A Baccalaureate Degree Program for the Traditional Surveyor

Indrajith Wijayratne

ABSTRACT: Many states now require a four-year college degree as the minimum educational requirement for the grant of a license to practice land surveying. This is a step in the right direction, but college degree curricula do not serve the profession well unless they are designed to offer the kind of education that the practitioner needs. If graduates of college surveying programs are not capable of carrying out traditional land surveying tasks, their employment opportunities may be limited. The B.S. degree program in surveying at Michigan Technological University—a result of the Michigan legislature mandating a baccalaureate degree for licensure—was designed from the outset as a program to educate traditional land surveyors. The program, accredited by ABET under RAC and now in its sixteenth year, enjoys a healthy enrollment. It has all the ingredients of a modern surveying curriculum but the practical nature of its course offerings is well suited to the traditional surveyor.

Introduction

To be or not to be a graduate...that is the question being asked by every person aspiring to be a surveying professional these days. Even though all 50 states require some formal education for surveyors, there are only eight states (Gibson 1993) in which a four-year degree has become the mandated minimum educational requirement for licensure. A number of other states are moving towards making a four-year degree the minimum requirement. The debate as to whether or not land surveyors need four years of college education is settled in the minds of surveying educators, who are in favor of the idea. The profession at large is not yet in complete agreement, but opponents are in the minority. One issue that has not been completely resolved is the type of education that a surveyor needs. Most surveying programs are in their infancy and surveying educators have spent considerable time and energy in developing college surveying curricula.

Two issues that have received attention lately are those of a proper name and an academic home for baccalaureate degree programs in surveying. These have been discussed in the past at the North American Surveying and Mapping Teachers Conferences (NASMTC). At the 14th NASMTC, held in May 1993 at the University of Florida, considerable time was spent on the subject of a proper name for a college surveying degree program. The discussion centered on making surveying attractive to high school graduates. This is also the subject of a study conducted by two educators from the University of Maine (Onsrud and Pinto 1993).

While the title of the academic program is important in so far as it portrays an image of the profession and may help the survival of university surveying programs by attracting students, this author feels that the needs of the practitioner should not be left by the wayside. The needs of the practitioner is an issue that surfaces rarely in any discussion of college curricula. It is our duty as educators to model academic curricula so that graduates are ready to face the real world of surveying. A university is a place where a product (graduate) is assembled. If this product is not marketable, cessation of the program will result. A great deal of attention is given to new technologies and digital revolution, but not enough is said about how these will affect the practicing surveyor in the application of his or her knowledge when determining real property boundaries or in construction layout in the field. If the primary goal of the graduate is to become a licensed surveyor, this can only be achieved by passing the relevant examinations coupled with acquiring appropriate experience. The emphasis of the licensing examinations, conducted jointly by the National Council of Examiners for Engineering and Surveying...
(NCEES) and the state licensing boards, has always been heavily on the practice of boundary and construction surveying. The state of Michigan was the first state in the union to legislate the requirement of a baccalaureate degree for licensed surveyors (from January 1, 1977). Other states have been slow in following. This is due mainly, in this author’s opinion, to a lack of action on the part of the professional surveying community. This may be because of a notion that surveying graduates straight out of college are not very familiar with fundamentals, and have not had sufficient field experience. This may be justified in the sense that most university surveying programs have embraced the engineering model, in which mastering the theoretical concepts is considered more important than the ability to apply such concepts to real world situations. The result has been that a large number of potential students have lost their interest in college surveying programs.

Some college surveying degree programs available today offer highly specialized courses in geodesy, photogrammetry, cartography or geographic information science. While these technical tools are important in surveying, a land surveyor needs skills in boundary retracement and related legal research, land subdivision and stakeout, construction stakeout, mortgage surveys, and so on. A thorough knowledge of the rectangular survey system, commonly known as the public land survey system, is a must for a surveyor practicing in the mid-western or western states.

