s was built around each state having a surveying program. The rationale for this was that each state has its own specific way of dealing with land and property, and should therefore educate professionals with state-specific knowledge. While this model was modified in some cases, such as the New England states developing one common program and other states developing more than one program, the model has remained largely intact to this day.

This model contrasts starkly with that adopted in Europe and Canada. In these countries, programs were usually concentrated. While this may involve students going to a specific university, most European countries are small enough and with sufficient public transport for this not to be a major issue.

The consequences of the US model are apparent today. The largest program in the US has fewer than 10 faculty, and most have 4 or fewer full-time faculty. The three main programs in Canada have at least 10 faculty each, as do most of the European programs. The small numbers of faculty places all the US programs into the 'marginal' category for survival. The departure of one or two faculty, restructuring of a college, and the repeated budget cuts make it all too easy for a program to close, or get run down to the point where it struggles to continue.

Small programs do not have the luxury of the resources to put significant effort into recruitment, program expansion, new equipment, courses in new, leading edge fields, and the ability to allow faculty to take sabbaticals. Every change carries the risk of something going wrong and bringing more survival pressure on the program. By contrast, very few opportunities arise that aid survival.

Adding to the problems is the fact that surveying and geomatics programs are expensive to set up and operate. Equipment changes rapidly, and it is not hard to have $1 million in equipment for the program sitting in laboratories. As programs are often in engineering colleges, salaries can be at an engineering level, rather than at a humanities level, which can attract the attention of administrators looking to save money. Without the resources to tackle student recruitment, it becomes difficult to bring up student numbers and ensure long-term viability.

Within the ivory tower, faculty are called upon to take up increasing amounts of administrative work, as administration continues to expand. Faculty on fixed salaries cannot get overtime, and so are seen as an infinite resource that is available at a fixed cost. While effort is directed to administrivia, other more important functions get less attention. Teaching, research and non-university service get less time, as does

actually running the program to be a long-term viable entity. Recruitment becomes more difficult and less productive as a result. College and university efforts to save money tends to force recruitment into one-size-fits-all efforts, and specialized programs like surveying/geomatics tend to get lost in these efforts.

Another effect of the small faculty numbers are that programs have great difficulty offering courses that involve major specializations. A number of programs in the US have little to no photogrammetry or remote sensing, despite these fields being at the forefront of the technological revolution in the discipline. Very few programs offer any significant amount of hydrographic surveying. Many programs have only a handful of elective courses to offer. Some programs have outsourced important parts of their program, such as GIS/LIS, to geography departments who may not understand errors and quality measures in any depth, and may have no real understanding of cadastral issues and LIS.

With few faculty, what can be offered is limited to the interests and skills of the current faculty. The departure of one faculty member can cause a major disruption if their courses cannot be covered by anyone else.

In summary, US surveying and geomatics programs are unable to take any advantage of the economies and benefits of scale, because the model works against these advantages. In order to try to take advantage of these economies and benefits, we need to try something different.

Introduction — The Problems Faced

When the author arrived in the US 20 years ago, he was confronted with a set of very different systems in which he had to operate. To get up to speed required considerable study of these systems. Looking at these systems from the 'outside' made it easier to see many of their more subtle aspects, which may be difficult to see when one's experience is predominantly within the system.

Program Distribution Model

One of the important differences observed concerned the geographic distribution of surveying programs in the US. The model was very like Australia, with programs distributed by state or region, rather than concentrated, as in Europe, Canada and New Zealand. In Australia, geographic distribution of people is a larger driver than the situation of 'states,' but it ends up with the same result. While some states developed additional programs (NSW, Vic), most operate only one program (WA, SA, Qld, Tas), and any additional programs (Qld) have since closed.

The proportional numbers of students and programs in the US compared to other countries indicates that US programs have fewer students per head of population than almost all other countries. This suggests unproductive recruiting and that there is considerable room for growth. See Table 1 for details.

Looking at Table 1, if we exclude Uganda (which has had some internal issues) and the USA, the other 25 nations have an average number of 4.31 million people per program. Looking at the 16 most developed nations, apart from the USA, the average number is 4.38 million people per program (less than 2% difference). With these figures, we would expect that the US could support about 70 programs. The fact that suggesting this would be considered almost ludicrous indicates the issues we have. The other way of considering the situation would be to suggest that student numbers nationally could be increased by a factor of at least three. Noting that many programs in countries such as Canada, Israel, Slovenia, Switzerland, New Zealand, Turkey, Singapore and Germany are much larger than any US program, the expansion factor could be six or more. Imagine 100 programs that are all twice the size of the current average US program.

