Past and Future Trends of Surveying Education in Australia

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This paper examines the development of surveying education programs in the light of Australia’s national needs over the past years, particularly in the period 1965–1985, and attempts to project these trends into the future. During this period a number of new courses were commenced and previously established courses underwent considerable change. Data from each of these courses are analyzed with regard to course content and length of course. The major changes to be seen are the broadening of the courses to include more land related subjects, and reflect the growing public awareness of the importance of land and the environment, and the strengthening of environmental planning legislation. Major advances in technology over the past decade, particularly in the fields of computers and spaceborne systems, are also shown to have had impact. It is suggested that the surveyor’s role will move increasingly toward a central role in the management of spatial data.

Dans cet article, on examine le développement des programmes d'éducation des sciences de l'arpentage à la lumière des besoins nationaux de l'Australie au cours des dernières années, plus particulièrement durant la période de 1965 à 1985, et on essaie de projeter les tendances de cette évolution dans l'avenir. Durant cette période, bon nombre de nouveaux cours ont été introduits et de nombreux autres antérieurement établis ont été considérablement modifiés. L'information recueillie sur chacun de ces cours est analysée vis-à-vis de son contenu et de sa durée. Les changements importants à survenir sont, en premier lieu, l'élargissement des cours dans le but d'insérer plus de matières se rattachant à la gestion du territoire, en deuxième lieu, l'évolution de la société qui attache un plus grand intérêt sur l'importance des bien-fonds et de l'environnement et en dernier lieu, le raffermissement de la législation concernant l'aménagement du milieu géographique. Les progrès technologiques majeurs qui ont marqué la dernière décennie plus spécialement dans les domaines de l'informatique et des systèmes spatiaux, sont vus comme ayant une influence décisive sur ces événements. Il est suggéré que le rôle du géomètre se déplacera vers un rôle de plus en plus centralisé sur la gestion de l'information à référence spatiale.

Introduction

It is only in recent times that surveying education in Australia has changed from an article-based system to one of a college or university-based education, the first surveying degree course having been established in the late 1930s. In many states the articlec system continued in parallel to tertiary training until the 1970s. The articlec system, which required a pupil to work under the guidance of a master surveyor for a minimum of four years and pass a series of examinations set by the reciprocating Surveyor's Boards (in each state and New Zealand), is continued into the present system in a modified form. Following graduation a pupil must gain two years of practical experience (although some credit is
given for vacation work prior to graduation), submit various plans, and undertake a practical and oral examination to the satisfaction of the Board of Surveyors in that state, before he or she can be licensed to undertake cadastral and boundary redefinition surveys.

Details from all Australian courses were obtained and analyzed to determine changes that have occurred over the past two decades. These give some indication of the direction of change and allow extrapolation into the future. Contact hours and percentage of time spent on various basic subject areas have been extracted for each of the present courses, while for the two largest schools, the University of New South Wales and the Royal Melbourne Institute of Technology, a comparison is made between courses given in the years of 1965 and 1985. In particular, the syllabuses of the subjects at the University of New South Wales for the two periods are compared with the details of change being examined.

A brief introduction to each course is given which is followed by an explanation of the basic subject areas that have been used for comparison. While technician-level courses are provided at a number of institutions throughout Australia these will not be considered in this paper.

Current Courses by State

The location of each of the institutions offering tertiary-level surveying courses is shown in Figure 1, which also shows population distribution. Details of staffing and student intake for each course are given in Table 1.

Queensland

Two courses are offered in Queensland, one at the University of Queensland and the other at the Queensland Institute of Technology (QIT). The university course is the oldest in Australia having first been established in the late 1930s. The latter course was founded in the seventies following pressure from the Queensland Division of the Institution of

Figure 1. Location of tertiary surveying courses in Australia and population distribution (shaded areas have more than 20 persons per km²).
Surveyors (Australia) which felt that the existing course at the University of Queensland was not fully satisfying the needs of the profession in that state. At the present time the university offers a three-year degree with a fourth-year honors degree and the institute a three-year degree. Following a study supported by the Commonwealth Tertiary Education Commission, rationalization of the courses is now being proposed [Lyons 1985]. Basically this will result in QIT providing a three-year undergraduate degree with the university providing an honors fourth year. Other proposals relating to postgraduate education and the bridging of technician and degree courses have also been suggested [Lyons 1985].