Case for the Traditional Surveyor

A traditional surveyor, for the purposes of this discussion, is one whose primary area of work is in cadastral and engineering/construction surveying. Most surveyors in the United States are employed by firms whose primary business is in these areas. In a recent study (Brandenberger 1993), out of a total of 17,065 surveying and mapping-related firms in the United States, 2,498 are listed as construction, civil engineering, and survey sections of power companies. The study also lists 13,001 firms as surveying companies. This is more than 90% of the total (see Figure 1).

The primary survey activities of all the firms in the study can be considered to be construction and property surveying. It is clear that these companies provide employment to a majority of surveying graduates and that these graduates are expected to work in the area of property and
<table>
<thead>
<tr>
<th>Year</th>
<th>Number of graduates</th>
<th>Number of graduates employed in land surveying</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Private</td>
<td>State/federal</td>
</tr>
<tr>
<td>1981</td>
<td>10</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>1982</td>
<td>14</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>1983</td>
<td>12</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>1984</td>
<td>8</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>1985</td>
<td>9</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>1986</td>
<td>9</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>1987</td>
<td>14</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>1988</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1989</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1990</td>
<td>4</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

Following are the state and federal agencies where Michigan Tech graduates found employment:

1. Michigan Department of Transportation
2. U.S. Department of Interior
3. U.S. Department of Commerce
4. U.S. Department of Agriculture
5. U.S. Department of Defense
6. U.S. Air Force

Table 1: Percentage of graduates employed in traditional surveying.

construction surveying. This has been our experience at Michigan Technological University with our graduates as well (Table 1). We notice a drop in the demand for surveyors when there is a poor construction climate.

It is the responsibility of universities to ensure that their graduates are capable of fulfilling the needs of the industry. Onsrud (1987, 33) states that “knowledge of the law of property line location is a primary factor distinguishing the licensed land surveyor from the licensed engineer in the United States.” Locating old property lines as well as establishing new ones in the field and writing accurate legal descriptions are tasks expected of a land surveyor. Whether the surveyor is working as a specialist in land information management or testifying as an expert witness in a court of law, he or she should be proficient in property boundary laws and related legal issues. Surveyors working in construction surveying should not only be able to produce construction-related computations and drawings, but also be knowledgeable about the location of legal boundaries and layout of projects in the field. Most construction projects involve demarcating legal boundaries such as road right-of-ways. Communication and business skills are equally important for the professional and leadership roles that surveyors are expected to play as they advance in their profession. The preceding discussion is not, in any way, meant to imply that a surveyor does not need an education in geodesy, photogrammetry, GPS, or GIS/LIS. On the contrary, these areas help the surveyor to become a true professional. Nonetheless, even though the professional surveyor should offer such services, he or she should be the recognized expert in locating legal boundaries. Knowledge of geodesy and photogrammetry is marginally important in most day-to-day survey jobs, but boundary and construction surveys are the “bread and butter” of most surveyors.

The report of the National Study on Surveying Education (ACSM 1993), states that employers support “real world” practical academic programs. While it is true that the surveying profession is moving toward the information age, we cannot disregard the fact that the employer hiring the graduate is looking for an individual who is capable of executing most survey jobs without supervision. We, as educators, have a responsibility and an obligation to ensure that our students are ready for employment in the real world after more than four years of hard work and after thousands of dollars have been spent on their education. The majority of publications on surveying education only discuss the exposure of students to
<table>
<thead>
<tr>
<th>Year/month</th>
<th>Fundamentals of Land Surveying</th>
<th>Principles of Land Surveying</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Morning part</td>
</tr>
<tr>
<td>89/10</td>
<td>42.6</td>
<td>90.5</td>
</tr>
<tr>
<td>90/04</td>
<td>59.4</td>
<td>81.6</td>
</tr>
<tr>
<td>90/10</td>
<td>40.7</td>
<td>68.6</td>
</tr>
<tr>
<td>91/04</td>
<td>59.3</td>
<td>71.2</td>
</tr>
<tr>
<td>91/10</td>
<td>37.0</td>
<td>64.5</td>
</tr>
<tr>
<td>92/04</td>
<td>41.3</td>
<td>53.6</td>
</tr>
</tbody>
</table>

