Promoting the Interaction between Education, Research and Professional Practice

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Key words: Surveying Education; Curriculum Development; Professional Competence.

SUMMARY

Curriculum development is the key to the future. It is an ongoing process and it is crucial to both the educational institutions and the society they serve. This relates especially to educational programs designed to professionals such as the surveyors.

There is no doubt that the main challenge of the future will be that the only constant is change. To deal with this constant change the educational base must be flexible. The graduates must be adaptable to a rapidly changing labour market. The point is that professional and technical skills can be acquired and updated at a later stage in ones career while skills for theoretical problem-solving and skills for learning to learn can only be achieved through the process of academic training at the universities. The focus should be on educating for life - not for short term skills.

The paper touches on a range of issues and lessons learnt with a special emphasis on ways and means of building professional competence through curriculum development. The basic argument is that development, maintenance and enhancement of professional competence should be seen as a process facilitated through an efficient interaction between education, research and professional practice.

1. INTRODUCTION

Let me start by presenting some key international trends in surveying education. These are presented previously (Enemark and Prendergast, 2001) but they are still very valid and actual. In a short version, the trends are as follows:

Management skills, versus specialist skills. Technological developments take the skill out of measurement and the processing of data. Almost any individual can press buttons to create survey information and process this information in automated systems. In the same way, technological developments make GIS a tool available to almost any individual. The skill of the future lies in the interpretation of the data and in their management in such a way as to meet the needs of customers, institutions and communities. Therefore, *management skills will be a key demand in the future surveying world.*

Project organised education, versus subject based education. An alternative to traditional subject-based education is found in the project organised model where traditional taught courses assisted by actual practice are replaced by project work assisted by courses. *The aim is broad understanding of interrelationships and the ability to deal with new and unknown problems.* In general, the focus of university education should be more on "**learning to learn**". The traditional focus on acquisition of professional and technical skills (knowing how) often imply an "add-on" approach where for each new innovation one or more courses must be added to the curriculum to address a new technique. It is argued that this traditional subject-based approach should be modified by giving increased attention to entrepreneurial and managerial skills and to the process of problem-solving on a scientific basis (knowing why).

Virtual academy, versus classroom lecture courses. There is no doubt that traditional classroom lecturing will be supported by or even replaced by virtual media. This trend will challenge the traditional role of the universities. *The traditional focus on the on-campus activities will change into a more open role of serving the profession and the society.* The computer cannot replace the teacher and the learning process cannot be automated. However, there is no doubt that the concept of virtual academy represents new opportunities especially for facilitating for process of learning and understanding and for widening the role the universities. And the www techniques for course delivery on a distant learning basis represent a key engine especially in the area of lifelong learning programmes.

Lifelong learning, versus vocational training. There was a time, when one qualified for life, once and for all. Today we must qualify constantly just to keep up. It is estimated that the knowledge gained in a vocational degree course has an average useful life span of about four years. The concept of lifelong learning or continuing professional development (CPD) with its emphasis on reviewing personal capabilities and developing a structured action plan to develop existing and new skills is becoming of increasing importance. In this regard, *university graduation should be seen as only the first step in a lifelong educational process.*

2. GLOBAL DRIVERS FOR CHANGE

The trends presented above all relate to the change deriving from the global drivers for change in the spatial information world. These can be identified as technology development, micro-economic reform, globalisation, and sustainable development (adapted from Williamson and Ting, 1999). These global drivers therefore also affect the profile of the surveying profession and they challenge the whole educational basis of the profession. The global drivers are as follows:

Technology development is the major driving force in changing the face of the spatial information world. The GPS technologies for measuring have revolutionised the traditional surveying discipline and the high resolution satellite imagery tends to revolutionise the mapping discipline. The database technologies for storage of large data sets and the GIS technologies for data management, analysis and manipulation arguably have had the greatest impact on the spatial information environment. And in the future the communication technologies such as the WWW and the Internet will become the focus of attention for

viewing and using spatial data. However, it must be acknowledged that technological development is not the only driver.

Micro-economic reform in many countries has had a dramatic impact on the spatial information environment. The micro-economic reform initiatives represent the institutional and governmental side of the changes observed during the latest two decades. This includes initiatives such as privatisation, decentralisation, downsizing, cost recovery, performance contracts, quality assurance, public/private partnership, and other policies to ensure service delivery and cost effectiveness. These initiatives have changed the focus from the pure technological issues to include also the more managerial components of building and maintaining national spatial data infrastructures.

