A 'Modernized' Survey Profession — An Australian View

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As a means of establishing the present breadth of the Australian surveying profession, its historical development is reviewed with particular emphasis on the academic institutions and professional societies. A case study is made of a present course revision at the School of Surveying, University of New South Wales. The future of the Australian surveying profession is discussed using the same approach as the Canadian Council of Land Surveyors in its moves to ‘modernize’ the profession in Canada. The approach considers the profession to cover the four areas of legal surveying, positioning and measuring, land information and land management.

De façon à établir l'ampleur actuelle de la profession d'arpenteur-géomètre en Australie, on en donne l'historique en mettant l'accent sur les maisons d'enseignement et les associations professionnelles. On donne l'exemple de la révision actuelle d'un cours à la School of Surveying de l'université de New South Wales. On discute de l'avenir de la profession en Australie en abordant la question de la même façon que le Conseil canadien des arpenteurs-géomètres l'a fait lorsqu'il a ‘modernisé’ la profession au Canada. On aborde la question de façon à subdiviser la profession en quatre domaines: l'arpentage légal, la localisation et l'arpentage, l'information sur les terrains et la gestion des terrains.

Introduction

The surveying profession primarily has a service role in society — surveying as a discipline is rarely an end in itself. Surveyors should therefore be prepared to continually evaluate the services they offer to see if they efficiently and economically meet the present and future demands of society. The Canadian Council of Land Surveyors is to be commended for its moves to ‘modernize’ the profession in Canada. To help in its deliberations the Council might be encouraged to look elsewhere at other survey systems that are experiencing similar periods of development. A good example is the system in Australia.

Because of similarities between Australia and Canada, comparison between their two systems is instructive. Both are large countries of similar size and much of their area is desolate and sparsely populated. The countries were settled at about the same time and experienced similar problems during early settlement. The legal, conveyancing and surveying systems developed along similar lines. The Australian cadastral surveyor has a similar professional standing and plays a similar role in society to his Canadian counterpart.

In looking to the future, it may be of interest for the Canadian Council of Land Surveyors to refer to the keynote address of the 22nd Australian Survey Congress in Hobart (1980). The address was given by the Honorable Mr. Justice Kirby, chairman of the Australian Law Reform Commission, and was concerned mainly with change in the surveying profession. He suggested that such change
will come about by the dual impact of the forces of science and technology, on the one hand, and of changing social and community values on the other. How the surveying profession addresses these changes will determine its future.

Mr. Justice Kirby also appealed to professionals who were contemplating change in their profession not to lose sight of the ‘professional ideal’, which he described as follows

"It is to pursue excellence, service to the community, high standards of day-to-day performance and self-criticism. It is to look at proposals for change not from a purely selfish point of view, but from how change will improve the service offered by the professional to the community."  [Kirby 1980]

As an aid to any discussion on modernizing or changing the direction of the profession, the scope of services offered by the present body of professionals should be discussed and, more importantly, the historical development of the profession should be fully understood.

**Historical development of the surveying profession in Australia**

Cadastral surveying has dominated the profession since its earliest beginnings in Australia and is still the major specialization for surveyors. A strong profession has built up, based around this cadastral surveying core. Today, access to the survey profession is by a formal degree of surveying, together with a period under articles and further Board of Surveyors examinations, if the cadastral specialization is chosen. For a population of approximately 14 million, Australia boasts nine institutions offering formal three or four year full-time academic courses to degree level in surveying. This compares with a handful of such courses in the United States, for example. The reasons for the development of such a strong profession in Australia are historical.

At the time of early settlement in the colony of New South Wales the major concern was the administration of convicts; however the governor was empowered to make land grants to settlers, military personnel and emancipated convicts [Toms, 1976]. Land was plentiful, although much of the terrain was rugged and inhospitable, therefore the settlers spread far and wide in a sporadic manner selecting the best farming areas throughout the country.