Country	Programs	Population (millions)	Million People Per Program
Canada	5	34	6.8
USA	23	312	13.6
Netherlands	3	17	5.7
Slovenia	1	2	2.0
Sweden	3	9	3.0
Uruguay	1	3	3.0
Switzerland	4	8	2.0
Botswana	1	2	2.0
Greece	3	11	3.7
Hungary	2	10	5.0
Czech Republic	6	11	1.8
Finland	3	5	1.7
Germany	19	81	4.3
Turkey	8	72	9.0
Israel	1	8	8.0
Uganda	2	33	16.5
Sri Lanka	4	21	5.3
Singapore	1	5	5.0
Hong Kong	2	7	3.5
Ghana	4	24	6.0
Slovakia	1	5	5.0
Lithuania	1	3	3.0
Moldovia	2	4	2.0
Poland	5	38	7.6
Denmark	1	6	6.0
NZ	1	4	4.0
Australia	8	22	2.8

Table 1. Proportions of 4-year Surveying/Geomatics Programs to Population in a Range of Countries. (Source: FIG data and world population data, as at 2013.)

In the last 15-20 years, at least eight 4-year programs in the US have closed, three of which were long established and had graduate programs. Four others have started and closed during this period. Seven additional 4-year programs have started, but all remain small and usually under-resourced. Programs within civil engineering departments are mostly gone, Pomona being the notable exception. Many US programs are 'marginal' at best, in terms of long-term survival. Many of the nations listed above have 2-year programs. Other countries, e.g., China, the UK, and the Latin American nations, have a different educational structure in this field, and so a direct comparison is not as meaningful. These other nations have strong and well-developed programs within their own models, as indicated by the number of students they send to US graduate programs.

The large numbers of students at many overseas programs cannot be passed off as them being less developed and needing more surveyors. Switzerland, France, Germany, Poland, Sweden and Denmark have been closely settled and heavily mapped and surveyed since long before the US existed. Canada, Australia and New Zealand were settled at about the same time as the US.

The core argument for having programs distributed at the state level in the US was that each state had its own way of dealing with boundary issues. However, examination of most programs found that the number of courses that dealt specifically with local boundary issues was usually just two. The rest of the program was, largely, universal, and a significant part of the boundary issues were also common across the nation. The use of a few nation-wide textbooks for these courses supports the assessment that the 'local' argument was probably fallacious, however well intentioned it may have been at the time.

Another argument for state-based programs was that students were unlikely to travel to a distant institution. Unfortunately, these students are the least motivated to succeed, and therefore not those that we want to attract to programs and the profession. Having motivated students means better retention and better academic progress. Such students will find ways to complete the program, despite difficulties like distance and cost.

While the current model may not be easily changed, there are other options. While we are very aware of distance and remote learning activities, we often overlook using the same concept for program management activities. But before we can work around system limitations, the system has to be understood.

Resource Limitations

All but one program in the US is located at a state university, and so programs are subject to the vagaries of state funding of higher education. While there were cutbacks in state funding, in many cases, in the wake of the economic slowdown following the 2008 financial crisis, not only have these cuts not been restored, but another round is being contemplated as a result of on-going state funding problems.

We can argue about causes and solutions at the state government budget level, but none of that helps the programs. Cost-cutting tends to have a worse effect on small programs, and programs that have previously cut back their costs. There are probably no 'fat' surveying/geomatics programs in the USA, so additional cuts are unlikely to help survival rates.

One way to cut costs is to employ adjunct faculty, but this can be problematic for the long-term success of the program. When a program is too dependent upon adjunct faculty, there is a greater risk of problems concerning long-term survival. Shifting from tenured faculty to adjunct faculty shifts program management responsibility onto fewer people, with increased risks if any of them leave. It also means that it is difficult to keep the program developing in these times of rapid technological change. There are some other serious problems with this shift in academic employment from full-time to part-time, but they are beyond the scope of this paper.

With the reduction in available funds, resources for equipment and other teaching aids are getting tighter. Most programs have become adept at finding funds in non-traditional places, and acquiring equipment by all manner of methods. However, this is not a path to long-term success.