Globalisation is becoming a reality driven by IT and communication technologies. A globalised world is one in which political, economic, cultural, and social events become more interconnected. The process includes that events in one part of the world increasingly have potential to impact on people and societies in other parts of the world. Globalisation widens the perspectives from the local to the global level. This should lead to a world movement towards improving the quality of lives of people by thinking, working together on common concerns. Globalisation has a social, economic, political, as well as an educational dimension. The www is the most graphic example of this trend, even if the full potential of the web as an educational resource is still to be seen.

Sustainable development will be a driving force in policies developed through the decades ahead. Sustainable development means development that effectively incorporates economic, social and environmental concerns in decision making for development which thereby should "meet the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission, 1987). The professional areas of land administration and, more generally, land management include decision making of such a multidisciplinary nature to be carried out at national, regional and local level of government.

Taking these global drivers into account, it is no surprise that changes are taking place in the definition and nature of the surveying education, as well as the surveying profession and professional practice. Changes in technology and institutional frameworks may provide new opportunities for the surveying profession, but they will also be the destroyers of some professional work. The challenges will be to integrate modern surveying technology into a broader process of problem solving and decision making.

This leads into the understanding that surveying education can no longer rely on measurements skills in relation to engineering and cadastral surveys. There is a need for changing the focus from an engineering discipline into a more managerial and interdisciplinary perspective. The strength of our profession lies in its multidisciplinary approach supported by skills for mediation and project management. The strength lies in the combination of technical, legal, and managerial competence when dealing with development opportunities and property rights and restrictions.

Curriculum development in Surveying (or Geomatics) should therefore be designed in a fruitful cooperation between the responsible faculty board, the faculty research staff; and the

professional stakeholders in terms of the professional surveying institution and relevant employers of the graduates. This interaction should ensure that curriculum development is carried out in response to professional and societal needs.

3. EDUCATION, RESEARCH AND PROFESSIONAL PROCTICE

A successful educational system depends on a comprehensive interaction between education, research and professional practice. This dynamic interaction is shown in figure 1 below (Kjaersdam and Enemark, 1994).

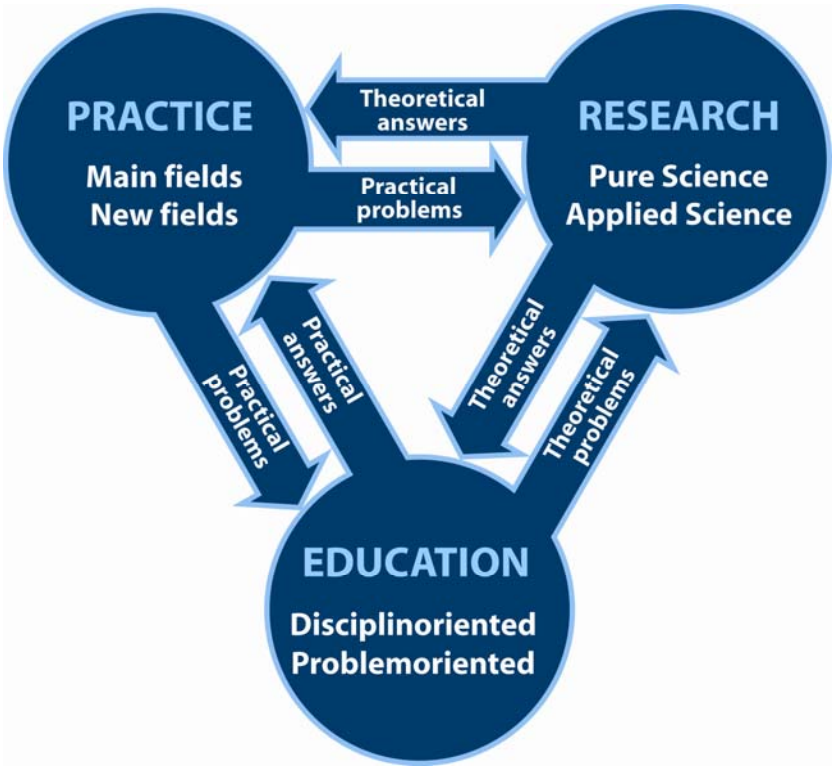

Fig 1. The interaction between education, research and professional practice

Practice may be defined as specific fields or tasks within society that conform professional functions which are carried out by academically trained persons, e.g. surveyors or civil engineers. In a society of increased complexity one has to continually face new problems and new challenges in practice. The traditional way to deal with these challenges is through in-service training, professional seminars, publication of articles, etc. However, this method of development is a rather slow process. The answers, or even the problems themselves, may no longer be of current relevance when the solutions are found. And, at the same time, society is still developing new problems which require new solutions. The answers to the challenges are no longer to be found only within the profession itself.