Table 2: Success rate of four-year degree surveying graduates in NCEES examinations.1

1 Data extracted from a paper presented at the 14th North American Surveying and Mapping Teachers Conference by John Ed Isbell, Chairman, NCEES Land Surveying Exam Committee.

emerging technologies. Operating an instrument is a task easily learned by a technician. A measuring tool based on a given technology only allows measurements to be made in the field. In most land surveys, data not only includes measurements but also other evidence gathered in the field.

A truly professional surveyor should be able to analyze the measurements and evidence in order to weigh the integrity of each piece of data and then make a decision based on the findings. Surveyors who ignore, or are ignorant of, unacceptable measurements or evidence put themselves and their employers in jeopardy in today’s litigious society. Erroneous data—a possibility with modern “black box” technology—may go undetected unless the surveyor is knowledgeable enough to sense and find them. Technology, as we have seen during the last two decades, changes very rapidly, but the well-educated surveyor will be able to adapt to new technologies provided that he or she understands the underlying basics. The procedures for evaluating boundary evidence and related methods for relocating property lines will not change. New technology should be used only as a means to an end, and not as an end in itself.

Some argue that, once all the communities in the country have implemented “multipurpose cadastre”-type comprehensive land information systems (LIS), the need for property surveyors will diminish. The author believes strongly that this will prove false. In any case, as of today only a few communities or municipalities have attempted even simple automated deed registration systems, let alone multipurpose cadastre. Even if the entire country decided to build this type of LIS, it would take a long time to complete, and surveyors would play an important role in ensuring the accuracy of boundaries as well as in resolving boundary disputes. Moreover, land subdivision and development would not cease with a multipurpose cadastre.

The surveying profession has been struggling to establish its identity among engineering and like professions. In order that this goal be achieved, university programs have increased the amount of theoretical and analytical concepts taught in the curriculum at the expense of practical education. The debate on whether surveying should be taught under the umbrella of engineering, geography, or science becomes irrelevant if the graduates cannot fulfill the expectations of their employers. Table 2 shows the success rate of four-year degree surveying graduates in NCEES examinations for five years. The results are disturbing, especially because students are doing poorly in fundamentals.

We must always integrate new technologies into university curricula, but technology alone will not make the curriculum complete. We must show students how to use new technologies to accomplish tasks that were previously performed with older techniques. Advice and input from state and local professional surveying organizations must be sought at the design stage, as well as at developmental stages, of college curricula.

A B.S. Program with a Mission

The baccalaureate degree program in surveying at Michigan Technological University (MTU) was developed with the philosophy of providing a solid education in traditional land surveying for those who wish a career in the professional practice of surveying. This has been recognized and acknowledged as the major strength of the MTU program in every evaluation made by ABET.

Michigan Technological University is located in the Upper Peninsula of Michigan, on the shores of Lake Superior. The nearest metropolis is
from Civil and Environmental Engineering, Civil Engineering Technology, Mining Engineering, Forestry, and Forest Technology. The total enrollment in the two introductory-level courses exceeds 400 per year. The surveying faculty teaches service courses for other departments, as well. These include Mathematical Astronomy, Natural Resource Use and the Law, Soil Technology, and Highway Technology. These are also required courses in the surveying curriculum, so the teaching places no additional burden on the surveying faculty.

Since the surveying curriculum was developed to meet the requirements of the Board of Professional Surveyors, from the outset it was strong in traditional surveying courses. This may be attributed also to the fact that three members of the surveying faculty at that time were licensed land surveyors. When surveying went through a technical revolution in early 1980s, the surveying faculty decided to revise the curriculum in order to incorporate new technologies into its courses. A complete revision of the curriculum was made, including the addition of several new courses and the revision of existing courses. These revisions, however, did not affect the practical nature of the program. In 1986, Michigan Tech sought ABET accreditation under the Related Accreditation Commission and were successful. The program has enjoyed continuous accreditation since 1986, and has received favorable reviews.