New South Wales (including the Australian Capital Territory)

Three courses are offered in New South Wales, two at universities and one at the Canberra College of Advanced Education (CCAE). The course at the University of New South Wales (UNSW) is probably the most well known internationally, and staff contribute extensively to research and the various international bodies including the International Federation of Surveyors (FIG) and the International Society for Photogrammetry and Remote Sensing (ISPRS). The University of Newcastle’s course initially developed from an association with the University of New South Wales (UNSW), with the first two years of the course being undertaken at Newcastle and the latter two years at UNSW. The Newcastle course is now a full four years, while the UNSW course has been four years full time from its inception in the late 1950s. The Canberra course of three years duration is the most recent to be offered in Australia, having commenced in 1982.

Victoria

Two courses are offered in Victoria: one at the Royal Melbourne Institute of Technology (RMIT) of three years duration and a four-year course at the University of Melbourne. The former was established in 1971 and the latter in 1949. In general the university course is
more academic in content and graduates tend to go into government service while those from the Institute go into private practice.

Tasmania

Only one course is available in Tasmania, that which is offered at the University of Tasmania located in Hobart. It commenced in the late 1970s having evolved from a lower level non-university based course. The course is three academic years in length with one additional year of industrial experience.

South Australia

The South Australian Institute of Technology (SAIT) offers the only tertiary-level surveying course in that state. It commenced in 1963 as a three-year course and was upgraded to a four-year course in 1981.

Western Australia

A three-year course is offered by the Western Australian Institute of Technology (WAIT). No other tertiary-level courses are available in that state. The course was first accredited in early 1970 and is currently (1985) in the process of being upgraded to a four-year course.

Comparative Analysis of Surveying Courses

Current Course by Subject Area

To allow a comparative analysis of all surveying courses in Australia, subjects and contact hours were allocated to eight basic areas. These were:
1. Basic Surveying: Plane surveying, engineering surveying, basic computations, some aspects of hydrographic and mine surveying and survey drafting.
2. Survey Camps: Scheduled survey camps but excluding periods spent during the course on industrial training.
3. Higher Surveying: Geodesy, astronomy, advanced hydrographic and deformation surveys, topographic surveys, associated computations, theory of electronic distance measurement, and advanced projects.
4. Photogrammetry and Mapping: Photogrammetry, cartography, remote sensing, digital mapping and advanced projects.
5. Land Studies: Cadastral surveying, land development, land information systems, valuation, subdivision design, resource surveys and advanced projects.
7. Engineering: Hydrology, hydraulics, soils and pavement design, transportation networks, engineering principles.

Many subjects of the various courses examined contained elements of different areas in each subject. Where this occurred an attempt was made to distribute the contact hours of the subject between the appropriate areas. By its very nature this will be a subjective exercise, however, it is considered that in a relative sense the subject areas will be
comparable for each course. Contact hours represent the total hours given over to a subject and include lecture, tutorial and practical components as a simple sum without the application of any weighting procedure. Table 2 lists the contact hours and percentages offered in each of the basic subject areas for each course or proposed course, where this is near implementation. The length of the course in years is indicated in brackets after the name of the institution. This figure does not include compulsory industrial training.

**Changes 1965 to 1985, RMIT and UNSW**

Two courses are examined, that of the Royal Melbourne Institute of Technology and that of the University of New South Wales. Both are long standing courses and have the largest student and academic staff numbers of all Australian courses. Table 3 lists the changes for each course over the period 1965 to 1985 using the same basic subject areas as discussed previously.