Therefore, in order to make improvement research and education should be involved in the development process in order to establish a dynamic interaction as shown in fig.1. Research is needed to produce theoretical answers, and interplay with education is needed to produce graduates who are capable of producing practical answers by applying new knowledge and skills when dealing with the new and unknown problems of the future.

3.1 Problem solving and applied science

Applied science is used mainly to deal with problems that can be observed in the "real world". Applied science is problem-oriented by nature. The scientific process of such problem-oriented research can be described as shown in figure 2.

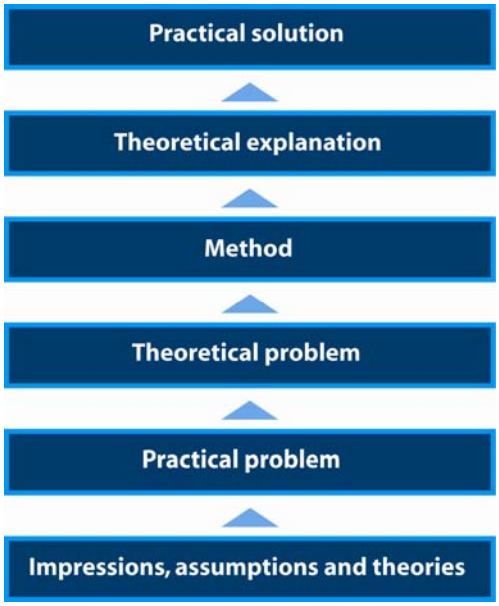

Fig. 2. A model for problem-oriented research.

As a basis for attaining a conscious perception we have a number of impressions, assumptions, and theories built into our language, culture, professional practice and way of life. It is those impressions, assumptions, and theories that guide us in our professional lives. But sometimes we face situations where they are inadequate or insufficient and then practical problems arise.

The practical problem can be a symptom that something is wrong with our theories and assumptions. As a consequence, the practical problem produces a theoretical problem as to why there is a practical problem. The solution to a theoretical problem is a new theory that explains the problem. If the theoretical explanation of the causes of the practical problem can provide a solution to it, there is strong evidence that the theory is valid. What is described here is the dynamic interplay between practice and research, where practice produces practical problems (inter alia) and research produces theoretical possibilities and answers by producing new knowledge.

Applied science is in principle restricted to deal with the problems that are recognized in practice and identified outside the scientific world. Applied science then has the freedom to apply any theory or method that may be relevant for solving the problem. In contrast, pure Science is normally limited by specific paradigm in terms of choice of theory and methods to be used. This dialectic interplay between Applied and Pure Science provides for scientific progress.

This scientific interplay produces new paradigms, new theoretical explanations, and new practical solutions. But it often takes many years to achieve these innovations. Therefore, to produce graduates with relevant qualifications to deal with the problems of the future the faculty must be composed by active researchers. This also indicates the need for integration between education and research and professional practice. To pursue this aim, it is essential to design curricula which flexible and easily adaptable. Then, the curricula will be able to deal with the most actual professional problems and their current implications in society.

3.2 Educational innovation

Traditional higher education has been focused on rule-based disciplines with independent identities in their own contexts. In the discipline-oriented education, the special disciplines and theories, which are considered necessary/relevant for the specific subjects, are normally taught by means of set textbooks and lectures. The students become experienced in the use of these disciplines and theories through the exercises and case work that support these theories. The aim is specific knowledge in certain fields and standard solutions to standard problems. This system functions reasonably well in a stable society where the individual functions and tasks are reasonably standardized.

Problem-oriented education, however, is based on working with relevant, current and unsolved problems from society/industry/real life. By analysing the problems in depth the students learn and use the disciplines and theories which are considered necessary and relevant to solve the problems posed, i.e. the problems defines the subjects and not the reverse. Organizing problem-oriented education through project work allows groups of students to choose problems and to try to analyze and solve them. Through the project work the students should acquire the necessary basic knowledge by means of literature and lecture courses and, at the same time, develop the ability to formulate, analyze and solve relevant problems. In principle, it can thus be ensured that the graduates are capable of handling also the unknown problems of the future.

Educational innovation can then be achieved by being aware of the necessary dialectics between discipline and problem oriented education. The disciplines and their related theories are necessary for the graduates´ fundamental academic and professional basis. On the other hand, the problem oriented project work is necessary in order to understand the interdisciplinary character of the problems in real industry/society/real life, and to enable the graduates to deal with the new and unknown problems of the future. The aim is broad insight into and understanding of the connections between different fields and skills in order to be able to function in an ever-changing and increasingly more complicated society.

4. LEARNING TO LEARN

One of the main challenges of the future will be to accept that the only constant is change. To deal with this constant change the educational base must be flexible. Graduates must possess skills to adapt to a rapidly changing labour market and they must possess skills to deal even with the unknown problems of the future. Professional and technical skills can be acquired and updated at a later stage in one's career while skills for theoretical problem-solving and skills for "learning to learn" can only be achieved through academic training at the universities.