### The Curriculum

The B.S. degree curriculum was initially developed to meet state licensing requirements. At present, the Board of Professional Surveyors accepts ABET-accredited programs as meeting licensing requirements and does not have a separate set of guidelines. In the curriculum, a student needs a minimum of 206 quarter credits for graduation. A breakdown of minimum course requirements in different groups is shown in Figure 2. The curriculum is designed to meet ABET requirements as well as the general education requirements of the university, which apply to all baccalaureate degree programs and include a minimum number of credits in science, mathematics, communication, humanities, social science, physical education, and upper-division thematic studies. The upper-division thematic studies requirement is designed to give an in-depth knowledge of a subject matter outside the student’s major. Courses must be selected from a group of coherent, interrelated courses. The
<table>
<thead>
<tr>
<th>Subject area</th>
<th>Representative courses</th>
<th>Total credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>Algebra, Analytic Geometry, Calculus, Statistics</td>
<td>22</td>
</tr>
<tr>
<td>Basic Science</td>
<td>Chemistry, Physics, Geology, Astronomy</td>
<td>28</td>
</tr>
<tr>
<td>Humanities, Communication, and Social Sciences</td>
<td>English, Speech, Foreign Languages, Literature, Government, History, Philosophy, Sociology</td>
<td>39</td>
</tr>
<tr>
<td>Law &amp; Business</td>
<td>Legal Principles of Surveying, Natural Resource Law, Accounting, Economics, Labor Management, Business Law</td>
<td>16</td>
</tr>
<tr>
<td>Computer Applications</td>
<td>Structured Computer Programming, Computer Applications, Computer Aided Drafting and Design</td>
<td>7</td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Minimum quarter credits required for graduation is 206.

**Figure 2.** Course requirements in each category for the B.S. degree.

The university has a very broad course offering on topics dealing with science, technology, and society.

Surveying students are encouraged to take related courses offered by other departments as electives. Examples are the courses in GIS and Remote Sensing offered by the School of Forestry and Wood Products. Most engineering science courses are offered by the School of Technology. These courses can be replaced by comparable courses offered by regular engineering departments. This is required of those students wishing to obtain dual degrees with other engineering majors such as civil engineering. The emphasis of the program is on practical applications while a sufficient theoretical background is provided in every area of surveying. Continuing input from an advisory board made up of practicing surveyors makes this task quite easy.

The practical nature of the program is strengthened by the ten-week summer surveying course, which is required for graduation. This course is usually scheduled at the end of the sophomore or junior year. Students are divided into three-person crews. One student acts as crew chief, on a rotating basis. The crews are assigned projects similar to those they will encounter in their employment. Each crew has a locker containing the instruments needed for any job. They are expected to complete projects with minimal help from instructors. This is a field-work intensive course, but a certain amount of classroom instruction, quizzes, and exams are given to ensure that the students learn the material. Officially, classes are conducted from 7:30 a.m. until 4:30 p.m., but student crews often find themselves working late evenings and weekends to complete their projects. Background material and necessary instructions are given at the beginning of a project. During the project, classes meet only for a short time in the morning to answer questions and to discuss any other concerns. Instructors are present in the field to answer questions and to ensure safety.

The first five weeks cover general topics such as care and adjustment of instruments, angle and distance measurements, traversing, leveling, and laying out horizontal curves. Students also complete a planimetric mapping project, a profile leveling project, and a topographic mapping project, all of which require an industry-quality map as the final product. The second five weeks start with the survey of a quarter section and its subdivision into 40-acre parcels. Figure 3 shows a sample of instructions issued to the crews for this part of the course. The landscape of rural Houghton County, with its rolling topography, provides ample space for these field exercises.