**Syllabus Details. UNSW, 1965 and 1985**

The University of New South Wales course is analyzed in more detail (1) because of the authors' greater knowledge, (2) because it has graduated the largest number of students from a four-year-level course (approximately 1000) and (3) because the school has a high research profile with the result that changes in methodology and technology are introduced into the undergraduate program at a relatively early stage in their development. The

<table>
<thead>
<tr>
<th>Course and Duration</th>
<th>Basic Surveying</th>
<th>Survey Camp</th>
<th>Higher Surveying</th>
<th>Photo and Mapping</th>
<th>Land Studies</th>
<th>Maths and Science</th>
<th>Engineering</th>
<th>Broadening</th>
<th>Total Contact Hours</th>
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<td>11%</td>
<td>*</td>
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<td>32%</td>
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<td>(236)</td>
<td>(125)</td>
<td>(715)</td>
<td>(52)</td>
<td>(287)</td>
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<td>18%</td>
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<td>(553)</td>
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<td>(200)</td>
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<td>19%</td>
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<td>23%</td>
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<td>(410)</td>
<td>(410)</td>
<td>(335)</td>
<td>(480)</td>
<td>(75)</td>
<td>(117)</td>
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</tr>
</tbody>
</table>

*100 weeks of compulsory industrial experience
**Estimated from credit points
+ Compulsory year of industrial experience
individual subjects comprising the degree course in 1965 and 1985 (fourth year to commence in 1986) are allocated to the basic subject areas as previously defined.

Discussion of Results

It can be seen from Table 2, which tabulates percentage and contact hours for all courses, that there are some marked differences between the time allocated to basic subject areas. The major differences occur in higher surveying with percentages ranging from 8 percent to 19 percent (165 hours to 504 hours), photogrammetry and mapping, 6 percent to 19 percent (175 hours to 515 hours), land studies, 7 percent to 31 percent (145 hours to 690 hours), engineering, 2 percent to 12 percent (52 hours to 336 hours) and broadening subjects, 2 percent to 13 percent (38 hours to 360 hours). Some of these differences can be considered the result of inappropriate allocation of subjects between the basic and higher surveying areas, between the higher surveying and mathematics and science areas, and between land studies and the broadening areas. Others reflect the requirements of surveyors in a particular state, for example in Victoria very few surveyors are involved in engineering design for subdivision, whereas in New South Wales this is commonplace. Nevertheless the differences should be of concern to the reciprocating Boards of Surveyors who consider all qualifications resulting from these courses to be equivalent. Taking average figures it could be suggested that a 'base' course should have the following contact hours and percentages in each subject area.

Basic Surveying 340 hours (14%)
Survey Camp 160 hours (7%)
Higher Surveying 375 hours (15%)
Photogrammetry and Mapping 310 hours (13%)
Land Studies 380 hours (16%)
Maths and Science 525 hours (22%)
Engineering 135 hours (5%)
Broadening 200 hours (8%)
TOTAL 2425 hours

A more detailed analysis of the figures in Table 2 shows that the more recently established courses have a higher percentage content of the land studies subject area, in
particular the CCAE, 27 percent (563 hours), QIT 31 percent (690 hours) and University of Newcastle 20 percent (553 hours). This direction is further reinforced by the increase from 7 to 14 percent (145 to 335 hours) in the WAIT upgrade from a three- to a four-year course. If Table 3 is also examined it can be seen that the major change in the RMIT course and the UNSW course between 1965 and 1985 has been in the land studies area with percentage increases of 9 to 15 percent (196 to 342 hours) for RMIT and 7 to 12 percent (206 to 336 hours) for UNSW. Land studies can therefore be seen as having been the major growth area in the past two decades. Specific subject areas increased in the UNSW course have been in cadastral systems, land management and development, and land information systems. Other major inputs, but with deletion of less relevant material, have been in the areas of GPS (Global Positioning System), inertial surveys, remote sensing, computer graphics and cartography, computerized handling of data and precise engineering surveys. Between 1965 and 1985 the range of surveying subjects taught has approximately doubled, reflecting the broadening role of the surveyor.

In general, smaller departments in terms of academic staff (see Table 1) tend to have a higher engineering subject area content (see Table 2), with the exceptions of UNSW (18 staff, 6 percent) and the University of Queensland (4 staff, 2 percent). The figure for UNSW reflects the higher engineering component of the NSW surveyor’s contribution to land development projects. On the basis of higher surveying, mathematics and physics content, UNSW and the University of Queensland could be considered the most ‘academic’ while the CCAE course would be the least. The higher photogrammetry and mapping content of the SAIT and WAIT courses may also reflect the greater needs of these two sparsely populated states.

