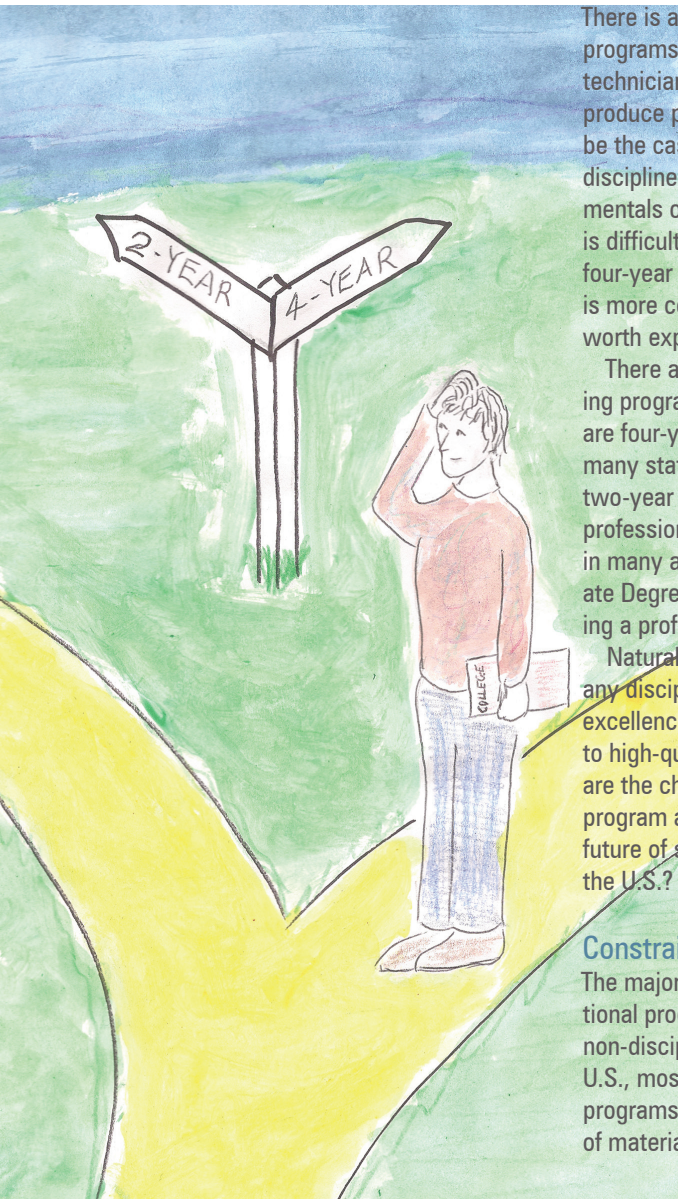


# Two- and four-year surveying and geomatics programs

“The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn.  
—Toffler and Toffler, 1999

The relationship between two- and four-year surveying and geomatics programs in the U.S. is more complex and interconnected than in many other countries. This says something about the nature of our profession, but more importantly, it has a major impact on surveying education in the U.S.

—By **N.W.J. Hazelton**



There is a general belief that two-year programs are designed for producing technicians, while four-year programs produce professionals. This may well be the case in many engineering disciplines where the NCEES Fundamentals of Engineering examination is difficult to pass without having a four-year degree, but the relationship is more complex in surveying, and worth exploring.

There are more two-year surveying programs in the U.S. than there are four-year programs. The fact that many states require no more than a two-year educational qualification for professional registration means that in many areas, the two-year Associate Degree is the pathway to becoming a professional surveyor.

Naturally, educational programs in any discipline have varying degrees of excellence. If we restrict discussion to high-quality programs only, what are the characteristics of each type of program and what is their role in the future of surveying and geomatics in the U.S.?

## Constraints

The major constraints on any educational program are available time and non-discipline content required. In the U.S., most scientific and technical programs require about 25 percent of material to be of a general nature,

e.g., English, humanities, and diversity courses. The standard programs are designed to run for two or four years, assuming well prepared, full-time students.

For many educators, the problem is what to omit from the program, as there are more than enough important topics to fill four years, even without going into great depth in various areas. As the rapid pace of technological change has provided ever more material to include in programs, the need to develop a rational basis for leaving topics out of a program has elevated the importance of connecting to a program's constituents. This is both a central theme in ABET accreditation and an opportunity for the profession to think about where it wants to go in the future.

There is an expectation in the jobs marketplace that a two-year program should produce a technically competent person, ready to work under direction with current equipment, but not necessarily ready to take significant responsibility.

With four-year graduates there is an expectation that they will have a longer learning period to be fully useful in the field, but that they are better prepared to take responsibility in the long term. They are also expected to become decision-makers and teachers, to understand and be

able to design measurement systems, to understand the why and how of technology and processes, and to be the profession's future leaders.

There is plenty of room for both types of graduates in the job market and the profession's future. There is a general trend that tends to eliminate jobs from the lower levels of the skills range, but there are still enough opportunities in surveying that this should not be a major factor in people's choice of a career level, and hence education choices.

The big question for educators is: how do we best prepare people to fill these two somewhat different markets? Clearly the two-year graduates need a lot of hands-on experience and technical skills, while four-year graduates need more theoretical and professional skills, and can get by with rather less hands-on experience.