Because of the huge demand for land during this period and the lack of qualified surveyors, the resulting standard of surveying was very low compared to today. The guiding principle during this period was to measure and demarcate land parcels by the cheapest and most rapid means possible [Barrie 1976]. Because of the vastness of the country and the nature of the terrain, no sophisticated systems of mapping or surveying were contemplated. The system of surveying that developed was based on ‘isolated’ surveys and ‘metes and bounds’ descriptions. The system was such that the boundaries of each parcel were determined numerically with the boundary corners being marked by wooden pegs or posts, although occupations and abuttals also played a significant role in the system. The survey was usually based on a magnetic azimuth or on the azimuth of an adjoining survey. The parcel was generally only connected by survey to other parcels that were immediately adjoining. The inadequacies of the above approach, together with poor methods of marking, measuring, description and charting, led to much confusion. Maps of Crown and private lands
became unreliable and overlaps of alienated lands occurred [Barrie 1976]. The culmination of this unsatisfactory situation was a Royal Commission into the New South Wales system in 1855. Unfortunately this investigation did not lead to any change in the basic approach to surveying.

In the late 1850s and early 1860s the Torrens system of title registration was introduced into most of the Australian states. Since the state governments were responsible for guaranteeing title under this system, they required the limits of the title on the ground to be precisely and unambiguously defined. Obviously the system of title or cadastral surveying had to be improved.

The foundations of the survey system which were laid at that time have had a major influence on the surveying profession. On the one hand there existed a very poor survey system with all its inherent weaknesses and on the other hand a requirement that the system had to be improved. The result was a system, still based on the isolated survey approach, that has been continually upgraded and refined to the present day and is now generally in use in all the Australian states. Such a system requires a competently trained professional person to operate within it and to ‘unravel the complexities of boundary definition due to the confusions arising from early inadequacies of survey and record [Barrie 1976].

To maintain the high level of cadastral surveying, the various state governments have introduced the following measures over the years

1) high academic qualifications as a prerequisite for entry into the profession, followed by a period under articles and further Board of Surveyors examinations;

2) stringent legislative controls on the conduct of surveyors and on the methods of carrying out and marking cadastral surveys, and

3) detailed administrative checks by either the Department of Lands or the Land Titles Office in each state, of any plan of survey submitted for registration.

Most surveyors in the nineteenth and early twentieth century either worked for the government or carried out surveys for the government under contract, and the majority had a wealth of experience in rural areas doing original Crown surveys. These surveyors were more than just measurers — they had a ‘feel for the land’. They had a practical knowledge of geology, forestry, soils, valuation and land administration, and it was considered a part of their professional expertise to prepare detailed reports on such matters [Forster 1978].

During the same era various government or semi-government departments established their own survey organizations. For example, in New South Wales the Department of Public Works, the Department of Main Roads and the Metropolitan Water Sewerage and Drainage Board commenced their large survey organizations at that time. The work of the surveyors in these organizations was generally directed to engineering projects although, obviously, cadastral surveys were a significant part of their work. The only professional surveying qualifications available to these surveyors during this period was to be registered or licensed as a surveyor, even though this qualification really only applied to cadastral surveying.
Prior to World War II, a small number of surveyors were involved in geodetic surveying throughout the states although the programs were given relatively low priority by the various state governments. Between World War I and World War II the Australian Survey Corps was responsible for the majority of topographic mapping and geodetic surveying throughout Australia [Barrie, 1976]. With the exception of the military, the majority of surveyors doing geodetic surveys started work in the profession as registered or licensed cadastral surveyors.

Even though many professional surveyors were involved in either engineering or geodetic surveying prior to World War II, the vast majority were still involved in cadastral surveying. During this period the urban areas of Australia were expanding and many private surveyors were engaged in all the phases of subdividing and developing land. Town planning, as a profession, had not yet come of age and most designs for new urban areas were prepared by surveyors with the emphasis in design on mathematical simplicity.

During World War II, the very poor state of Australia’s topographic mapping became evident due to military requirements; at the conclusion of the war, the federal government gave top priority to national mapping. Also at this time the surveying profession found its ranks filled with surveyors who had been exposed to topographic and trigonometric surveys during the war — these were just the people Australia required to get the country’s mapping program under way.

It was during the 10 to 15 years after the war that most of the degree courses in surveying were created. Within these courses there was almost exclusive emphasis on measurement technology. The courses were mathematical in nature and based around the subjects of geodesy, photogrammetry, higher surveying and computations. This situation was understandable at the time, considering the urgent requirement for expertise in these areas, although it should not be forgotten that the vast majority of surveyors were still involved in the cadastral area.