The lack of funds means that resources are limited when help is needed for administrative support, as well as when a major project has to be done, such as an accreditation review. These additional duties add to the loads on already overloaded faculty. As the full-time faculty are usually exempt from receiving overtime, they are seen as a limitless and pre-funded (i.e., free) resource by administrators. This means that

progressively more administrative work gets added to faculty workloads. This takes more faculty time, especially as the administrative component of universities has been the major growth area over the past several decades. While the total outlay on faculty has remained steady, or dropped in real terms, administrative salaries have grown faster than tuition. Faculty costs have been contained by shifting more faculty positions to part-time and adjunct positions. However, administrative costs have grown consistently and rapidly, and this growth has resulted in increasing the administrative burdens on faculty. Because faculty time in hours per week is finite, adding more workload is a zero-sum game. Other parts of the workload suffer. As research adds income to the uncommitted part of the institution's budget, it is encouraged. Administration increases, so what loses is teaching and student interaction.

With cuts at the university, one area that often gets consolidated is recruitment. Rather than supporting individual recruitment efforts program by program, funding is consolidated into central efforts. As a result, recruitment focuses on the large programs, where there is more obvious return on investment. Small programs are further marginalized. God is on the side of the large battalions!

Two-year programs are seen as closer to the jobs that they support, and so are more likely to survive serious cuts to a state's higher education budget. Any strategy for the wider discipline therefore needs to pay close attention to the two-year programs, as they must form an integral part of survival, as well as expansion and growth.

Course Offerings

With the resource limitations facing programs, what can be offered in courses has also decreased. About 20 years ago, ABET required every program to demonstrate that it was covering five different areas across surveying and geomatics. These Program-Specific Criteria included boundary and/or land surveying, geographic and/or land information systems, mapping and geodesy, photogrammetry, remote sensing, and other related areas. The current Program-Specific Criteria have much the same areas, but programs have to demonstrate covering only one of them.

This is recognition that many programs cannot provide a broad education in geomatics, given the shrinking resources. Many programs cannot offer courses in many of these areas in any depth. Half a course might be devoted to photogrammetry and remote sensing, but these are two of the critical growth areas in the discipline. This growth is in jobs, not just 'interest levels.' Very few programs offer any significant amount of hydrographic surveying. Many programs have only a handful of elective courses that they can offer. Some programs have outsourced important parts of their program, such as GIS/LIS, to geography departments who may not understand errors and quality measures in any depth, and may have no real understanding of cadastral issues and LIS. The attitude that 'the cadastral information is just another layer in the GIS,' betrays an almost complete lack of understanding of boundary determination and the fact that it is primarily a legal solution, not a mathematical or geometrical solution. This leads to conflicting messages to students about what is important and what matters.

In many places there are insufficient people available to work as adjunct faculty in these discipline areas, and there may be a serious lack of equipment. While photogrammetry and remote sensing can now be handled on PCs, the software still needs to be acquired.

Getting faculty with a broad foundation, who can teach in all or most of these disciplines, is also becoming more difficult. If a faculty member with that skill set leaves, it may be very difficult to replace them, and doing so may cause another area to lack coverage. Trying to balance everyone's skills into a comprehensive program is extremely difficult.

Elective courses are another issue here. While programs would like to offer a range of interesting electives for students, the more that are offered, the fewer students in each course. For small programs, this means that a significant proportion of elective courses cannot be run because insufficient students are enrolled. While some institutions will allow courses to run with as few as five students, as costs (mainly administrative overhead) increase, the minimum number of students required increases. The number of students to break even on a course varies with the teaching costs, but is readily calculated. Sometimes it may require over 20 students to cover the costs of a course. This won't work for trying to run a reasonable number of electives.

There were discussions some years ago about offering courses at more than one institution, but while a few were set up and run, these were not widespread. Various internal problems led to the experiment being largely ineffective in dealing with any of the problems listed above. In addition, on-line and distance courses cannot cover all the areas of learning that are needed.

Summary

Surveying/Geomatics programs in the US face a large number of serious problems. These problems have the potential to endanger the survival of individual programs. The triggers that move the problems from potential to actual are often small things, such as faculty retirements, shifts in college leadership that look upon the program differently (and often disparagingly), changes in budgeting procedures, prioritization processes, and changing demands on faculty time.

Regardless of the causes, these problems seem to occur regularly. Over the past 20 years, the author has watched several programs close, seen successful programs suddenly seem to collapse and have to claw their way out of a difficult situation, and observed programs seeming to skate around the edge of closing by means that are difficult to determine. Other faculty with long experience have seen the same things happen many times, often with monotonous regularity.

There should be ways to minimize some of these problems, especially as a new round of budget pressure is building across the country.

On-Line Courses — A Solution?

