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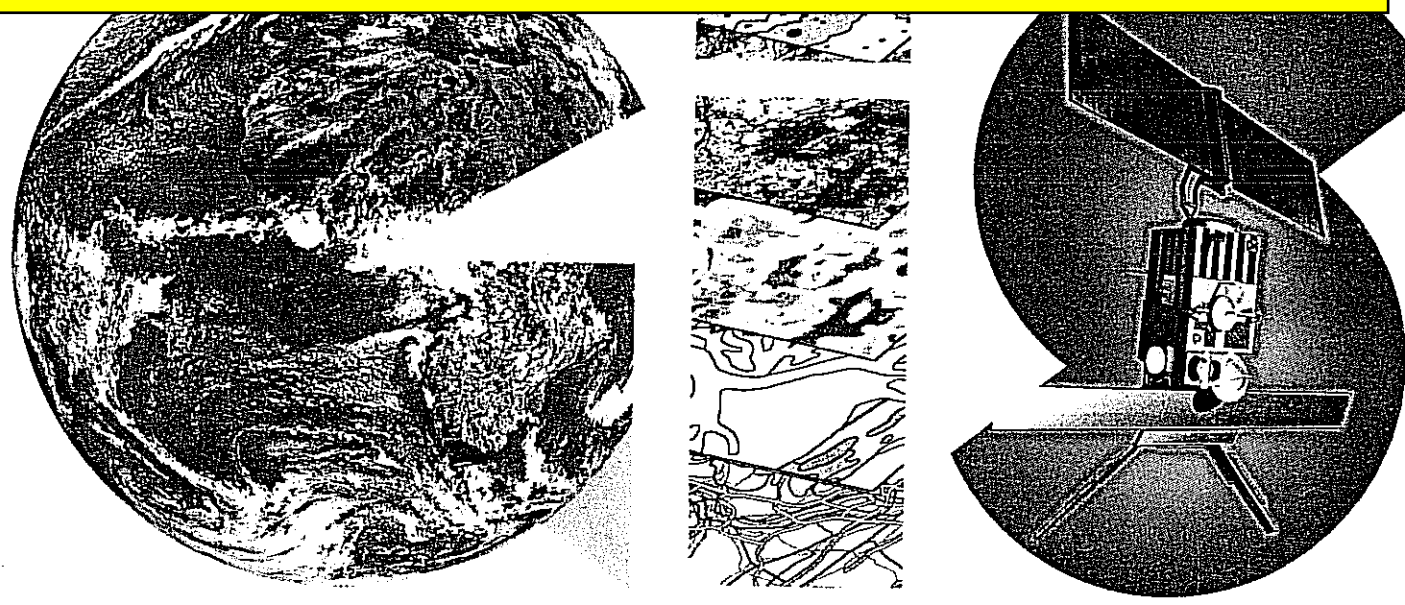

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Surveying, Mapping, and Land Information Systems Education in the United States

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Abstract

This paper briefly describes some current concerns of the surveying and mapping academic community in the United States and how that community is responding to those concerns. Initiatives such als the ILI Centers of Excellence in Land Information Studies program and the recently created National Center for Geographic Information and Analysis are described. The likely impacts of such initiatives on research and education in the United States are also described.

Zusammenfassung: Vermessungs-, Kartographie- und Landinformationssystem – Ausbildung in den Vereinigten Staaten von Amerika

Dieser Artikel beschreibt im Überblick die Situation der akademischen Ausbildung in Vermessung, Kartographie und LIS in den USA und Maßnahmen im Zusammenhang mit aktuellen Problemen. Initiativen, wie die des ILI-Verbandes (Institute for Landinformation) mit einem „Center of Excellence"-Programm für Landinformationsstudien und das neue Nationale Zentrum für geographische Information und Analyse werden erläutert, ebenso wie die erwarteten Auswirkungen solcher Initiativen auf Forschung und Lehre in den Vereinigten Staaten.

Résumé: Formation académique en géodésie, cartographie et systèmes d'information du territoire aux Etst-Unis

Cet article donne un aperçu de la situation de la formation académique en géodésie et cartographie aux Etats-Unis et des mesures pour faire face aux problèmes actuels. Des initiatives telles que de l'association ILI (Institut for Land Information) avec un programme de concentration des études de systèmes d'information du territoire (center of excellence) et le Centre National de l'Information et l'Analyse Géographique récemment crée y sont décrits, ainsi que l'influence que de telles initiatives peuvent avoir sur la recherche et l'éducation aux Etats-Unis.

