ONE STRATEGY FOR REPOSITIONING SPATIAL SCIENCES EDUCATION IN AUSTRALIA

R. Bennett
C. Ogleby
I. Bishop
Department of Geomatics
The University of Melbourne
Victoria 3010
Australia
rohanb@unimelb.edu.au

ABSTRACT
Australian spatial sciences education is facing a paradox: the demand for graduates is steadily increasing yet enrolments remain static. This paper examines a new strategy aimed at resolving the paradox. To this end, the University of Melbourne’s new degree structure and its impact on Geomatics are examined. The new model enables students to obtain a Geomatics Major within three years - as part of a Science or Environments degree - or a Masters in Engineering (Geomatics) within five years. Results from the first year of implementation suggest there have been increases in student quality, student engagement and the exposure of spatial sciences to undergraduates. Enrolments suggest Geomatics has halted the recent decline in numbers; however, it is too soon to determine what increases, if any, the Masters program might achieve. This paper suggests that the new model will produce both pure spatial science professionals and spatially skilled workers in other professions: both are required to combat existing skills shortages. The new model should be viewed within a larger set of industry-wide strategies to increase professional numbers.
INTRODUCTION
Australian spatial sciences education is facing a paradox: the demand for graduates is steadily increasing yet enrolments remain static. Indeed, many institutions offering spatial science qualifications are experiencing a decline in enrolments. The existence and impacts of the paradox are well documented: In 2001, The Spatial Information Industry Action Agenda (ISR, 2001) revealed a range of statistics. Such trends have been confirmed by additional studies (c.f. Baker, 2005; CRCSI, 2005; Hannah, 2006; 2007; Kelly and Chipchase, 2005; Kelly, 2006a, 2006b; and McDougall et al, 2006).

This paper examines a new strategy, emerging from the tertiary sector, aimed at addressing the lack of growth in enrolments. The paper begins with an analysis of spatial sciences enrolments at Australian Universities. Questions emerging from the analysis leads to further investigation of The University of Melbourne. The courses on offer, changes made to the offerings and the outcomes of change are explored. What results is a synthesis of potential opportunities and future challenges for spatial sciences education in Australia. Possible responses are discussed and left open for debate; however, the conclusion focuses upon the importance of collaborative efforts to promote spatial science education in Australia.

A SNAPSHOT OF SPATIAL SCIENCE EDUCATION IN AUSTRALIA
It is difficult to source detailed statistics on Australia’s spatial science education sector. Traditionally, Australian Government statisticians combined enrolments in surveying with those in engineering. In contrast, the spatial sciences routinely divided themselves into traditional surveying and geography categories. Moreover, until recently statistics concerning student numbers, staff ratios and annual turnover were kept within individual institutions - there was no aggregation.

This changed with publication of the Spatial Information Industry Action Agenda (ISR, 2001). A section of the agenda was dedicated to education and skills. It attempted to provide statistics on the sector and also outlined a range of improvement strategies. The agenda prompted the Australasian Surveying and Mapping Lecturers Association (ASMLA) to change their name and constitution. ASIERA, the Australasian Spatial Information Education and Research Association, sought to provide a unified voice to government and industry on matters relating to education and research in spatial information and spatial science (ASIERA, 2008).

The inception of ASIERA saw more meaningful attempts to quantify the size of the spatial sciences educational sector in Australia, which included keeping records of undergraduate, postgraduate and staff numbers. Figure 1 is compiled from ASIERA data and illustrates the total undergraduate enrolment over three 12-month periods: 2002/03, 2006/07 and 2007/08. Data are ordered by the size of an institution’s enrolment in the 2002/03 year. Institutions included are University of Tasmania (UTas), The University of Newcastle, The University of New South Wales (UNSW), The University of South Australia (SA), Queensland University of Technology (QUT), Curtin University of Technology, The Royal Melbourne Institute of Technology University (RMIT), The University of Melbourne and The University of Southern Queensland (USQ). While not authoritative, ASIERA suggests the numbers are a very good indication of the enrolment status of each institution.
Figure 1. Undergraduate enrolments in spatial science courses within Australian Universities - headcount
(Note: data does not distinguish between enrolment types e.g. part-time vs. full-time)

Analysis of the graph requires the introduction of a few caveats. Firstly, only the nine foundation members of ASIERA are considered. This represents the traditional surveying, geomatics or spatial science schools. Data from other institutions, offering a range of geography, GIS and spatial information programs, were not available. Such institutions also contribute to the total number of spatial science graduates. Secondly, three data items: SA 2006/07, QUT 2007/08 and RMIT 2007/08 were not available. To assist with the readability of the graph, figures from the preceding or following year are used. Thirdly, the number of epochs was limited to three and these were unevenly spaced: any discussion of trends must therefore be treated with caution. Finally, there are no distinctions according to enrolment status: whether a student is enrolled part-time, full-time, or as part of a combined or distance education degree is not identified in the dataset. The data in Figure 1 therefore represent headcount rather than fulltime equivalent data.