A number of research studies (e.g. Coleman, 1998) have confirmed that students retain only 10 per cent of what they read and only 20 per cent of what they hear. However, if a problem is simulated, then up to 90 per cent of the lessons learned may be retained. This finding is behind the shift in the pedagogical doctrine toward project work and problem-based learning. It emphasizes learning instead of teaching. Learning is not like pouring water into a glass. Learning is an active process of investigation and creation based on the learners` interest, curiosity and experience and should result in expanded insights, knowledge and skills (Kolmos, 1996).

A consequence of this shift from teaching to learning is that *the task of the teacher is altered from the transferring of knowledge into facilitating learning.* Project work also fulfils an important pedagogical objective. Student must be able to explain the results of their studies and investigations to other students in the group. This skill appears to be vital to professional and theoretical cognition: *Knowledge is only established for real when one is able to explain this knowledge to others.* In traditional education the students restore knowledge presented by the teacher. When the project organized model is used, the knowledge is established through investigations and through discussion between the student members of the project group, and mainly without the presence of the teacher.

5. PROJECT-ORGANIZED AND PROBLEM BASED LEARNING

The PBL approach applied at Aalborg University is both project-organised and problem- based. In order to provide for the use of project work as the basic educational methodology the curriculum has to be organised into general subjects or "themes" normally covering a semester. The themes chosen in a programme must be generalised in such a way, that the themes in total will constitute the general aim or professional profile of the curriculum. The themes must provide for studying the core elements of the subjects included (through the lecture courses given) as well as exploring (through the project work) the application of the subjects in professional practice. The principles of project-organised and problem-based learning are shown in figure 2 below (Kjaersdam and Enemark, 1994).

Real life problems are not defined in surveying/engineering terms. Therefore Problems analysis and formulation of the problem in surveying/engineering terms is important before staring the problem solving problems. Through this process the students also develop skills for communications and documentation of the results – as is the case in real life.

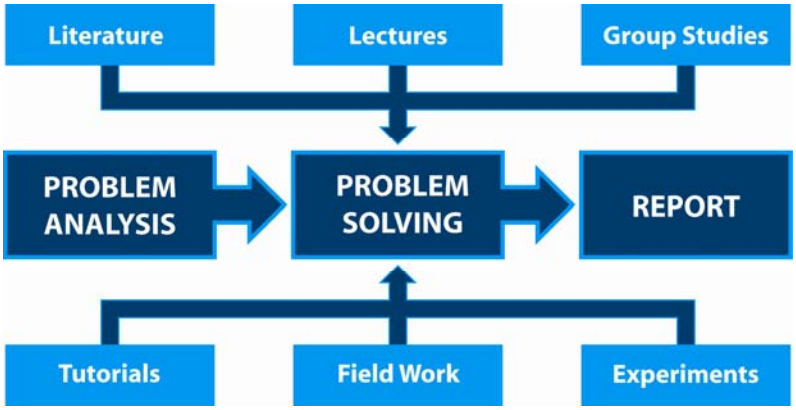

Fig 3. Principles of project-organised and problem-based learning

Project-organized means that traditional taught courses and labs is replaced by project work assisted by lecture courses. The project-organized concept moves the perspective from description and analyzing into synthesizing and assessment. The concept is based on a dialectic interaction between the subjects taught in the lecture courses and the problems dealt with in the project work. Each term has a basic structure containing, in principle, equal distribution of lecture courses and project work. But the study-time is dominated by lecture courses at the beginning of the term and by project work at the end. The project work is carried out by groups of four to six students having a teacher appointed as their supervisor.

Problem-based means that traditional textbook-knowledge is replaced by the knowledge necessary to solve theoretical problems. The problem-based concept moves the perspective from understanding of common knowledge into ability to develop new knowledge. The aim of the project work is "learning by doing" or "action learning". The project work may be organized by using a "know-how" approach for training professional functions, or it may be organized by using a "know-why" approach for training methodological skills of problem-analysis and application. The former is normally applied in first half of the curriculum where the necessary disciplines are taught in the lecture courses. The latter is applied in the second half of the curriculum and is supported by lecture courses presenting the necessary theories within the specific professional areas.