In recent years, on-line courses have often been touted as the solution to all manner of academic problems. In many cases, the advocates are administrators with minimal teaching experience, especially when attempting to educate professionals. The sudden rise of MOOCs a few years ago has been matched by an odd loss of interest: perhaps the hype has worn off and their true value and utility is being seen. All too often it seems that there is a mantra being chanted: "Shove it on-line, and all will be fine."

To move courses to distance learning mode, we need to look at all the components of each course. Basically, a course, as a unit within a discipline or program, has nine components that need to be considered for planning distance learning. These are briefly discussed here. Not all of these components apply to all courses, but consideration still needs to be given to them, to ensure they aren't needed.

The External Component is how the course relates to the outside world, beyond the program. This needs to be made explicit, and will be part of the feedback loop for ABET.

The Interconnection Component is how the course connects to other courses within the discipline or the program. This may be by prerequisites, but also by explicit links to previous or concurrent material. Links can also be made forward to help maintain students' curiosity.

The Support and Reference Component is the equivalent of the textbook, providing the library resources for the student. Part of this will come from on-line text, as well as wikis and similar on-line resources. Other parts remain in print, e.g., almost everything before about 1993.

The Assessment Component can be as fine-grained as needed, and includes assessment of both the students and the course.

The Factual Component is the core material in the course, which can be conveyed by canned material: notes, videos, podcasts, etc. This is largely factual or core theory, and tends to last for long periods of time. This is the component that on-line courses can do well.

The Collaborative Component is the discussion between the students, as well as that between the students and those outside the course (e.g., other students). This is where students help each other learn and teach each other, as well as share what they have learned and reinforce it. It also helps build a community of learners around the discipline.

The Interactional Component is the interaction between the student and the instructor. This can be face-to-face or via intermediary virtual tools. But this interaction is critical, and goes beyond what is in the Factual Component.

The Practical / Work Experience Component is where the students get to practice what they have learned in exercises that reinforce the theory and instruction. This may be in more extended projects, or in small contained labs.

Each course needs to have each of these components made explicit and developed. If this isn't done, the course will be less than successful. Too many on-line courses have developed the Factual Component and ignored the others, on the basis that the students merely need to memorize 'facts.' This notion is reinforced by the idea that the student is buying a qualification (the degree), not an education.

There is a strong interactional component required for courses. The Factual Component is well suited for on-line delivery, but there is a strong need for real people who can interact with students and involve them in the material. By focusing faculty attention on this aspect of the course, while out-sourcing the factual part of the course, faculty can offer more courses without adding to their workload. This allows greater diversity of course material, as well as the ability to offer a wider range of electives. This will take advantage of the strengths of the faculty, while not spending time on teaching factual material.

It is also well established that the more the faculty connect with the students, and the less that they lecture, the more the students learn. Rather than spending time lecturing, it is far more important that faculty get involved with getting students involved. The more involved students are, the more they understand. But involvement needs a real person. This is the role of the faculty, and it is how faculty must attract students to their programs, by how they involve students in the discipline.

A relevant quote, variously attributed to an ancient Chinese proverb, Dr. Herb True, and occasionally and erroneously to Benjamin Franklin and a Native American proverb, plus an additional rider from a trainer:

> "Tell me, and I'll forget.
> Show me, and I may remember.
> Involvement me, and I'll understand.
> Step back, and I'll act."

But improved involvement is only one reason for changing the models we are using. We are in the middle of changing economic systems, and with those economic changes will come major social changes, as well

as changes in work and what geoscience/geospatial/geomatics/surveying people do. Universities will also change, in what they do, as well as how they do it. Unfortunately, one of the ways that they can change is by being destructive before they are creative, cutting costs before increasing income. This is a challenge for small programs.

Economic Changes

"We are, in fact, living more and more in an intangible economy, in which the greatest sources of wealth are not physical. We aren't yet used to an economy in which beauty, amusement, attention, learning, pleasure, even spiritual fulfillment are as real and economically valuable as steel or semiconductors … Increasingly, people aren't just buying goods and services. They're buying experiences." (Postrel, 1996, p. 118). The sources of wealth in these new sectors of the economy are not physical, but intellectual.

Within surveying, we have seen continual decreases in employment levels, primarily among the field crews. One reason for abandoning the 'apprenticeship' path to licensure is the one-person field crew: who can afford to take on someone unproductive and teach them, when you need to double the crew size. It was straightforward in a crew of five or ten, where there was also peer instruction, but it is no longer economically viable.