A further result that emerges from Table 2, is that courses offered by institutes of technology, apart from SAIT, have a higher percentage ‘surveying’ content and a lower ‘other’ content, i.e., engineering, mathematics, physics and broadening subjects, when compared to university courses, and this also carries through to contact hours. This may reflect the broader, more philosophical nature of universities and the more applied nature of institutes of technology.

A further change in the past two decades which is not reflected in the tables is the increasing number of female students undertaking surveying degrees. While the percentage is still small it offers the opportunity of further raising the standard of entry to surveying courses by drawing on a larger pool of potential students.

Postgraduate Studies and Research

While a very important area, postgraduate studies and research will only be briefly mentioned in this paper. Most institutes undertake postgraduate education at the masters and Ph.D. levels. Institutes of technology are however somewhat restricted in their research as the majority of research funding by government is to the universities. The number of students undertaking postgraduate courses in Australia is relatively small. This is not due to the lack of expertise among academic staff nor the availability of appropriate courses (in most areas) but the lack of support by government departments and private organizations in sponsoring suitable students. There is little realization that a first degree is only a basic entry into the profession and that further studies are required to gain expertise in advanced topics. This may be the result of senior surveyors who, having entered the profession
through an articulated system, see the young graduate as better qualified than they and not requiring further education.

The various institutions tend to specialize in one or more postgraduate areas, with the larger institutions, particularly the universities, having a range of specializations. For example, the University of Tasmania has a growing interest in computerized land information systems, the University of Melbourne has for many years been involved with non-topographic photogrammetry and SAIT conducts a postgraduate diploma in remote sensing. The University of New South Wales has for many years been preeminent in geodetic teaching and research, and more recently has been heavily involved with the establishment of a multidisciplinary center for remote sensing, a computer graphics laboratory and a land information research unit, which is reflected in their teaching and research. Queensland University is also proposing similar areas of research and graduate studies (remote sensing, land and geographical information systems, computer assisted cartography) [CTEC 1984].

To some extent, the area of land information systems and the growing computerization of the surveyor's activities, have tended to act as a catalyst drawing together the previously disparate areas of global positioning, remote sensing, cadastral and land information systems, and computerized cartography. This trend will continue and can only be of benefit to surveyors by highlighting their role as spatial information managers. From the private surveyor undertaking peg-outs for subdivisions, to the geodesist determining position from satellite systems, their efforts are directed toward the provision of spatial information.

Surveying academics in Australia are involved in all areas of surveying research, and are world leaders in some. The University of New South Wales, for example, is internationally recognized for its contributions to research in the areas of photogrammetry, geodesy, land information systems, inertial surveys, remote sensing and cadastral and titling systems. In excess of thirty papers are published by staff each year, nationally and internationally, and staff are represented at various levels on the International Union of Geodesy and Geophysics (IUGG), FIG and ISPRS.

Summary and Conclusions

A comprehensive analysis of tertiary-level surveying courses throughout Australia has shown a marked range in the amount of time allocated to basic subject areas. This is disturbing in some cases as the imbalance appears excessive. Changes in the past two decades have strongly indicated the growing importance of land studies, but more broadly speaking the total spatial information concept. Increasing interaction between the previously disparate areas of surveying will see this trend continued.

At the postgraduate level the same trend is perceived, but is not being supported by the government or private sector in the form of sponsored postgraduate students. Greater effort, however, is also needed by the institutions to provide relevant postgraduate education and to attract students from the lucrative (in terms of potential student numbers) Asian and Pacific region. Particular specializations appear to be developing in Australia at the postgraduate level, but only with a relatively large body of academics and dedicated and widely published research, can the broader role of a center in the all encompassing spatial information area be successfully established. Universities must also play a greater
role in attracting research funds from non-traditional sources for this important area of research.

The surveying courses in Australia are now well established, are of a high standard, and provide the only means of entry into the surveying profession. We believe that they could provide a model for the development of surveying education in many other parts of the world.

References


NOTE: This paper is a modified version of a paper presented at the First Australian Surveying and Mapping Industry Conference (ASMIC 1, Brisbane, May 1985).