The difference between traditional subject-oriented education and this project-oriented educational model may be expressed in short by an old Chinese proverb:

"Tell me and I will forget
Show me and I will remember
Involve me and I will understand
Step back and I will act"

5.1 Curriculum design

In order to provide for the use of project work as a basic educational element the curriculum has to be organised into general subjects or "themes" normally covering a semester. The themes chosen in a programme must be generalised in such a way, that the themes in total will constitute the general aim or professional profile of the curriculum. The themes should provide for studying the core elements of the subjects included (through the lecture courses given) as well as exploring (through the project work) the application of the subjects in professional practice. The curriculum for educating chartered surveyors (Fig 4.) may be used as an example to illustrate the selection of themes as well as to explain the adaptability of the educational model.

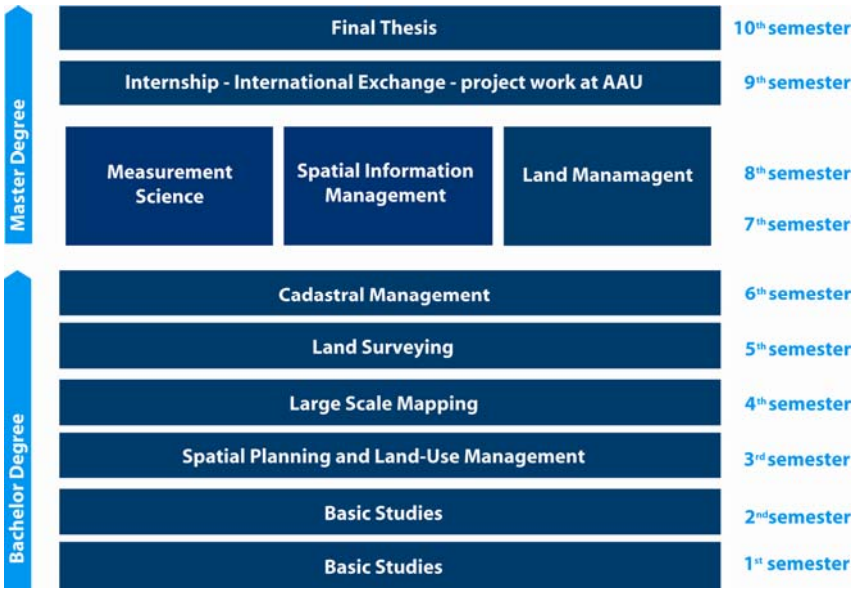

Fig. 4. The curriculum for educating chartered surveyors at Aalborg University, Denmark

Each semester has a basic structure containing, in principle, an equal distribution of lecture courses and project-work. But the study-time is dominated by courses at the beginning of the semester and term and by project-work at the end.

There are two types of lecture courses: curriculum related courses and project related courses. The aim of the curriculum related courses is to establish the necessary fundamental and general scientific knowledge in relation to the curriculum. The aim of the project related courses is to deal with the theoretical and professional contents of the theme. The professional and discipline oriented approach dominate the lecture courses given in the undergraduate studies, while the theoretical and scientific approach dominate lecture courses given at the graduate level. In the entire curriculum 50% of the study time is spend on project, 25% on lecture courses related to the project work, and 25% on lecture curses related to the curriculum.

The aim of the project-work is "learning by doing" or "action learning". The professional skills are established during the discipline-based project-work, which is dominating at 3-6 semester.

The professional cognition and the methodical skills are established during the problem-based project-work at 7-10 semesters where the ability of carrying out independent investigations on a scientific interdisciplinary basis is trained. Also the ability of presenting independent conclusions and the ability of finishing the project in time is trained. In fact the process of the project-work at this stage is very similar to the problem-solving process in practice.

4. THE ONLY CONSTANT IS CHANGE – Case study Denmark

The professional profile of the Danish surveyor is a combination of technical, judicial and design areas. The profile thus is a mix of an engineer, a layer and an architect. The professional fields then consist of three areas: surveying and mapping, land administration (including cadastral management), and land management (including spatial planning). Cadastral tasks are the monopoly of licensed surveyors in private practice, and the role of this private surveyor has traditionally epitomised the Danish surveyor. However, both the structure of the surveying profession and the profile of the Danish surveyor are turned upside down through the latest two or three decades.

Since the late 1960´s the Danish Association of Chartered Surveyors has carried out a survey of the surveying profession every 10 years starting in 1967. The changes taken place over these 30 years and especially over the latest two decades are quite remarkable. The evolution of surveying profession in Denmark is shown in the figure 5 below.