Regardless of the graph’s limitations, it does raise some interesting points. Firstly, the total number of enrolled students remained steady, and increased slightly, across the three epochs. The figures were 1516, 1542 and 1621 respectively. This appears encouraging, however, as will be explained, the USQ model exaggerates the later epochs because of the high proportion of part-time distance students: it is likely that the full-time equivalent students slightly dropped between 2002 and 2008. Secondly, most institutions fit into one of two categories: those losing small numbers steadily (UTas, UNSW, QUT) and those gaining small numbers steadily (SA, RMIT, Curtin). Newcastle fits into neither category, appearing to be in a holding pattern with small positive and negative variations. Making any further determinations regarding the enrolments of the above institutions requires additional case-by-case analysis.
The remaining two institutions, Melbourne and USQ, exhibit far greater variations. In 2002/03 these held the highest enrolment figures, 250 and 295 respectively. Since then, they have moved in opposite directions: Melbourne dropped to just over 100 in 2007/08, whilst USQ almost doubled to 535. In relation to USQ, much of its gain can be attributed to the online distance education model it implemented. A large proportion of students are now part-time distance education students. This inflates its enrolment figures as many students complete degrees over 8 years rather than 4. At any rate, the model has been highly successful in attracting students and is discussed in McDougall et al (2003) and Young (2005). In relation to Melbourne, the reasons for the 2006/07 drop remain unclear, however, the significant drop in 2007/08 was due to the implementation of a new degree structure: there was no first year undergraduate intake. The story of this institution and its spatial sciences courses will form the discussion for the following sections. However, before this, it is worth making one final point about the graph.

In the last ten years Australia has experienced a period of economic growth (~3-4% per annum) unrivaled since the end of WWII (Hannah, 2006). Two key facets of the growth - mineral exports and land development - should have demanded the expertise of spatial scientists. Moreover, the service and government sector embraced the use of spatial information, maps and GIS in large numbers (ASIBA, 2005). It is staggering that in such a climate, not only were spatial science courses failing to dramatically increase enrolments, in many cases they were declining. Whilst not the focus of this paper, the continuing efforts emerging from the Spatial Information Industry Action Agenda appear to need either urgent implementation or review.

**CHANGING ENVIRONMENTS: THE UNIVERSITY OF MELBOURNE’S STRATEGY**

The Change
In 2008, almost sixty years after its creation, The Department of Geomatics (formally Department of Surveying - then Department of Surveying and Land Information) at The University of Melbourne began implementing radical changes to its degree structure. The changes were not isolated to Geomatics: institution-wide changes to all academic programs were implemented as part of Melbourne’s overarching Growing Esteem strategy (The University of Melbourne, 2008a). Growing Esteem had three core activities: Research and Research Training, Learning and Education and Knowledge Transfer.

The Learning and Education component of Growing Esteem became known as the *The Melbourne Model*. It aimed to align the University with the best practices from Europe, North America and Asia. The number of undergraduate degrees was slashed from dozens to six broad areas: Arts, Biomedicine, Environments, Science, Commerce and Music. Each degree was three years in length and upon completion students could either enter a 2-year professional masters degree or direct employment (The University of Melbourne, 2008b). Students wishing to take research higher degrees needed to first complete the Masters or an Honours year still offered by some programs. The model aimed to provide all graduates with academic breadth, a feature it was felt professional degrees often lacked, whilst maintaining disciplinary depth. All degrees required that 25 percent of the course load was from outside a student’s chosen discipline and usually outside their degree.