The above direction of specialization was also taken because many of the new courses had stemmed from civil engineering courses and consequently had to justify that surveying technology was as difficult and as complex, and thus as worthy of tertiary study as the technology of engineering. [Forster 1978].

Education in the areas of cadastral surveying, planning, land administration and development — all the traditional areas of the surveyor — was either neglected or the subjects were taught in a fragmented manner. Expertise in these areas had to be gained by either private study or experience within the profession.

At the same time as courses in surveying were developing with their emphasis on measurement technology, the professions of town planning, cartography and valuation were becoming established outside the surveying profession.

The end result has been a reduced role for the surveyor in Australia.

The organization that represents the surveying profession in Australia is the Institution of Surveyors, Australia. The predecessors of this organization were state institutes, which had their beginnings during the latter part of the nineteenth century at a time when the profession consisted almost exclusively of legal or cadastral surveyors. Consequently, these early institutes were designed to serve
these cadastral interests. As the profession developed and expanded over the years, the Institution of Surveyors or its state predecessors remained relatively conservative organizations. They retained their strong cadastral surveying base and tended not to embrace any of the developing areas unless they were directly related to the cadastral surveying specialization. The creation during the last decade of the Association of Consulting Surveyors as a subgroup of the Institution of Surveyors has partly filled the gap in the land development and management area, although it is an organization limited to private practitioners who are generally working in the cadastral area.

The role of the educational institutions — a case study

Educational institutions generally take the lead in introducing new technology and new areas of expertise into the professions. Unfortunately, however, while achieving this goal they sometimes tend to neglect teaching and research in those aspects that are a part of everyday professional practice. If the institutions do neglect such areas, then those areas tend to drift outside the range of the profession’s accepted skills. All institutions teaching surveying in Australia have to varying degrees been guilty of this neglect.

Several aspects of the latest course revision of the School of Surveying, University of New South Wales, illustrate the way that the changing needs of the profession can be met. One of the many avenues that the school pursued when reviewing its course structure was the preparation of a questionnaire which was sent to all graduates of the school [Williamson and Morrison 1978]. It was realized that the role of the surveyor in society was changing — it was hoped that the questionnaire could help in quantifying this change. The questionnaire covered aspects relating to the backgrounds of graduates, job profiles, the relative importance of areas of surveying to the graduate’s professional career, the undergraduate course structure, graduate courses and professional matters. The questionnaire comprised 24 questions and was sent to over 400 graduates — 263 replies were received. The results that have relevance to the concept of a modernized survey profession are itemized.

1) The relative importance of areas in surveying to a graduate’s professional career. Importance has been rated on a scale of 0 (no importance) to 10 (highly relevant). The importance of cadastral surveying and engineering surveying should be noted.

<table>
<thead>
<tr>
<th>Area</th>
<th>Importance</th>
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<tbody>
<tr>
<td>Cadastral surveying</td>
<td>8.5</td>
</tr>
<tr>
<td>Engineering surveying</td>
<td>7.5</td>
</tr>
<tr>
<td>Management and administration</td>
<td>5.5</td>
</tr>
<tr>
<td>Land development and management</td>
<td>4.8</td>
</tr>
<tr>
<td>Cartography</td>
<td>4.1</td>
</tr>
<tr>
<td>Geodesy</td>
<td>3.9</td>
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<tr>
<td>Digital data processing</td>
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<tr>
<td>Town planning</td>
<td>3.9</td>
</tr>
<tr>
<td>Photogrammetry</td>
<td>3.5</td>
</tr>
<tr>
<td>Astronomy</td>
<td>3.4</td>
</tr>
<tr>
<td>Research</td>
<td>2.9</td>
</tr>
<tr>
<td>Hydrographic surveying</td>
<td>1.8</td>
</tr>
<tr>
<td>Other</td>
<td>1.6</td>
</tr>
</tbody>
</table>
2) Graduates were asked to comment on the existing course structure (as at 1977). The major changes recommended by the graduates were increases in the areas of land law and tenure, surveying and computations, land development and management, and decreases in the areas of general studies (courses such as English, political science, psychology) and physics.

3) Regarding the percentage of electives in the course, the majority of graduates wanted an increase from the existing four percent to eight percent or more of the course. This increase suggests a desire for more specialization by surveyors.