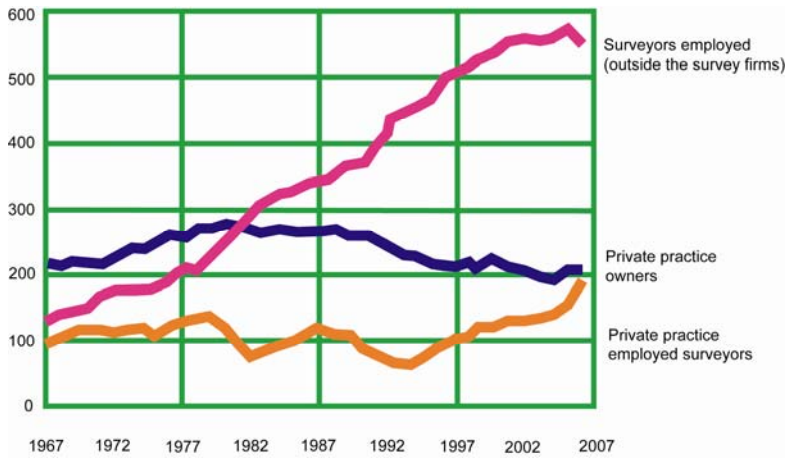

Fig. 5. The evolution of surveying profession in Denmark

In 1967 the number of surveyors working in the private surveying firms accounted for about two thirds of the total profession while surveyors employed in the public sector or in other private business accounted for only one third. In 1997 the situation is reversed. Two thirds of the profession is employed outside the private surveying firms. During these 30 years the number of active surveyors is doubled from about 450 in 1967 to about 850 in 1997. This means that the growth is located within the surveyors employed in the public sector or other private business while the number of surveyors working in the private surveying firms has been more or less steady over during the last 40 years.

Over the same period, the general professional profile has changed completely. In 1967 and still in1977 the profile of the Danish surveyor was dominated by the cadastral area while in 1997 it accounts for only 20 percent of the total working hours. In 1997 the distribution was as follows: Planning and Land Management 23 %, Cadastral Work 20 %, Mapping and Engineering Surveys 26 %, and "Other Areas" 31%. Next to the decrease in the cadastral area it is remarkable that the biggest area in 1997 is located outside the traditional working areas. These "other task areas" include general management, general IT-development, and other business developments. The evolution of the professional profile in Denmark is shown in the diagram below. It will be interesting to see the results of the next survey being carried out in 2007.

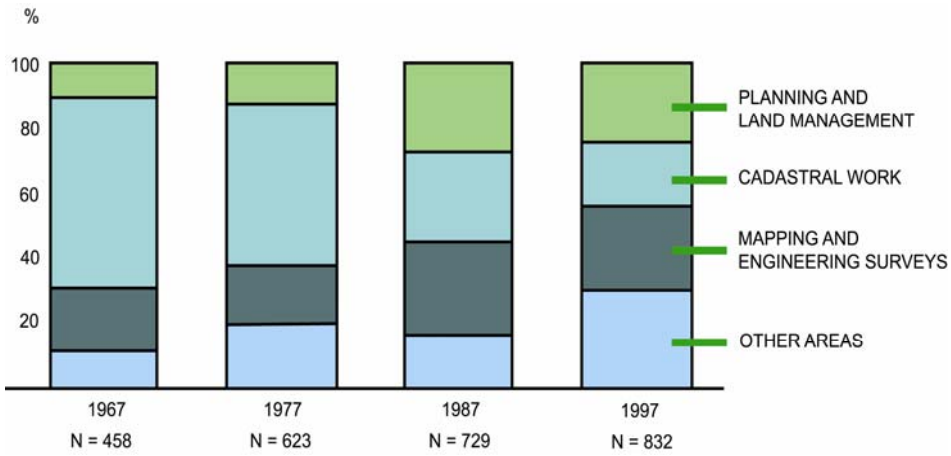

Fig. 6. The evolution the professional profile of the Danish Surveyor

The changes shown above are significant and must of course be reflected in content and structure of the educational base. In fact, the changes have been coped with rather easily within the profession and also with regard to the labour market. It is safe to assume that this is mainly due to the flexible and easily adaptable educational model that was introduced in 1974 when the surveying programme was moved from the Royal Veterinary and Agricultural Academy in Copenhagen to a new university established in Aalborg.

5. THE EDUCATIONAL CHALLENGE

The developments as discussed above have a significant educational impact. There is a need to change the focus from being seen very much as an engineering discipline. There is a need for a more managerial and interdisciplinary focus. The strength of our profession lies in its multidisciplinary approach.

Surveying and mapping are clearly technical disciplines (within natural and technical science) while cadastre, land management and spatial planning are judicial or managerial disciplines (within social science). The identity of the surveying profession and its educational base therefore should be in the management of spatial data, with links to the technical as well as social sciences.

The universities should act as the main facilitator within the process of forming and promoting the future identity of the surveying profession. Here, the area GIS and, especially, the area managing geographical and spatial information should be the core component of the identity. This responsibility or duty of the universities, then, should be carried out in close co-operation with the industry and the professional institutions.