The summer field course enables students to learn teamwork, make decisions independently, and develop their leadership qualities. The advantage of teaching the course during summer, apart from the beautiful weather in the region, is that students are not burdened by other work.
LS252: Advanced Land Surveying Field Procedures

Taking account of all existing monumentation, accomplish a survey of the Northwest quarter, Section 17, T54N - R34W, Houghton County, Michigan. Use true North as determined by Polaris observations as your basis of bearings. Calculate the coordinates of all section corners, quarter corners, and sixteenth corners.

On 18” x 24” mylar, show the subdivision of this quarter section into 40 acre parcels showing all existing monumentation, record and measured distances, coordinates, etc.

Calculate the coordinates of the 20 acre parcel assigned you. Stake out this 20 acre parcel in the field.

Design a preliminary plat for the 20 acre parcel assigned you. Draw up and submit on 18” x 24” mylar. Stake out 5 lots, including a lot on a curve, in the field.

The existing dirt road will be improved to provide access to your subdivision. Run a plan and profile of this existing road with ties to the North quarter corner and North sixteenth corner of said Section 17. Draw up and submit your plan and profile. Design an appropriate vertical curve for the creek crossing.

Determine the existing degree of curve for the horizontal curves as indicated by CD and BE on the sketch. Hand in a sketch and your calculations.

The County Road Commission will not approve a horizontal curve greater than 7.5 degrees. Design and field stake a new curve at BE.

You must acquire a 200’ right-of-way from the landowner from A to B, 100’ each side of the center line. Write up a legal description for this easement for purchase.

Draw up typical sections for your new road design. Plan on 11’ lanes, 4’ shoulders, and 4’ for guardrails in the vertical curve area. Use a 1 on 2 backslope, a crown of 0.02’ per ft., a shoulder drop of 0.04’ per ft. Submit on 18” x 24” mylar.

Cross section, set slope stakes, and determine fill volume for your vertical curve area. Hand in data.

Figure 3: Instructions for summer field project.

Students are not allowed to be enrolled in any other courses and are discouraged from seeking any temporary employment during this period.

During the regular academic year, students can take up any project in their area of interest as independent studies, under the guidance of a surveying instructor. Students also receive a good dose of Michigan statutes relating to surveying and other associated fields (which form the basis of part of the licensing examinations) before they graduate. Material for other courses has also been developed with the practical surveyor in mind.

One example is Adjustment Computations.

The emphasis in the Adjustment Computations course is on analysis of measurement errors and their propagation, and analysis of adjusted values and their precision estimates. Relatively little time is spent discussing the theory of least squares adjustment, which is mainly demonstrated by examples. In most assignments in this course, students are required to develop observation equations from field measurements but are not required to linearize these equations or to derive the normal equations. A thorough analysis of the results of the adjustment has to be performed. It is our view that most surveyors will use software for the adjustment but they need to be able to understand the input (measurements and their precision estimates) and to analyze the results. This approach is used in most upper-division courses, as most surveyors will be at the user end of any new technology.

Computer usage is vital to surveying. However, it is our view that surveying graduates need not necessarily become computer programmers but should be able to use computers effectively. Surveying graduates should be able to use application programs with minimum help. Nevertheless, sufficient flexibility is provided in the curriculum to enable a student to obtain programming skills if he or she so desires. Although it is not possible to expose students to every software package available, they are exposed to most major software, such as AutoCAD and several COGO packages. The university places a strong emphasis on developing communication skills, both verbal and written, among its graduates. This applies to surveying graduates as well. The graduate should not only be capable of offering his or her services to an employer, but must also be motivated to
attain and maintain a professional stance. Good communication skills are needed not only in dealings with clients but also for sharing ideas with fellow professionals.

The University Writing Center, operated by the Humanities Department, is open to any student who wishes to develop writing and communication skills. Faculty from other departments are encouraged to develop classroom assignments, such as detailed lab reports or research papers, which require some writing.