What we do is, quite literally, transform people: we take a high school kid, and four years later, turn out a proto-professional. Their understanding, modes of thinking and problem-solving, and hopefully their entire worldview is different to four years before. If we are going to maintain this process in the face of a changing economy and, indeed, changes to the entire economic and social systems, it will require an intentional approach to change.

That is our work as educators, but our students should not be educated for an economy that is shedding jobs in some of our traditional areas of work. We need to be creative in how we educate for a new economic system, a new set of ways of employing people, and in explaining what they do to clients in the middle of an economic system in a state of flux.

In the middle of this, programs are under increasing pressure, from all directions. As the amount of technology and theory grows, as one-person crews require employees to be productive from their first day across a wide range of technologies and techniques, we cannot abandon the process of a formal education as the mode of entry to the profession. However, how we education the next generations of professionals is something that we can change. How we support our programs in the face of the growing rate of change outside the discipline is another major issue.

Moving Towards Some Broader Solutions

Programs with declining resources face a potential death spiral. As they come under pressure to do more with less, one of the areas that may be overlooked is student recruitment. So numbers decline, the budget pressure increases, faculty attention focuses on short-term survival issues, while the lack of attention to the longer-term issues accelerate the decline, which adds to the pressure. The loss of a faculty position can be a serious blow to the program, which may have great difficulty recovering.

One of the downsides of creating very many small state-based programs was that economies of scale were impossible to develop. Because the US culture emphasizes competition over collaboration, even where competition is suicidal for all concerned, collaboration is difficult to set up. If the programs can arrange to collaborate, the institutions often cannot manage it: there is too much political and administrative difficulty. So each program faces the storm alone, rather than being able to collaborate and have a better chance of survival.

One solution may be to collaborate through an external, independent body. If the external body was able to mediate the connection to each program and institution, then many obstacles could be overcome. Courses would able to be shared, which would allow student numbers to be lowered, if the cost structure was right.

However, the solution is not "shove it on-line." That can be part of the solution, but it has to make sense for everyone involved. Pushing courses on-line so that faculty can be dragged into an administrative mire makes no sense for education. Shifting all teaching positions to adjuncts to reduce the costs, based on a factory model of education, flies in the face of 2,500 years of research into education. These are the array of hazards on the path of on-line education. If we want to educate the next generation of professionals and set them up to be able to take advantage of the new economic system as it evolves, then a factory model of education, with 'teaching machines' pumping 'facts' into students, is a road to failure. If we implement on-line courses, then we need to ensure that all parts of the course are dealt with, not just one.

Collaboration in recruitment is one area where everyone can benefit. Some years ago, there was a national effort to increase program enrollment, which seemed to start somewhere on the east coast and involve some of the then-national professional organizations. Videos and materials were produced and professionals recruited to present the discipline of surveying to potential students. There seemed to be little, if any, outcome in terms of increased numbers of students. The author was involved in several (unrelated) efforts that doubled student numbers in a few years, but these were intensive and focused efforts, carefully targeted to very specific groups. It should be noted that when the recruitment efforts were stopped, student numbers fell soon afterwards.

So a different approach to recruitment is required. This should be a collaborative effort, as shared materials keep costs down, and lesson learned can be shared. Until there are well over 70 programs, each with about 100 full-time students enrolled across the country, US geomatics programs will not be in any serious competition with each other. There are far more students for everyone out there, if we can but reach them.

With pressure to deal with institutional issues, such as administrivia, faculty attention is dragged away from teaching and program management, and, most importantly, from involving students. Since most programs face similar sets of issues, such as accreditation, teaching, program updating, course development, program management, student recruitment, etc., some of these issues could be partly out-sourced, to allow faculty more time to deal with institutional issues. By centralizing this operation, there are economies of scale that can be created.

The economies of scale should be pointed out. At present, no program in the US has more than ten faculty; most have four or fewer. If every operation needs to be dealt with by every program, then there is a great deal of duplication. However, there are at least 100 surveying/geomatics faculty in the US, which effectively creates a very large 'program' or 'department' that can collectively afford significant levels of support. If these support options can be co-ordinated through a suitable external body that creates the collaboration, then the economies of scale can be realized. With the ability to undertake these tasks more efficiently and effectively, the survival chances for each individual program increase.

The question is: how to create that external body to manage this collaboration, and provide this level of support?