The challenge of the future will to implement the new IT-paradigm and this new multidisciplinary approach into the traditional educational programmes in surveying and engineering. A future educational profile in this area should be composed by the areas of Measurement Science and Land Administration and supported by and embedding in a broad multidisciplinary paradigm of Spatial Information Management. Such a profile was promoted at the FIG/CLGE seminar on Enhancing Professional Competence of the Surveyor in Europe, held in Delft, November 2000, and increasingly it seems to become generally accepted world wide. The profile is illustrated in figure 7 below (Enemark and Prendergast, 2001).

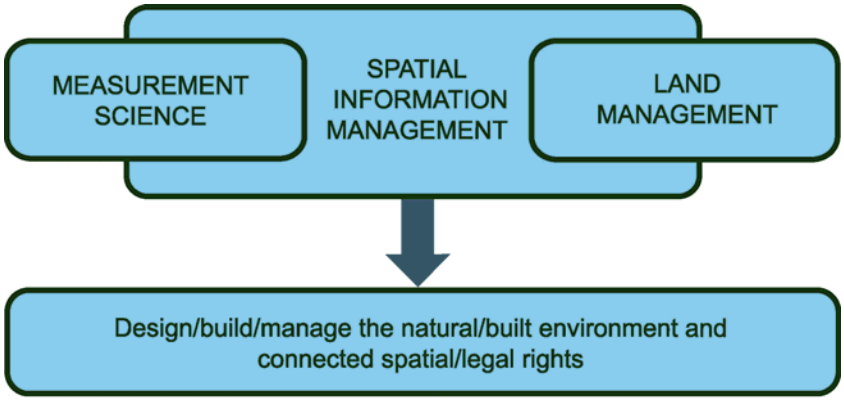

Figure 7. The educational profile of the future

Both in Europe and in US there are examples of surveying programs being closed down due to the fact that they have insisted on maintaining the traditional technical focus and have not changed to comply with a more interdisciplinary approach. On the opposite, programs that have changed to comply with a broader and more interdisciplinary approach seem to flourish.

The affiliation with engineering science has served the surveying discipline well. However, the future will possibly rather point at an alliance with Geography based on Spatial Information Management and focusing on Land Management. There will still be a need for teaching the basic skills within measurement and mapping, and it should still be possible to specialize within these areas. We must, however, be aware that the GPS technology makes these disciplines available also for many other professions and for non-professionals as well.

6. THE MANAGERIAL CHALLENGE

The managerial challenge relates to a range of issues that will all have an impact on running the programmes. Three key areas can be identified in terms management challenges:

Structural changes. These may relate to changes in departmental structures that may impact the educational profile; available resources are always a key factor and these may not be stable; and the student base may vary a lot over the years. At national level changes may occur in relation to governmental responsibilities, performance criteria, and resources allocated to the universities. International agreements, such as the Bologna Agreement within the European Union, may also causes a whole range of structural changes that impact both the educational profile and the way it should be managed. Structural changes often jeopardise educational programmes and call for leadership focusing on visions, processes, and outcome in terms of professional competence of the graduates.

Quality assurance. The capability and the quality of the programmes should be assessed continually within the educational system itself. Such a system of internal monitoring serves the purpose of quality management with regard to the relevance and quality of the lecture courses as well as the quality of the entire semester concerning supervising, organisation and resources. Ideally the system of quality management should be built into the educational model, and the processes should be described in the "Handbook of Quality Control". These processes should be carefully designed to underline the common responsibility for improving the quality of programmes as well as the quality of the total study environment. The development and implementation of such a system is basically about creating a quality culture. The students play a very key role in the process. The students at each semester should understand that only by fulfilling the duty of a serious evaluation of the past semester they can enjoy the benefits of commencing an improved up-coming semester themselves. Procedures for quality assurance are a must and, ideally, they should form an ongoing circle of quality improvement (see FIG publication no. 19, 1999)

Accreditation, monitoring and assessment. Procedures for accreditation vary a lot through the world and also within regions of the world. Basically accreditation is about evaluating whether a certain program meets some minimum standard criteria. Such systems of accreditation tend to become the norm at national as well as international level. Design of an adequate system of quality assurance is important in this regard. It is also important to establish adequate systems of monitoring the labour market both in terms of in terms of employment of the graduates and in terms of the whether the competences of the graduates meet the demands of the various employment areas. Such documentation is increasingly important as a tool of justification but also as a tool for strategic management and curriculum development. Assessment of such monitoring should be carried out in cooperation with representatives from the employment areas e.g. by establishing an "Advisory Board" with representatives from the key employment areas, representatives from the faculty staff, the students, as well the professional association. Such a forum may also discuss the balance between the different areas in the program, and thereby identify any needs for adjustments in relation to the demands of the various employment areas. The forum may also discuss the interaction between the university program and various activities of continuing professional development.