*The Melbourne Model* presented both challenges and opportunities to the Department of Geomatics. Between the mid 1980s and 2002 total enrolments increased from just over 50 to 250 (Bervoets et al, 1999). This great increase was due to active marketing of *Geomatics* and the introduction of combined degrees. However, between 2002 and 2007 enrolments steadily declined. The new model offered the
opportunity to reverse the trend by repositioning the discipline within the University. However, countering the potential benefit were complications: course offerings required redesign to fit with the new model, professional accreditation bodies needed to be satisfied with the changes (Engineers Australia, Surveyors Registration Board of Victoria, Royal Institute of Chartered Surveyors (RICS)), and the relatively new brand of Geomatics risked being obscured.

The main changes to the courses are summarized in Figure 2. No longer are there first year enrolments in the Bachelor of Geomatic Engineering: students wishing to undertake Geomatics first complete a 3-year Bachelor of Environments or Bachelor of Science. As part of their degree they need to Major in Geomatics by completing 3 mathematics and 8 spatial science subjects. Upon completion of the 3-year degree, or an approved degree from another institution, a student will enter the 2-year Masters of Engineering (Geomatics) program to commence in 2011. In essence, it now takes five years to achieve a recognized spatial sciences degree, however, this was a Masters qualification rather than a Bachelors degree.

Figure 2. Changes to the Geomatics at The University of Melbourne

The new structure aimed to provide maximum flexibility to students: they could spend the first years of their undergraduate degree exploring different disciplines before choosing a particular Major. For example, a student need only have completed a single Geomatics subject (Applications of GIS) halfway through 2nd year and they could complete the Geomatics Major. This flexibility, whilst seen as highly beneficial to students, left the Department with considerable uncertainty regarding future enrolments.

The new Geomatics program offered students an improved syllabus (Figure 3). Substantial funding was offered by the University to redevelop and deliver all subjects from the old degree for a wider audience. In addition to spatial science subjects, Geomatics students could undertake a range of new electives from the Bachelor of Environments (or Bachelor of Science). This enabled students to
complement their spatial skills with theories, skills and perspectives from disciplines such as Construction, Property Management, Architecture, Urban Planning, Land Management, Environmental Science, Landscape Architecture and Environmental Science. Additionally, 25 percent of the course load was derived from the other broad degrees: students could pursue their interests in music, commerce, biomedicine or the liberal arts. In the context of Geomatics, the new syllabus would produce graduates with a broader range of skills and the ability to adapt their skills in a global marketplace. The Department had reason to expect the changes would be well received as before 2008, approximately half the students were taking combined Geomatics with other degrees (predominantly Science, Arts and Information Systems).

### Bachelor of Environments

<table>
<thead>
<tr>
<th>Year 1 Semester</th>
<th>Subject</th>
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<tbody>
<tr>
<td>Sem 1</td>
<td>Natural Environments</td>
<td>Designing Environments</td>
<td>Virtual Environments</td>
<td>Calculus 1</td>
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<tr>
<td>Sem 2</td>
<td>Reshaping Environments</td>
<td>Constructing Environments</td>
<td>Mapping Environments</td>
<td>Linear Algebra</td>
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<tr>
<td>Year 2 Semester</td>
<td>Applications of GIS</td>
<td>Data Analysis for Scientists</td>
<td>B.Env Elective</td>
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<tr>
<td>Sem 2</td>
<td>Surveying and Mapping</td>
<td>Residential Surveying Field Course</td>
<td>B.Env Elective</td>
<td>Breadth</td>
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<tr>
<td>Year 3 Semester</td>
<td>Programming Geomatics Applications</td>
<td>Imaging the Environment</td>
<td>B.Env Elective</td>
<td>Breadth</td>
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<tr>
<td>Sem 2</td>
<td>Integrated Spatial Systems</td>
<td>People, Land and Sustainability</td>
<td>Computational Methods in Geomatics</td>
<td>Breadth</td>
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### Master of Engineering (Geomatics)

<table>
<thead>
<tr>
<th>Year 4 Semester</th>
<th>Subject</th>
<th>Subject</th>
<th>Subject</th>
<th>Subject</th>
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<tbody>
<tr>
<td>Sem 1</td>
<td>Advanced Surveying and Mapping</td>
<td>Land Administration</td>
<td>Least Squares</td>
<td>Geomatics Elective</td>
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<tr>
<td>Sem 2</td>
<td>Land Law</td>
<td>Engineering Management</td>
<td>Photogrammetry</td>
<td>Satellite Positioning</td>
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<tr>
<td>Year 5 Semester</td>
<td>Cadastral Surveying</td>
<td>Prof. and Business Studies</td>
<td>Geomatics Elective</td>
<td>Geomatics Elective</td>
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<tr>
<td>Sem 2</td>
<td>Research Project</td>
<td>Research Project</td>
<td>Residential Land Development</td>
<td>Advanced Imaging</td>
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**Figure 3. Sample Course Design and Subjects**

