Implications and risks of technology change in the geomatics curriculum

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(Received: February 23, 2012; in final form September 03, 2012)

Abstract: As technology advances to cope with the changing societal needs, a number of challenges have sprung in the respective educational curriculum to satisfy this demand. This paper investigates the impact of technology on geomatics curriculum, and discusses some measures that can be undertaken to cope with these changes.

Keywords: change, curriculum, geomatics, technology.

1. Introduction

Implementation, and efficient management of spatial information technology, is crucial for sustainable development. Spatial information processing, and management is the core activity of surveying. FIG (1991) defines the surveyor as “a professional with the academic qualifications, and technical expertise to practice the science of measurement and/or accurate positioning of land and sea, and structures thereon, and to instigate the advancement, and development of such practices”. The traditional surveyor’s role was to make maps, however with increasing computer speeds, and accessibility to digital technology, the role of the surveyor has become multi-disciplinary, and expanded to include managing and advising on mapping, or geospatial related issues, hence the name change to geomatics engineer.

Geomatics is a new science utilizing digital information technology to make maps. The term “geomatics” is an acronym formed by “geo” (earth) information, and “matics” (measurement) (Bédard et al., 1988). The terms geospatial, and geomatics are used interchangeably in this paper. In order for the geospatial (survey) professional to meet the current market needs, sound training is crucial at various levels so as to impart the required skills. Disciplines such as geodesy, planning, statistics, computer programming, geography, photogrammetry, remote sensing, natural resource management, agriculture, mathematics, cartography, land law, civil engineering are involved at various levels, and from different perspectives.

Societal evolution, increasing computer speed, and user expectations have created the need for review, and expansion of the geomatics curriculum. For example, the content of traditional surveying courses focused on the mathematics of map making, however because of the automation in mapping procedure, geomatics courses encompass a broad based education emphasizing not only intellectual development but also entrepreneurial skills, such as the providing added value in terms of map products, and advice on map applications. Upgrading curriculum to meet societal needs can improve student learning, motivation, retention, and compliance of the educational institution with accreditation requirements (Froyd et al., 2006).

A good curriculum should be designed to enable students develop critical thinking, and sufficient problem solving skills in the shortest possible time. Each body of knowledge should be made up of units that focus on the concepts, methodologies, techniques, and applications specific to that subject. This paper explores the circumstances influencing contents of technological curricula, such as: 1) societal/user expectations, 2) technological advancements in tools and equipments, and 3) role of instructor development.

2. Society expectations

The societal benefit areas of mapping science include the study of weather patterns, natural disasters, ocean resources, climate variability, agriculture and forestry, human health, ecological forecasting, national security, water resource, and energy resource management. For example, digital maps can support the setting up of a suitable land management system that can enable the provision of up to date information useful to policy makers. The drawbacks in existing land management systems especially in developing countries such as Kenya are related to: (i) paper processing, which is a slow, inefficient process, and exposes much of the data to permanent loss, (ii) bureaucratic red tape due to excessive suspicion between land information users, and authorities, which hampers the flow of land information to users, and researchers who might suggest improvements, and (iii) a non-integrated approach, given that land information is useful to multidisciplinary users such as planners, farmers, construction engineers, policy makers (Mulaku and McLaughlin, 1996).

3. Technological advancements in tools and equipments

Producing maps using survey equipment such as the odolites, levels, tape measures, the electromagnetic distance measurement (EDM) equipment, and so forth, is an expensive undertaking, especially when mapping over large areas. Technological advanced equipments
such as Total stations and the GPS have transformed mapping. Total stations have EDM equipment incorporated into the theodolite, and are capable of storing data in digital format. GPS receivers on the other hand, utilize satellites to provide location data, which can be downloaded to produce digital or hard-copy maps.

The GPS (global positioning system) utilizes signals received from at least four space based satellites, to determine the coordinate, elevation, and time with great accuracy, usually within a few meters or even less. GPS technology is used in mapping, cell phones, navigation etc. In recent times, the cost of GPS receivers has decreased substantially, therefore becoming more accessible to the general public. It is important to note that these current mapping equipments can be operated by a technician having basic high school education, and trained over a period of one week to less than six months. Therefore, is it necessary to train a student over a period of 3 to 5 years to make maps?