As noted in a previous article (*ACSM Bulletin*, April 2010), the spatial information cycle can help with understanding the differences in each type of program and graduate. Two-year programs produce people whose strengths are in the measurement area and the basic structure and transformations area. The primary processes used here are variations of transformations, and so are largely algorithmic in nature. These can be taught using something closer to a cookbook approach ("get this, do that"). There is no need for a deeper understanding of the processes involved, and learning by experience is central to developing graduates who can do practical measurement work.

Four-year programs come in focus later in the spatial information cycle. While their graduates are expected to understand the measurement and transformation processes, they also have to understand them at a deeper level, which means a sound theoretical understanding. They are expected to understand the results of these processes, and how to apply them

to very different processes. Knowing how errors work plays a significant part in this understanding. The focus is on pattern recognition, measurement system design, and moving spatial information and knowledge around the spatial information cycle. It is dealing with the planning for, and products from, measurement systems, not just doing the measurements.

Teaching people pattern recognition means supplying them with a lot of patterns, and explaining those patterns, so that they can build up their own systems of recognition. Algorithmic methods don't work here, otherwise you end up with the one-solution-fits-all-problems approach. Pattern-recognition-based problem solving is a hallmark of a professional with an understanding of his/her field at a deeper level.

Clearly—going back to surveying education—there are two types of programs here, each with its own focus. It is fairly simple to work from their general objectives and develop suitable programs, albeit with the limitations of available time affecting the content for each.

## Articulation

The next question is, "How do the two-year programs articulate with the four-year programs?" There are several programs around the country where the first two years of a four-year degree are actually a stand-alone two-year program. In some cases, the two-year programs are very much technically focused, but some graduates choose to continue with the four-year degree. In other cases, the two-year program is basically the first two-year period of a four-year program. Other programs are somewhere in between these two extremes.

The problem we face in articulating between these two types of programs is that their principles and focus are radically different. Two-year programs focus on algorithmic approaches

and delineate fairly strict boundaries to the knowledge that students are required to obtain.

The worldview for a two-year program graduate is necessarily limited by what is needed for the specific work expected after graduation. Four-year programs focus on pattern-based learning, with much more flexible boundaries to the curriculum.

Deeper understanding means much more theoretical knowledge, whence comes the need for some calculus and physics, together with lots of linear algebra and statistics, the mathematical language of modern surveying.

The four-year programs have to provide the "proto-professional" with professional skills, which are often some collection of business, presentation, leadership, and management skills; an understanding of the history of the profession; and an understanding of the ethics and standards expected of professionals. Sometimes these courses can be part of the general education requirement; usually they cannot.

For graduates of a two-year program there is a lot to unlearn before they can fully take advantage of a four-year program. First, we need to realize that the limits set upon the knowledge that a two-year program imparts are not relevant to the four-year program: there is almost no limit to available knowledge in surveying and geomatics.

For these reasons, the two-year graduate is unlikely to 'know it all,' no matter how well he or she did in the program. The second thing to realize is that while an algorithmic approach to problem solving may work in some cases, it is not the ideal solution. The algorithmic approach plays a role in turning a solution from an idea into achievement, but it is unlikely to generate the idea.

When articulating students from two-year to four-year programs, we

may need to include an additional year of “unlearning,” depending upon the nature of the two-year program and the profile of the student. During this additional time, students can be introduced to the broader field of surveying and geomatics, obtain the foundational material in more advanced math and science, and generally change how they think about the profession as a whole.

In the wider profession, we need to think about what we consider to be a well prepared surveying or geomatics professional for the future; decide what level of under-

standing they need to have in the surveying field; decide how well prepared they need to be to deal with technological change over decades; decide at what level they need to be compared to other professionals (e.g. lawyers); and decide what education level is required to meet these needs. In the middle of all this, the connections between two-and four-year programs can also be decided.

### Professionals

Professionals are made, not born. While there may be an inclination

towards professional approaches, the need for education in a discipline’s patterns means that professionals are not a ‘natural’ occurrence. Professions in the modern sense did not appear until about 500 years ago.

The conceptual approach of the spatial information cycle has implications for the wider profession, and the schisms within it. When our view of the profession is narrow, constrained by our earliest experiences, there doesn’t seem to be anything beyond the boundaries we perceive. We need to take ourselves beyond what we consider to be the limits of the profession to recognize new possibilities—for ourselves, our businesses, our profession and our relationship with the society in which we find ourselves. This is very difficult and unsettling for many people. It’s easier to dismiss what’s beyond the boundary as not being “real surveying.”

Ultimately, we need to unlearn our earliest impressions, our way of doing things in the past. We need to relearn skills, perceptions, and ways of thinking. As the Tofflers implied, this can be as difficult as learning to read and write. With the speed of change in surveying and geomatics, we risk becoming illiterate in our own profession, unless we can unlearn and relearn much of what we thought we knew.

### References

Toffler, A., and Toffler, H., 1999. Foreword. In: Gibson, R. (ed.) *Rethinking the Future: Rethinking Business Principles, Competition, Control and Complexity, Leadership, Markets and the World*. London: Nicholas Brealey Publishing.

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