Coolgardie LLC

Coolgardie LLC was created to address some of these problems. It seeks to do this by creating and offering a range of services to surveying and geomatics programs. Coolgardie, being an external private company, is able to avoid many of the difficulties that stand in the way of collaborative efforts, and provide the means of linking programs through its services. Mediating the connections for collaboration allows Coolgardie to develop the economies of scale across numerous programs, outside of many administrative structures.

The services that Coolgardie can offer to help with courses include the following.

- **Creation and delivery of on-line courses** that provide common material across many programs, but customized to each program's curriculum. These courses are to be delivered from Coolgardie's system through each university's on-line course system. These courses can be core courses, parts of courses, elective courses, or whatever combination meets an individual program's needs.
- **Delivery of elective courses** that are beyond the resources of a single program to offer. Courses are delivered on a charging basis that allows an institution to make money even if only one student enrolls. Any number of students can be managed, but electives are commonly small classes.
- **Supporting faculty as mentors and guides**. For programs under significant resource pressure, a different approach to course delivery can be developed. The mode of offering courses can be shifted to allow Coolgardie to offer the on-line portion, while supporting the faculty in a mentoring and guiding role, rather than direct teaching. This allows a learning model closer to graduate school. Faculty can offer seminars that integrate material and provide local support to students. Coolgardie is keen to remain in the background, so that the students deal directly with the faculty, rather than with the company's people.
- **Support lab components on-line**, while others can have **on-site support**.
- **Grading and related support services**. These can be provided, or these can be handled by the local faculty. In all cases, analytical support of student involvement can be provided to faculty on a regular basis.

In addition to direct course delivery and support, Coolgardie can offer a range of support materials, including the following.

- **Support materials for instructors and students**, including new textbooks. The materials can include anything related to a course, ranging from quizzes and assignments to final examinations. Textbooks will be offered by Coolgardie's publishing division.
- **Lab materials** designed to complement on-line materials. Labs can be developed as required for each course, ranging from materials for the lab to lab-based examination. Labs are designed in collaboration with the program, and tailored to curriculum and equipment.
- **Support for labs** for faculty with limited workplace experience. Some labs may require additional support, and these can be supported in whatever ways work for the individual program.

These services are designed to provide extensive support for programs, to allow programs to operate with efficiencies of scale that extend beyond their own departments and institutions. In addition, these services allow faculty to focus on students and student involvement. This is an important step for recruitment and therefore for program survival and growth.

Coolgardie Consulting

Coolgardie LLC includes a division dedicated to consulting services, to allow some separation from the course-focused efforts. Coolgardie Consulting provides a range of support services for programs beyond courses. These include the following.

- **Support for student recruitment**, including recruitment plans and materials. Because this is a critical requirement for program survival and growth, support for large-scale recruitment is offered. Plans for targeting suitable audiences are developed, timetables for actions and materials for support are generated, tailored to each program.
- **Support for accreditation efforts**. After multiple successful accreditation visits, there is a great deal of experience available to help programs meet ABET requirements. Direct efforts to meet the requirements, without wasting effort, is important in resource-strapped environments. Preparing for an accreditation visit is a major effort, and can strain a program's resources.
- **Support for prioritization efforts**. As institutions start to face budget crunches, prioritization is one process that may be implemented by the institution to try to find programs that can be cut. With our significant experience in the prioritization process, programs can be helped to develop materials that maximize their changes of getting through prioritization unscathed. Similar processes can be supported, as variations on prioritization are developed. Our experience with Expert Choice software, for example, which approaches prioritization in a more numerical manner, can be utilized to help programs.
- **Support for restructuring and program expansion**. As the discipline changes, support can be provided to help programs evolve and restructure to undertake different directions. At the same time, support for other diversification efforts can be provided.
- **Support for faculty locums**. If a faculty member is absent for a significant period of time, e.g., sabbatical or medical leave, a short-term replacement can be found and supported to be physically present at the program during the required time.

The purpose of these support services is to assist programs build systems to help them survive existential crises and thrive. The stronger the foundation upon which the program is built, the better equipped it is to survive the inevitable difficulties it will face through changing circumstances. By providing a viable alternative to facing the challenges alone and unaided, Coolgardie aims to increase the survival among surveying and geomatics programs.

Conclusions

Coolgardie has been created to provide a range of support services to surveying and geomatics programs. These services include course materials through to full on-line courses, course support materials and services. In addition, Coolgardie Consulting offers services to support student recruitment, accreditation, program development and restructuring, locum needs, and prioritization efforts at the institution.

References

Postrel, V.I., 1996. "It's All in the Head." *Forbes ASAP*, February 26, 1996.