(note: Students undertaking the Bachelor of Science would complete Science electives after a straight science first year)

### Implementation

At the time of writing, only the first year of the new program was complete. The phase out of the heritage degree was underway as students completed second, third and fourth year. The design and development of Year 2 and Year 3 were well advanced, but are not discussed here. Despite there being no first year Geomatics intake, the Department of Geomatics still played an active role in delivering the first year of the Environments program.

A cohort of approximately 560 students enrolled in the Bachelor of Environments in 2008. The ENTER required was 85, an increase on Geomatics’ previous entry scores which have been below 80 for several years. The first year program consisted of 8 new Bachelor of Environments subjects: Natural Environments (core), Reshaping Environments (core), Designing Environments, Constructing Environments, Virtual Environments, Governing Environments, Urban Environments and Mapping Environments. The intent of these subjects was to introduce all the different *ways of knowing* about...
environments. Thus, spatial information is seen as one of those essential sources of environmental knowledge. Students selected 6 of these (3 per semester) and 2 breadth subjects (1 per semester). All subjects were interdisciplinary in both content and teaching method. Students planning to enter some Majors, including Geomatics, were advised to take 2 mathematics subjects as their breadth in first year.

The Department of Geomatics took an active role in the delivery of Mapping Environments - providing the subject coordinator, mapping equipment and fundamental content for the course. The subject ran in Semester 2 and attracted an enrolment of 220 students. These students could potentially complete the Geomatics Major, however, they were just as likely to complete one of the 9 other majors. The enrolment was very encouraging: it meant that spatial sciences were being taught to a much broader cohort than in previous years.

Mapping Environments focused on delivering a new type of mapping course. It aimed to present the fundamental concepts of spatial science, while also providing hands-on practical mapping skills that would be useful to a diverse range of professions. A conceptual map of the subject is provided in Figure 4. The subject was made up of seven modules. Each built upon the previous, eventually resulting in a modern understanding of the process of spatial measurement, mapping and its wider application in society.

Figure 4. The content, learning activities and tools utilized in Mapping Environments
Each module had a range of learning activities including lectures, readings and online quizzes; however, the centerpiece of each was an assessed 2-week mapping problem. Students were given a spatial problem and asked to develop a solution in groups. Each problem introduced students to a range of new spatial theories and focused on the process of data collection, analysis and presentation. There were six in total: How can we map and visualize where we have been (Geo-Caching using a Trackstick and GPS Camera)? How can we map all the bins on campus (Mobile Asset Mapping using a PDA/GPS, ArcPad and ArcGIS)? How old is this image, how healthy is the vegetation and what are place and space (Image Interpretation and Manipulation using ER Mapper and Google Earth)? How high is this point and how can we map the surrounding surface (Height Determination and Contour Mapping using Levels and Google Sketchup)? How can we measure this building and visualize it in three dimensions (Floor/Section Plan Sketches and 3D Modelling using Leica Distos, Digital Compasses and Google Sketchup)? Where is the most appropriate place to build a new climate-change research centre on campus (Spatial Analysis using ArcGIS)?

To facilitate these learning activities the subject needed to be well resourced. One full time academic coordinated the subject and provision was made for a part-time senior tutor, a full-time web developer, and seven lab demonstrators. Additionally, guest lecturers from a range of Faculties and Departments contributed time and content. A web presence was developed: the Universities Learning Management System (LMS) was used for subject administration and a separate learning site was also developed (Figure 5). The learning site consisted of a Lecture Theatre with downloadable podcasts; a Tutorial Centre with online demonstrations and activities; an Instrument Room with manuals and animations; a Library with online readings, maps, data and imagery; a Newsroom with up-to-date stories from the spatial sciences industry; and an IT Department with downloadable software. Additionally, the subject was completely paperless: all submissions, marking and exams were conducted online.
Outcomes
Ultimately, the success of the Melbourne Model will be determined over the long term; however, a number of quantitative measures and qualitative discussions can be used to assess short-term outcomes. These are now reviewed.