7. THE PROFESSIONAL CHALLENGE

The term professional competence relates to a status as an expert. This status cannot be achieved only through university graduation and it cannot be achieved solely through professional practice. University graduation is no longer a ticket for a lifelong professional carrier. Today one must qualify constantly just to keep up. The idea of "learning for life" is replaced by the concept of lifelong learning. No longer can "keeping up to date" be optional, it is increasingly central to organisational and professional success.

The response of the surveying profession, and many other professions, to this challenge has been to promote the concept of continuing professional development (CPD) as a code of practice to be followed by the individual professionals on a mandatory or voluntary basis. Maintaining and developing professional competence is of course the responsibility of the individual practitioner. This duty should be executed by adopting a personal strategy which must be followed systematically. Implementation of such a plan, however, relies on a variety of training options to be offered by different course providers, including the universities (see publication no. 16, 1996).

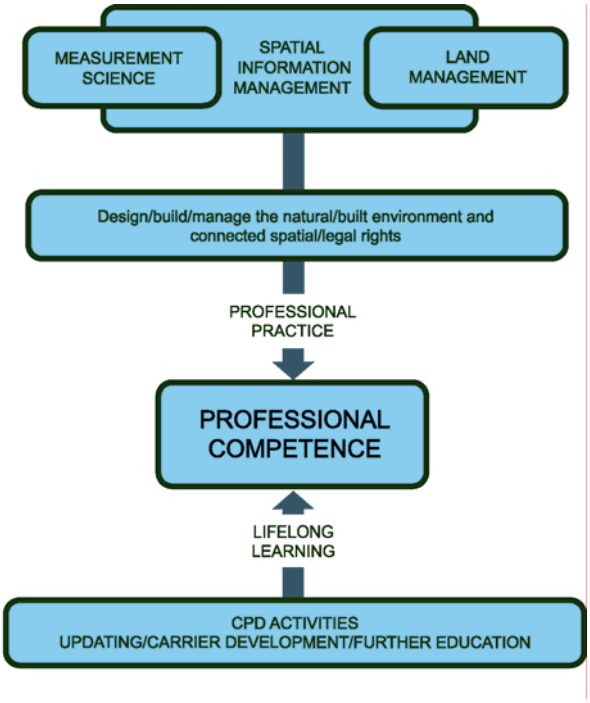

Fig. 8. The professional competence model

The individual practitioner should be able to rely on a comprehensive CPD concept which is generally acknowledged by the profession and which is economically supported by the industry (public as well as private). Furthermore, the practitioner should have a variety of training and development options available for implementation of his or her personal plan of

action. The options should be developed by the universities offering for example one-year masters courses as part time studies based on distance learning; and also by private course providers offering short courses for updating and just-in-time training. These options should be developed in co-operation between the universities, the industry and the professional associations.

Furthermore, the individual practitioner should be able to rely on a comprehensive concept for getting his or her professional competence recognised in a regional and global context. There is an attraction in developing and extending such a principle of Mutual Recognition of Professional Qualifications. Mutual recognition allows each country to retain its own kind of professional education and training because it is based, not on the process of achieving professional qualifications, but on the nature and quality of the outcome of that process. In turn this should lead to enhancement of the global professional competence of the surveying profession. And the national associations as well as the universities should play a key role in facilitating this process (see FIG publication no. 27, 2002).

In short, enhancement of professional competence relies on an efficient interaction between education, research and professional practice. To facilitate this interaction – based on mutual respect - is the true challenge of the new millennium.

8. FINAL REMARKS

Even if the content of surveying curricula may vary between countries, some general trends can be identified. There is clearly a trend towards increased focus on managerial issues and the acquisition and application of interdisciplinary problem-solving skills. Regarding course delivery, there is a trend towards increased use of project-based education as well as skills for teamwork, co-operation and communication. And web based learning tends to become an integrated tool for course delivery.

The challenge of the future will be to apply the new IT-paradigm and a new interdisciplinary approach to surveying education. Furthermore, it should be recognised that the only constant in the future is change. To deal with such significant change the educational base must be flexible. The graduates must process skills to adapt to a rapidly changing labour market and they must process skills to deal even with the unknown problems of the future. Therefore, skills for learning to learn have become increasingly essential.

The paper identifies three major challenges in terms of curriculum development. These relates to the educational profile, the managerial qualifications, and the professional competence of the graduates. Each of these challenges is analyzed in some length.

The paper states that curriculum innovation essentially depends on establishing an efficient interaction between education, research and professional practice as the key driver.

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