Concerns with Traditional Surveying and Mapping Academic Programs

There are currently fourteen university programs in the United States which hold themselves out as offering bachelor's degrees with an emphasis in surveying. Most of these programs are very small having only one or two faculty members assigned to teaching the surveying curriculum. Most ot the programs are actually specialty programs within civil engineering, forestry, or similar departments. Only two or three surveying programs in the entire country could be considered strong and vital at the current time.

Even for the strong programs there is a continuing concern with the number and quality of students being attracted to the programs. There ist an extremely high demand for the graduates of the rigorous surveying degree programs yet our undergraduate enrollments are far less than we would like to see them. Low enrollments are a perennial problem for surveying programs nationwide and have led over time to the demise of several programs. However, looking at cartography programs within geography departments nationwide we see that enrollments are high and the programs are growing. The problem with these programs is that graduates as a rule lack the analytic skills which would be acquired within engineering curriculums and therefore the employment opportunities after graduation are very limited.

Even though modern surveying and mapping has become a highly complex field with significant opportunities for graduates from programs providing solid academic foundations, the field suffers a significant image problem in the United States. Many licensed surveyors in the U.S. lack any type of University degree and would be considered technicians by Europeans as well as American standards. They are paid accordingly for the services they are able to provide. The best and brightest students coming into college have a difficult time seeing that substantial opportunities exist in this field when many practicing surveyors have no more public esteem than a plumber or real estate agent.

In addition to a concern with the current state of health of a number of our academic programs and a concern with the public image of U.S. surveyors, our surveying academicians are also concerned with the impact new technologies and changes in the marketplace are having on our programs. The demand for graduates with computer skills and the ability to work within automated environments continues to grow rapidly. Due to black box technologies, measurement skills are no longer in as high a demand. Management skills and the ability to view problems in a broader social and environmental context are becoming more and more important.

Responses of the Academic Community

Revolutionary technologies are forcing us to continually rethink what the role of the U.S. land surveyor will be twenty to thirty years from now and what foundation knowledge we should expose our students to in order to ensure they will be able to continue to learn and readjust throughout their professional careers. Certainly the day will come when GPS technology will

be available, useable, and affordable by any person with rudimentary math and computer skills. The day will come when any layperson will be able to purchase a laser disk for their personal computer containing a GIS data bank for their locality with detailed utility, topographic, surveying, and resource information on it. The day is already very near when all surveying computations may be done automatically and least squares analysis becomes so user friendly that any technician can manage the data in a continually updated automated measurement management system. When these technologies become highly user friendly and efficiently integrated with each other in automated environments, many of the tasks which today's surveyors are accustomed to carrying out on a day to day basis will no longer be necessary.

It is obvious to many in academic fields related to surveying and mapping that the move from an industrial society to an information society is occurring very rapidly. That the societal roles of the land surveyor will change is inevitable. Our perception is that the highly trained land surveyor in U.S. society will have much broader roles than we are currently witnessing in the profession today. For the immediate future at least some of our academic surveying programs are readjusting curriculums with an eye toward providing graduates who are able to develop the hardware and software associated with integrated geographic information systems, are able to install, implement, and troubleshoot within a systems environment, and have the skills to manage people and computerized systems. Knowledge of the law in regard to property line location has always been crucial to the societal role of the surveyor in the U.S. and will continue to be so in the future. In response to the changes in societal needs, university programs in surveying and mapping in the U.S. are experimenting with methods to help them become more vital and grow. The results to date are very promising and we are seeing in a few programs a resurgence in academic vitality.

There is a general consensus that our programs should return to stressing the basics. Strong foundations in math and computer science are particularly crucial to enable students to continue to learn over the length of their careers. Grammar, technical writing, economics, and law are crucial in providing breadth and are being re-emphasized. Rather than attempting to cover all the technical knowledge that graduates may need in the future, our primary goal is to provide them with the ability to readily learn additional material on their own during their professional careers. There is a definite movement towards multidisciplinary approaches in the leading surveying programs in the U.S. For instance, at the University of Maine, the surveying engineering faculty is made up of individuals with a wide range of doctorate degrees Material is typically taught from a systems approach and from the perspective that the academic fields o surveying, geography, computer science, and law are intertwinned and merging.

Several academic programs are stressing regiona centers of surveying education. By doing so, they are able to draw students from a larger population area and are not bound by state political boundaries. This requires a more global approach in addressing particularly legal course materials. Programs are also trying to become more responsive to the marketplace. Curriculums are being designed not necessarily to meet some licensing board's narrow idea of what should be covered in the curriculum but are being designed to ensure graduates have a marketable set of land information skills which will allow them to effectively compete in the marketplace against graduates of any other curriculum.