Facilities and Students

The library has a good collection of surveying reference material. The inventory of surveying and photogrammetry equipment is sufficient for the present mission and includes traditional as well as modern instruments. Although we do not own GPS receivers, we work with either manufacturers or government agencies such as the Michigan Department of Transportation so that their equipment is available to us for short periods for instructional purposes. The current university lab fee structure allows us to keep our inventory of equipment current and well serviced. Courses having a lab component can charge a lab fee from students. Money collected can be used only for improvement of laboratory facilities.

In addition to university-wide computer facilities, the School of Technology operates a microcomputer lab comprising a network of 20 computers with 80486 processors and another ten Macintosh computers. Other computers serve as individual workstations. The network runs general software such as word processing, spreadsheet, databases, and special software such as AutoCAD. Most COGO software, GPS postprocessing software and GIS software run on independent workstations. We work with equipment manufacturers and software developers in order to keep our labs up-to-date. For example, Trimble Navigation, Ltd., ESRI, and LEICA have donated their software for use in instruction.

Student recruitment, a major hurdle in any surveying program, is one of our main concerns. The remoteness of the university from major population centers makes it difficult to attract students. This has not been a problem for other engineering programs due to their reputation. Surveying, a major not well known to most high school graduates, has less appeal for young students. Our average student used to be about 30 years old, most had been employed previously, and a few had even had field experience in surveying. It is only quite recently that younger students have started joining the program. The present student body consists of 42% freshmen, 52% transfers, and 6% post-graduates. Forty-five percent have had prior work experience. Transfer students come from other programs within Michigan Tech as well as from different colleges and universities. We have also seen older graduates from such fields as forestry and civil engineering returning to pursue a second degree in surveying. A dual-degree option with several other B.S. programs in the university and a direct transfer option for associate degree students in civil engineering technology is already in place. The B.S. degree in surveying requires an additional seven quarters beyond the associate degree, and this has to be planned well ahead so that the necessary courses can be included in the student’s associate degree schedule.

A university-wide program which offers “in-state” tuition rates for students from Wisconsin, Illinois, and Minnesota who rank in the top 15% of their high school graduating class helps the surveying program to draw a large number of students from these states. Other students from these states receive the same concession after enrollment if they maintain a 3.25 GPA (4.0 scale). Minnesota mandated a four-year degree for licensure a few years ago, but to this writer’s knowledge there is no university in that state offering a four-year surveying degree. As a result, a large number of students from Minnesota are enrolled in Michigan Tech’s surveying program. The Minnesota Society of Professional Surveyors (MSPS) also offers an annual scholarship to students pursuing a degree in surveying. In addition, we have had students from other states and from foreign countries.

Students are active in the Douglass Houghton Chapter of the American Congress of Surveying and Mapping (ACSM), and in MSPS. The student chapters regularly arrange for outside speakers and work with instrument distributors to arrange demonstrations of latest instruments.

A Self-Evaluation

Faculty and students have a cordial relationship which works to the advantage of both. The department’s relationships with the professional societies of Michigan and the neighboring states are very healthy. The societies provide the surveying students with three guaranteed scholarships and a fourth for which they compete with surveying students at Ferris State University. Other
scholarships are offered by private companies. In addition there are competitive scholarships available through the university. We have on-going co-op programs sponsored by government agencies such as the Michigan Department of Transportation (MDOT), Bureau of Land Management (BLM), and some private companies.

Despite the fact that the university is located in an isolated part of the country, our program has, with the exception of the late 1980s, enjoyed a healthy enrollment. Current enrollment (1993-94) stands at 50+, which is fairly large compared with most surveying programs in the U.S. We plan to maintain the current faculty/student ratio, and therefore any further increase in enrollment will necessitate an increase in faculty.

From the outset, Michigan Tech graduates have had a high success rate in both parts of the licensing examination. Neither we nor the State Board of Professional Surveyors maintain any statistics by school, but we believe from our personal knowledge of past students that the success rate of our graduates at the fundamentals is around 100% and that at the practice part it is above 90%.

Placement of surveying graduates has been excellent, even during recessions, and most students receive several job offers. Their salaries are comparable with those in other engineering disciplines. A large percentage find employment in traditional land surveying in public and private sector, as indicated in Table 2.