4) At the graduate level, the graduates rated the relative importance of subject areas; again on a scale from 0 (no importance) to 10 (very important).

<table>
<thead>
<tr>
<th>Subject</th>
<th>Rating</th>
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<tbody>
<tr>
<td>Land development and management</td>
<td>7.0</td>
</tr>
<tr>
<td>Advanced surveying techniques</td>
<td>7.0</td>
</tr>
<tr>
<td>Modern instruments and techniques</td>
<td>7.0</td>
</tr>
<tr>
<td>Management and administration</td>
<td>6.7</td>
</tr>
<tr>
<td>Town planning</td>
<td>6.2</td>
</tr>
<tr>
<td>Cadastral surveying</td>
<td>6.2</td>
</tr>
<tr>
<td>Photogrammetry</td>
<td>5.9</td>
</tr>
<tr>
<td>Digital data processing</td>
<td>5.8</td>
</tr>
<tr>
<td>Geodesy</td>
<td>5.6</td>
</tr>
<tr>
<td>Remote sensing</td>
<td>4.9</td>
</tr>
<tr>
<td>Spatial information systems</td>
<td>4.7</td>
</tr>
<tr>
<td>Valuation</td>
<td>4.2</td>
</tr>
<tr>
<td>Cartography</td>
<td>4.1</td>
</tr>
</tbody>
</table>

5) The results showed that 26.5 percent of graduates were not members of the Institution of Surveyors, Australia, and of those who were members, only 39.5 percent were either satisfied or very satisfied with the benefits of the Institution — the remainder were either undecided, dissatisfied or very dissatisfied (in other words only 29 percent of graduate surveyors in N.S.W. are satisfied members of the Institution). Obviously the Institution of Surveyors, Australia, is not fully serving the interests of graduate surveyors. This should be of concern to any similar institution as such a position can have an adverse effect on the future of the profession because it encourages splinter groups that have the potential of developing into completely independent professional disciplines.

After considering all the available advice at length, the school considered that the course should be broadened, while at the same time retaining the opportunity for specialization. The 'land based' strands of cadastral surveying and land law, land development and land inventory were all given increased emphasis along with surveying and management. The strands of astronomy and photogrammetry were slightly reduced. A new strand relating to human communications, specializing in public speaking and report and technical writing, was introduced. The possibility of increased specialization was also introduced into the course by increasing the number of elective options from 11 to 23 and by increasing the percentage of the course allocated to technical electives from
four percent to eight percent. The electives cover a wide range of topics and include subjects in the areas of higher surveying, geodesy, photogrammetry, hydrographic surveying, remote sensing, cartography, land development, land inventory and cadastre. In addition, approximately six percent of the course is allocated to general studies electives.

Once the undergraduate course was revised, the school turned its attention to the postgraduate area. The consequence has been an increase in the range of subjects offered at the graduate level. The school now offers programs leading to the graduate diploma and the master of surveying science degrees, in a range of topics including advanced surveying, geodesy, land development and management, photogrammetry, remote sensing and spatial information systems.

**Comments on the future of the Australian surveying profession**

The Australian surveying profession can be considered as comprising the same four fields of expertise as that conceived by the Canadian Council of Land Surveyors; that is, legal surveys, positioning and measurement, land information, and land management. The four fields are discussed.

**LEGAL SURVEYS**

In the future the only desirable change in cadastral surveying in Australia is that it should become more a part of the operation of the cadastre. The cadastre of the near future will be based around a computerized land information system with one of its central components being an accurate statewide large-scale mapping system. Cadastral surveying should become an integral part of such a mapping system. Presently, in all the Australian states, cadastral surveying and large-scale mapping are two independent processes. These two processes can be combined by basing all cadastral surveys on the same state plane coordinate system as that used in mapping. Such a change in emphasis should have only a marginal effect on the cadastral surveying profession in the short term. In the long term it will lead to a more efficient cadastral system with a consequent decrease in the number of surveyors carrying out cadastral surveys as they are done today, although the decrease should be more than offset by an increased demand for surveyors in other areas.