4. What to change in the geomatics curricula

Just like humans have progressed from the stone, to the iron age, to the fossil fuel economy, and now to renewable energy, map making has evolved from the use of chains for measurement, to the digital age. Therefore, the geomatics curricula need to be re-invented in line with technological advancements. For example, apart from emphasis on computer science, the geomatics curricula will need to expand on theoretical aspects related to environmental sustainability such as soil science, climatology, land evaluation, ecology, and reduce time spent on geodesy, and cartography courses. However, deciding on the time allocation, and instructional approach for a specific course is a challenging undertaking. Felder et al. (2000) advises on the following approaches for improved teaching, and learning in academic institutions: (i) formulate and publish clear instructional objectives, (ii) establish relevance of course material, (iii) promote active learning in the classroom, (iv) give challenging but fair tests, and (v) convey a sense of concern about students’ learning.

In the United States of America (USA), the higher education institutions that offer geomatics include the University of Connecticut, University of Alaska Anchorage, Michigan Technical University, University of Florida, Purdue University, and Utah Valley University who are in the process of introducing the program. Other universities have geomatics within the civil engineering program. In Kenya, geospatial training courses are offered at the University of Nairobi, the Kenya Polytechnic, the Kenya Institute of Surveying and Mapping, Regional Centre for Mapping of Resources for Development, and the Jomo Kenyatta University of Agriculture and Technology. However, geography, environmental science, and civil engineering departments in some institutions offer geomatics training. In the USA, a majority of the instructors in the institutions offering geomatics are licensed to practice, or offer consultancy services. However, in Kenya, apart from the University of Nairobi, the other training institutions have instructors who are not licensed.

5. Obstacles to curricula change and role of instructors in change

In order to meet industry demands, and end user expectations, the curricula for geomatics courses are prepared in consultation with the respective professional bodies. For example, in the USA the National Council of Examiners for Engineering and Surveying (NCEES) are involved whereas in Kenya, learning institutions planning to offer such courses need approval from the Institution of Surveyors of Kenya (ISK), or the Institution of Engineers of Kenya (IEK). If the course is to be offered at tertiary level institutions such as technical colleges and polytechnics, then the syllabus is prepared by the Kenya Institute of Education (KIE).

Academic instructors contribute towards creating well structured support for curricula change, and innovation in teaching in a timely manner (Froyd et al., 2006). However, academic instructors need to re-invent themselves through learning new skills relevant to the current needs of the society. Furthermore, professional development for instructors is an expensive undertaking that institutions are reluctant to incur. Instructors may resist curricula changes that affect instructor research time, or necessitate the lay-off of academic staff whose courses are perceived to be irrelevant, and therefore not included in the new curricula. In addition, the costs of new curricula materials such as equipment may be expensive.

The implementation of new curricula may be delayed in circumstances where institutions suspect duplication of courses. There is also the issue on how to assess changes in curricula, and which changes should be permanent. For example, if an instructor who teaches a course makes changes to the course content, and the delivery approach. The following year, another instructor who teaches the same course decides that the content, and pedagogical changes are not justified, and reverts to the course content as it was before the changes. Can such a course be considered changed? Another controversial issue is whether to consider education as an avenue to intellectual, and character development, or as a path to a future career, or both. Finally, it is important to note that the future of geomatics engineering lies on professionals trained with a multi disciplinary background who can provide innovative land management advice.

6. Summary
This article discusses the impact of technology on the duration, and curricula of geomatics engineering. With globalization, continuing expansion of technology, increased ability of institutions to collaborate worldwide to create modules and programs, and the need to create uniform standards in professional disciplines, concerned authorities should provide a common format, and structure for sharing content and comparing programs. Developing the curriculum to satisfy the needs of students, educators, and industry, may serve as a starting point for national, and regional standards in geomatics curricula. It may also serve as the basis for creating exemplary pathways that can be used to define discipline in technological, and non technological courses for many different workforce domains. Continued participation, and interest from government, and professional organizations, through seminars and workshops, for example can also help improve teaching, and learning of geomatics engineering.

References