Student Quantity. In 2007, Geomatics at Melbourne attracted 42 first-year enrolments. In 2008, The Bachelor of Environments had an intake of 560 students and Mapping Environments enrolled 220 students. Students are not required to declare Geomatics as their Major until second semester 2009, however, an idea of potential enrolments can be sourced from enrolments in second year Geomatics Majors subjects. At the time of writing (December 2008), enrolments in second year subjects – Applications of GIS, Surveying and Mapping, Residential Field Course – suggested that at least 30 students will make Geomatics their Major. While this is a decline, it does not suggest a major exodus to other institutions. The new structure also means that classes in Geomatics subjects are likely to be larger even if the core group is somewhat smaller. This core is also coming almost entirely from the Bachelor of Environments because in 2008 Mapping Environments was not available to Science students. This changes in 2009. It therefore appears that the risk of further declines in numbers because of the model has been mitigated. There remains potential to attract more students through years 2 and 3. Additionally, a large proportion of Environments students have expressed a desire to eventually undertake a Master of Architecture – not all will be given places and courses like Geomatics may offer a desirable alternative.
**Student Quality.** In 2007, Geomatics had a clearly-in ENTER (Equivalent National Tertiary Entrance Rank: the 100pt scale used to rank Australian school-leavers), in the mid-70s. In 2008, all students wishing to enter the Bachelor of Environments or the Bachelor of Science required an ENTER of 85 and above. Consequently, all students who eventually enter the Masters program will have a score above 85: this is an increase in the standard of students entering the degree. However, the increased ENTER poses a threat to Geomatics as roughly 25 percent of its previous intake would not have achieved a score high enough to get into Environments or Science. Additionally, Environments had no requirement for final-year high school mathematics. While this could be an issue for subjects with mathematical content, bridging programs are in place. There seemed to be minimal impact on Mapping Environments results. Although the subject was not scaled in any fashion, a large proportion of students achieved very good results, with 86 percent achieving an honours grade (+65/100).

**Exposure of Spatial Sciences.** Traditionally, the Department of Geomatics has focused on marketing its courses to High School students through visits, dissemination of marketing materials and Open Days. The new model minimizes this task. While High School marketing is still highly important to the discipline, in 2008 a cohort of 560 potential spatial science students (not including Science students) was already on campus. Therefore, it is at least as important to focus attention upon on-campus marketing. Mapping Environments, as one of 8 first year subjects, can act as a key part of this strategy. Even if the majority of students decide not to make Geomatics their major, they will still have been imparted with good amounts of spatial science knowledge and skills. They may choose to build on these skills through their 3 Bachelor of Environments electives and to apply these in a wide range of future careers.

**Student Satisfaction.** The University of Melbourne measures teaching quality and student satisfaction primarily through Quality of Teaching (QoT) surveys conducted with students at the end of each semester. Mapping Environments averaged 4.3 out of 5 on the questions dealing with how well the subject was taught and overall satisfaction with the subject. Additionally, it scored over 4 for each of the 9 questions. This was the highest score of any subject in the Bachelor of Environments program (average 3.8). These are very promising results for a subject running in its first year and will most likely contribute to a higher enrolment for the subject in subsequent years.

**Postgraduate vs. Undergraduate.** The Department of Geomatics began building a strong postgraduate program in the 1980s. This involved both increasing numbers of research students and the introduction of coursework based programs in the 1990s: graduate certificate, graduate diploma, 1 year Masters and 1.5 year Masters. Intake steadily increased from under 10 to almost 100 between 1988 and 2008 (Figure 6). The new Melbourne Model fits with the long-term enrolment trend of the Department - greater numbers of postgraduate students. Additionally, it greatly improves integration between undergraduate and postgraduate teaching. Moreover, unlike undergraduate spatial science courses, the Department’s postgraduate courses have always attracted high percentages of full-fee paying international students (McDougall et al, 2006). In the current tertiary funding environment this is highly advantageous.
5 Years vs. 4 Years. A central point of debate in the introduction of the Melbourne Model is the increased length of professional degrees, including the Geomatics programs. For those school-leavers in no doubt about a career in surveying, a 4-year qualification is clearly more appealing in terms of financial costs and time commitments. For those still undecided about their future, the extra decision time can be appealing. At any rate, some students with a clear career direction may still wish to take a longer, yet broader, program culminating in a Masters degree. As students choose their preference over the next few years many may be uncertain about whether to choose a 4 or 5 year program. In the longer term the success, or otherwise, of the Melbourne Model from the perspective of both prospective students and demanding employers will be judged on the experience and the quality of the graduates. As noted above, however, even prior to the new model, the majority of Geomatics students were already completing 5-year combined degrees. Additionally, there is likely to also be demand for 3-year graduates with a Major in Geomatics, not as fully accredited professionals, but as technicians, field staff and key support staff. Indeed, the Royal Institute of Chartered Surveyors (RICS) provides an option for technical accreditation for 3-year programs such as the 3-year Geomatics Major program in Environments or Science. This provides a further option for the school-leaver who can consider moving into the work force with a 3-year degree while retaining the option of a higher degree after a period gaining industry experience.