When mathematical coordination of surveys is introduced it should be possible to rationalize the unnecessarily high degree of accuracy required in present day cadastral surveys in Australia, since the surveys will no longer have to be an inherent part of the state control network for charting such surveys. It will be possible to relate accuracy standards more to user requirements and the value of land, and to make more use of the legal concept of defining boundaries by occupation.

If there are no fundamental legislative changes affecting cadastral surveying, then the present system will remain unaltered for many years to come. Advanced technology alone will not significantly change the present cadastral survey system because it is statutorily controlled and is very labor intensive. This latter aspect is evidenced by the fact that surveys cost basically the same today as they did 10 years ago in N.S.W. (allowing for consumer price index increases), even though this has been the era of efficient and relatively cheap electronic distance measuring equipment and hand held calculators.
POSITIONING AND MEASUREMENT

Advances in technology have had and will continue to have more influence on the positioning and measurement function of the surveyor than any of the other areas in the profession. The new technology will significantly affect geodetic, photogrammetric, hydrographic and engineering surveys. The trend will be to position fixing and measurement by a ‘black box’ technology, which the profession is already experiencing. The consequence of this trend will be that more technicians will be involved in the actual measuring whereas the professional surveyor will either take on a managerial role or become a highly qualified specialist in one of the fields listed. The great demand for the services of surveyors in these fields should continue in Australia.

LAND INFORMATION

The surveyor’s role in this increasingly important area is in the acquisition, processing and presentation of physical, economic and social land related information on the microlevel and on the macrolevel. The areas of expertise that are central to this are mapping and cartography in both the traditional and automated forms, remote sensing, and in the design, development and management of land information systems. The surveyor is uniquely suited to such areas with his strong mathematical background, his ability to handle spatial data, his understanding of land law, planning and geography, and more importantly his ‘feel for the land’.

Remote sensing in particular has attracted considerable interest during the last decade due to the advent of earth resource satellites such as Landsat. A considerable number of surveyors have become involved in research related to this area during this period, although most of their activities have been directed to the cartographic use of the satellite data and more particularly to the geometric accuracy of the Landsat images. With the planned introduction of new earth resource satellites and of an Australian Landsat station, this area will continue to be most rewarding for surveyors at a research level. As the application of this technology increases and broadens, there should be an increased use of remote sensing by practicing surveyors.

In general, relatively few surveyors are involved at present in the land information disciplines in Australia outside the traditional activities of cartography and mapping, except at a research level or in several specialist positions. The field is experiencing expansion at all levels of government in Australia and to a limited extent in the private sector, and will require an increasing number of specialists in the future — it will be unfortunate if a large proportion of the specialists who become involved in these activities are not surveyors.

LAND MANAGEMENT

Land management could be one of the growth areas for surveyors in the future. This is one area where the profession and teaching institutions should consolidate their present involvement, otherwise, these areas of responsibility will move to other professions.

Historically, land management has been intimately tied to legal surveys at a governmental level in Australia, with the consequence that surveyors have
played a dominant role in this management activity. Therefore any discussion of land management should not lose sight of this important, although quite specialized, area of management which relates to the public service. This area comprises the management of Crown lands, the alienation of Crown lands, the acquisition and sale of lands for public authorities, the valuation of such lands, together with all the related administrative functions. These areas of responsibility are under challenge and, unless the profession regards them as one of the primary functions of the government surveyor, they could move out of the control of the profession.

Another aspect of land management — land development — is consuming more and more of the land surveyor’s time, especially in private practice. This is an important area to the profession and surveyors should establish themselves as primary consultants in the area, whether at the government or, more importantly, at the practitioner level. From an historical perspective, because of increasing urbanization in Australia, there has been a trend for more and more surveyors to work solely in urban areas. The result has been that these surveyors have virtually discarded their traditional skills which were gained working in a rural environment. Unfortunately they have not replaced these lost skills with a practical understanding of urban land economics, urban land appraisal and urban land use. “If the urban surveyor is to reestablish his relationship with the land he must become more concerned with the problems of planning and development and the better use of land” [Foster 1978].