Finally and perhaps most importantly, academic surveying programs are now placing a high stress on the development of new knowledge in the field. Without scientific and social advancement in a field, academic disciplines tend to stagnate. The past history of academic research in surveying in the U.S. was to use surveying and mapping techniques to foster the research of others in closely related fields. It appears that at least some of the surveying academic community in the U.S. is now back on track and is defining its own academic research agenda.

Those who see this time of rapid technological change as primarily an opportunity rather than a threat are attempting to articulate the important social functions the profession should be striving to provide in the future. Extensive discussions are occurring in both professional and academic circles. With a clear vision of the role of the profession in the future, visions of the educational system to support that profession begin to unfold. Goals for our educational programs to meet those visions can then be implemented.

Centers of Excellence in Land Information Studies

One important initiative which has substantially raised public awareness of the importance of high caliber academic programs in land information studies is the Centers of Excellence Program of the Institute for Land Information. By designating programs that meet its general criteria as Centers of Excellence and by supporting those programs the Institute for Land Information has been able to effectively move towards its goal of supporting in every appropriate way the education of individuals in the land information sciences. The primary benefit to a university program

designated as a Center of Excellence is the increased visibility which the designation brings. For instance, being able to point to such an august international recognition has given the University of Maine administration an opportunity to point proudly to one of its innovative academic programs. This in turn has resulted in substantially increased support to the surveying program by the university administration. Thus we highly recommend that other programs in the U.S. and Europe consider applying to the ILI Centers of Excellence program in order to aid them in strengthening their public and political support.

National Center for Geographic Information and Analysis

The single action in the past few years which hat the greatest potential for strengthening the academic vitality of surveying, mapping, and geography curriculums in the United States was the decision by the National Science Foundation (NSF) to provide long term funding for a National Center for Geographic Information and Analysis. The National Science Foundation has recognized the need to investigate the field of GIA/GIS in order to discover, explore, and disseminate sound concepts for improving our technologies and our understanding of geographic information. In its call for proposals, NSF identified five major areas needing further investigation:

1. Spatial analysis and spatial statistics;
2. Spatial relationships and database structures;
3. Artificial intelligence and expert systems;
4. Visualization; and
5. Social, economic and institutional issues.

The consortium of the University of California-Santa Barbara, the State University of New York-Buffalo and the University of Maine has been designated as the National Center for Geographic Information and Analysis (NCGIA). It has developed a research agenda and an education and outreach program that respond to these areas.

Research is being undertaken by means of initiatives, or projects designed to investigate fully the impediments to the more widespread implementation of GIS. These research initiatives involve interaction not only among academic researchers but also among industrial and government researchers and those applying GIS technology to aid in decision making.

For each initiative, there will be specialist meetings to define precise research objectives, working groups that will address problems for one to two years, and national and international conferences to present research findings. Specialist meetings will bring together individuals from different disciplines with expertise in particular aspects of the research problem. Working groups will then carry out specific research tasks as outlined by the specialist meeting.

Initiatives may naturally lead into long-term single-investigator projects of greater depth and specificity. The involvement of graduate students in research initiatives will have considerable educational impact; dissertation research will be a very important part of this outgrowth research. Many initiatives will also lead to applied research relevant to federal agencies, state and local governments, and the private sector. Initiatives will usually conclude with descriptions of new problems which have been exposed, and thus influence the Center's long-term research plan.

One of the Center's further objectives is to expand the nation's supply of experts in GIS. The Center's educational program includes the following:

- Development of a one-year model curriculum of basic GIS concepts, techniques and applications;
- Education of undergraduate, graduate and post-graduate students at the three NCGIA sites; and
- Extensive workshops, summer seminars, conferences, educational publications, and related outreach activities for the GIA/GIS community.

The educational and knowledge dissemination functions of the Center are of critical importance because the production, analysis, management, presentation, and use of geographic information involves the complicated interaction of theory, technology and practice. The gaps between theory and technology, technology and application, and application and theory in GIA/GIS are too wide; the Center will work toward integrating education and knowledge dissemination with research.

Conclusion

Although this paper began with a rather negative discourse on the status of surveying and mapping academic programs in the United States, very substantial gains are being made both within the academic community and the profession at the present time. For those academic programs pursuing research and adapting their curriculums to respond to the changing societal demands of the profession the future looks very bright. With a well-conceived vision of the future, goals established to allow the profession to be in the position desired, and a strategic plan to reach those goals we are confident the surveying and mapping professions will emerge in providing highly useful and crucial services for a smooth running society. We see the surveying profession of the future providing for more valuable services to society than the profession has ever provided before. We are just now at the beginning of a new dawn for the profession.