IMPLICATIONS OF THE STRATEGY ON THE SPATIAL SCIENCES INDUSTRY

The spatial sciences industry recognizes the skills crisis and for the majority of this decade has been acting to remedy the shortage of surveyors and other spatial science professionals. Preliminary work focused on determining industry requirements (Kelly, 2006a; 2006b; ASIBA, 2005) and embedding spatial science into secondary education through the SSI GIS in Schools program. Other discussions have included creating industry scholarships and potentially approaching the Australian Government through the Department of Education, Employment and Workplace Relations (DEEWR) for funding assistance. More recently marketing activities have become a focus. In Victoria, a Surveying Industry Taskforce has been meeting since 2007. The group incorporates The Surveyors Board of Victoria, The Office of the Surveyor General, Spatial Sciences Institute (SSI), The Institute of Surveyors – Victoria (ISV), RMIT University, The University of Melbourne, Australian Spatial Industry Business Association (ASIBA) and two student groups. Beginning in 2009 a 5-year advertising campaign specifically aimed at attracting students to Melbourne and RMIT University will commence.
It is unlikely that any one strategy can solve the spatial education paradox, however, the above initiatives all provide components. The new Melbourne Model, whilst not specifically designed for the purpose, offers another tool to the spatial sciences industry. To clarify this further it is worth considering the different personnel operating in the spatial sciences sector (Figure 7). According to Thompson (1996) the sector is composed of three categories: Specialists (1%), Analysts (4%) and Non-technical users (95%). Traditionally, spatial sciences courses have focused only on training Specialists - this focus should continue - however, as the spatial industry grows the need to provide Analysts and Non-technical users with more spatial knowledge increases. The Melbourne Model caters to all three sectors: it continues to produce Specialists through the 5-year Masters program, generates Analysts through the 3-year Geomatics Major, and equips Non-technical users with a range of spatial skills through electives in the Bachelor of Environments and other undergraduate degrees.

The strategy potentially offers utility to other institutions offering spatial sciences education in Australia. The 2-tiered approach allows training of niche specialists, but opens the discipline to a diverse range of students, many of who may have little knowledge of Geomatics or spatial sciences. Already, The University of South Australia utilizes a similar model, now offering a 3-year Bachelor of Sustainable Environments with a Major in Geospatial Information Systems.

Further debate of the model and the associated strengths and weaknesses is needed. Cursory analysis suggests that - like the variety of spatial science degree names used across Australian Universities - having multiple course structures is not ideal and ultimately creates confusion for school-leavers. An alternate view suggests the expansion of the discipline may require educational institutions to decide the skills, and program lengths, they are each best suited to provide: Specialists, Analysts or Less-technical users. The market will help to decide what works best, but it is important to remember that growing the sector, and meeting the demands of industry, is best undertaken collaboratively and with the input of accreditation bodies, the private sector and government.

CONCLUSION

Australian spatial sciences education is facing a paradox: the demand for graduates is steadily increasing yet enrolments remain static. It appears many foundation members of ASIERA will need to take some sort of action in terms of the marketing and the focus of their courses in the near future. The
Department of Geomatics at The University of Melbourne has now repositioned itself. It provides both a 3-year Major and 5-year Masters program. The first year of the implementation has been a moderate success with increased student quality, high student satisfaction and greater exposure of the spatial sciences at undergraduate level. However, the impact on total enrolments in Geomatics will not be known for a number of years. In the meantime, Melbourne will be creating a range of spatial professionals from specialists through to less technical users based in other disciplines. The model may not be suitable for all institutions; however, its utility should be assessed on a case-by-case basis in collaboration with the wider industry. Finally, the model is only one option in a suite aimed at improving overall uptake of spatial science education: more effort, collaboration and urgency in every sector is required.

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