The success of our program can be attributed to the practical nature of the curriculum. Employer feedback indicates that the performance of most of our graduates meets their expectations. We try to expose students to most real world survey situations, especially with the summer field surveying course. Our graduates cannot be categorized as survey scientists or mapping scientists. They are true land surveyors, even though some have taken up employment with ESRI, NOAA, the U.S. Corps of Engineers, and AMOCO, to name a few. Some have proceeded to graduate school, but most find employment in private surveying and engineering firms, and a few have started their own business.

**Future Outlook**

The future of the surveying program at Michigan Tech seems bright. The School of Technology seems a fitting home for the surveying program given the technical and practical nature of the discipline. Enrollment is increasing. The program has the blessings and support both of the School and of university administrators.

There are many improvements that could be made. We plan to increase our course offerings in order to broaden the curriculum. Additional faculty will be needed for such an undertaking and this will be possible only with increased funding. The faculty once considered a change of name from surveying to surveying engineering, but the idea was dropped because of the lack of support from the Practitioners' Advisory Board. Lack of Board support was also the reason for seeking accreditation of the program under RAC/ABET rather than EAC/ABET. Laboratories need improvement, especially in the area of photogrammetry. This is a high priority item and the faculty are working to secure funding for this and other planned upgrades.

The faculty are also working on a 2+2 program in which a student can complete two years of education at a community college close to his or her home and then attend Michigan Tech to complete the four-year degree. The two schools have to work out a curriculum so that course credits can be transferred directly.

Another approach under consideration and supported by the Michigan Society of Professional Surveyors (MSPS) is distance education. A similar program in mechanical engineering is already in place to provide education for General Motors employees working at Detroit plants. The university delivers engineering and business courses for the National Technological University (NTU) and the Michigan Information Technology Network (MITN). Lectures are either broadcast live via satellite links or video-taped and delivered to the remote sites. MSPS approached the faculty to investigate the viability of such a program for individuals already employed by surveying firms who do not have the educational qualifications required for licensure. Most of these individuals are older employees who have families to support—they are not in a position to give up their employment for four years to attend college. A large number of courses can be offered through distance education. Credits can be given for work experience in lieu of laboratory exercises.

**Conclusion**

There has been a lot of discussion on surveying education lately. Two issues still under debate are a proper name and an academic home for a four-year surveying degree program. Regardless of the outcome of these discussions, it is clear that the
practicing surveyor needs a solid background in traditional land survey techniques including legal research. A program in surveying science, or mapping science, or even surveying engineering will not serve the traditional surveyor unless this need is addressed. This does not preclude a surveying curriculum embracing new technology and expanding the role of a surveyor while preserving the traditional role.

The Michigan Technological University program is one of the early B.S. degree programs in surveying. Low enrollment and lack of support from the professional community are reasons for the failure of several surveying and mapping programs in North America. We believe that there is a need for surveying and mapping education and that that education should relate directly to what students are expected to perform in their professional career. We have always tried to maintain a balance between theory and practice, which students as well as employers seem to appreciate. Some improvements could be made and the faculty constantly strives for excellence. We hope to make our program the “best buy” in surveying education.

While surveying programs must find ways to attract more high school students to the profession, those who are already in the profession should not be neglected. There is a considerable number of young people working in the field as surveyors’ aids while still in high school and also after graduation. They have chosen surveying as their career and do not want to be rod-persons or instrument-persons all their life. In our experience, they are extremely talented individuals who are quite capable of pursuing a college degree. If states mandate the requirements of a four-year degree as the minimum qualification for the license, then this trend of young people who join the workforce after high school returning to get their college degree will continue.

ACKNOWLEDGMENT

I wish to extend my sincere thanks to Professor Charles Hein, Surveying Program Coordinator, for reading the manuscript and making valuable suggestions. The instructions used in the summer field surveying course, shown in Figure 3, were developed by him.

REFERENCES