Thirty or so years ago the process of subdividing land was relatively simple and was nearly the sole domain of the surveyor — today this is not the case. At that time the process consisted of a straightforward subdivision application with approval by the local authority, design and construction, final approval and registration of the subdivision plan. Today quite often the most time consuming and involved aspect of the development process is obtaining the initial approvals; for example, subdivision approval is required under the Local Government Act, 1919, as well as development approval under the Environmental Planning and Assessment Act, 1980, in New South Wales. In addition to these approvals, further arrangements must be made with, and approvals sought from, state planning authorities, the utility authorities and, often, various government departments. This initial process requires a good understanding of all the governing legislation (the Local Government Act with its Ordinances alone runs to several volumes), local government appeals procedures, environmental assessment, as well as an understanding of site evaluation and planning — and this is only the start. On the engineering side the trend is to more sophisticated designs, particularly for drainage, as well as increased emphasis on soil stability and erosion control during development. The financial administration of projects has also become much more sophisticated; feasibility studies, discounted cash flows and critical path analyses are becoming the norm. If the land surveyor, particularly in private practice, does not grasp these disciplines firmly, they will be lost to him, as has happened in some Australian states.

The surveyor’s attention should not be confined to ‘broadacre’ subdivisions but should also include projects involving multiple-ownership, based on the condominium or ‘strata title’ concept. Such projects include residential, com-
mercial and industrial developments. The surveyor should become involved in all aspects of these types of developments — to some extent this is the case in N.S.W.

One expanding area in the land management sphere where the surveyor has much to offer due to his training and experience, and where he is becoming increasingly involved, is in environmental assessment and site analysis on the microscale and on the macroscale. Because of recent legislation, expertise in these areas will become virtually mandatory for surveyors in N.S.W. if they are to retain their role in the development and management of land.

Conclusion

In looking to the future, the surveying profession should remain flexible and should be prepared to continually evaluate the professional services it offers to the public, but more importantly it should work as one profession, at both the academic and professional levels to promote its interests. In the past there have been divisions within the profession that have been counterproductive in its development. On the one hand, we have had in Australia a relatively conservative body in the Institution of Surveyors, Australia, which has been dominated by the cadastral interests within the profession, to the general exclusion of those bodies representing the technological and scientific areas of geodesy, photogrammetry, cartography, etc. On the other hand, the academic institutions have in the past concentrated almost exclusively on these mathematically oriented areas, and have given only minor attention to the land studies areas, where the majority of the profession is involved; this position is evidenced to some degree by the dissatisfaction graduate surveyors in N.S.W. have had with the Institution of Surveyors, as discussed previously. Consequently, new developments in the land-based areas have been neglected since virtually all research in the academic institutions has been directed to the mathematical, scientific and technical areas within the field of surveying. Even though the Institute of Surveyors has concentrated its efforts in the land studies area, it is more involved in doing the 'job at hand' than developing new areas within the profession. This is usually the role of the academic institutions, although the institute has made several moves in this direction in the past. Consequently, various areas which traditionally were considered part of the profession have neither been taught in academic institutions nor promoted by the Institution of Surveyors and have therefore drifted away from the profession. The same fate will befall new and developing areas if this dichotomy is not resolved.

A suggested approach to help alleviate these difficulties is that the professional societies should broaden their base to better represent and promote all facets within the profession. Perhaps this could be done by introducing interest groups or 'colleges' within such societies. For example, the societies could adopt the four interest groups outlined within this paper, although it may be desirable to combine the areas of legal or cadastral surveying and land management under one common group. The establishment of these groups could make it easier for all surveyors to identify themselves with their professional organizations and make it easier for the organizations to better serve the interests of all their members.
The academic institutions, on the other hand, should also broaden their teaching and research areas to truly represent the profession for which they produce graduates — as well as looking to the future, they should also be looking at the services their graduates perform and design courses accordingly. They should be encouraged to fully recognize the breadth of the profession by introducing the basic land studies subjects of land law, land economy and environmental studies into the early years of their degrees alongside the traditional mathematical and measurement oriented subjects. To encourage research and create graduate studies within the land studies disciplines, the surveying schools should consider having on staff specialists in these areas in the same way that they now have specialists in geodesy, photogrammetry and astronomy. For example, a specialist land economist, lawyer, planner, civil engineer or environmentalist would be a considerable asset to any school or department teaching surveying.

The future of a modernized survey profession as envisaged by the Canadian Council of Land Surveyors will rest to a large degree on the cooperation and joint efforts of these two important components within the profession — the academic institutions and the professional societies.

References