SURVEYING IN THE THIRD MILLENNIUM:
UNIVERITARY FORMATION AND PROFESSIONAL DEVELOPMENT
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Educating Surveyors for Land Management
-facing the challenges of the new millennium

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SUMMARY

Land management includes the management of land as a resource from both an environmental and an economic perspective towards sustainable development. The paper presents a global model for understanding the broad role of the cadastre in this area. The Nordic way is described, and the Danish evolution towards a global land management approach is presented.

Taking this land management approach to surveying education, it is argued that 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 as a basis for developing and running adequate systems of land administration. The educational impact of this approach relates to both the structure and content of university curricula for surveyors as well as to the demands for updating of surveying professionals.

An interdisciplinary approach to surveying education includes the need to address the issues and problems in a full context just like the issues appear in the real world. The combination of different disciplines can be taught through a "learning by doing approach". Problem solving skills can be taught through a project-oriented approach to surveying education with a focus on developing skills for "learning to learn". The basis principles of this educational model are presented using the surveying programme at Aalborg University as an example.

University graduation should, however, not be seen as the end in itself but as only the first step in a lifelong educational process. It is argued that the challenge of the new millennium will be to establish a new balance between the universities and professional practice. This new balance should allow the professionals to interact with the universities and thereby get access to continual updating of their professional skills in a lifelong perspective.

THE GLOBAL CHALLENGES

The main global drivers for change in the spatial information world can be identified as technology development, micro-economic reform, globalisation, and sustainable development (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.

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 profession and practice. Some of these are due to evolution of technology and some are due to institutional changes as a consequence of political and economical development in individual countries. 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 of the so-called information age will be to integrate modern surveying technology into a broader process of problem solving and decision making. We must assess carefully what range of skills will be required of those entering, and continuing within, the modern occupational world of surveying.

THE ROLE OF THE CADASTRE

The International Federation of Surveyors (FIG, 1995) defines a cadastre as a parcel based and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (valuation and taxation), legal purposes (conveyancing), to assist in the management of land and land-use planning (planning and administration), and enables sustainable development and environmental improvement.

The cadastral infrastructure includes a unique identification of the land parcels deriving from the cadastral surveys. The cadastral identification is then seen as the core component of any land information system. It is argued that within the next ten years such land information systems will form an integral part of a model of our man made and natural environment. The model will build on the core cadastral and topographic data sets which will be complete on a country wide basis and kept up-to- date. The focus will be on providing land information to the mass market to support the land market, financial and business sectors, environmental management, land administration, urban systems and community information systems.

A vision for the future role of the cadastre in a global land management perspective should reflect this scenario of IT development. This means that the cadastral systems must provide adequate information on the land parcels to be presented in a variety of interfaces. The design and maintenance of cadastral systems must reflect this multi-purpose use.

A cadastral vision of the future, as presented in the UN Bogor Declaration 1996, is to: “develop modern cadastral infrastructures that facilitate efficient land and property markets, protect the land rights of all, and support long term sustainable development and land management”.

In Figure 1, the cadastral system is seen as the basic infrastructure to support the different systems in the area of land management.

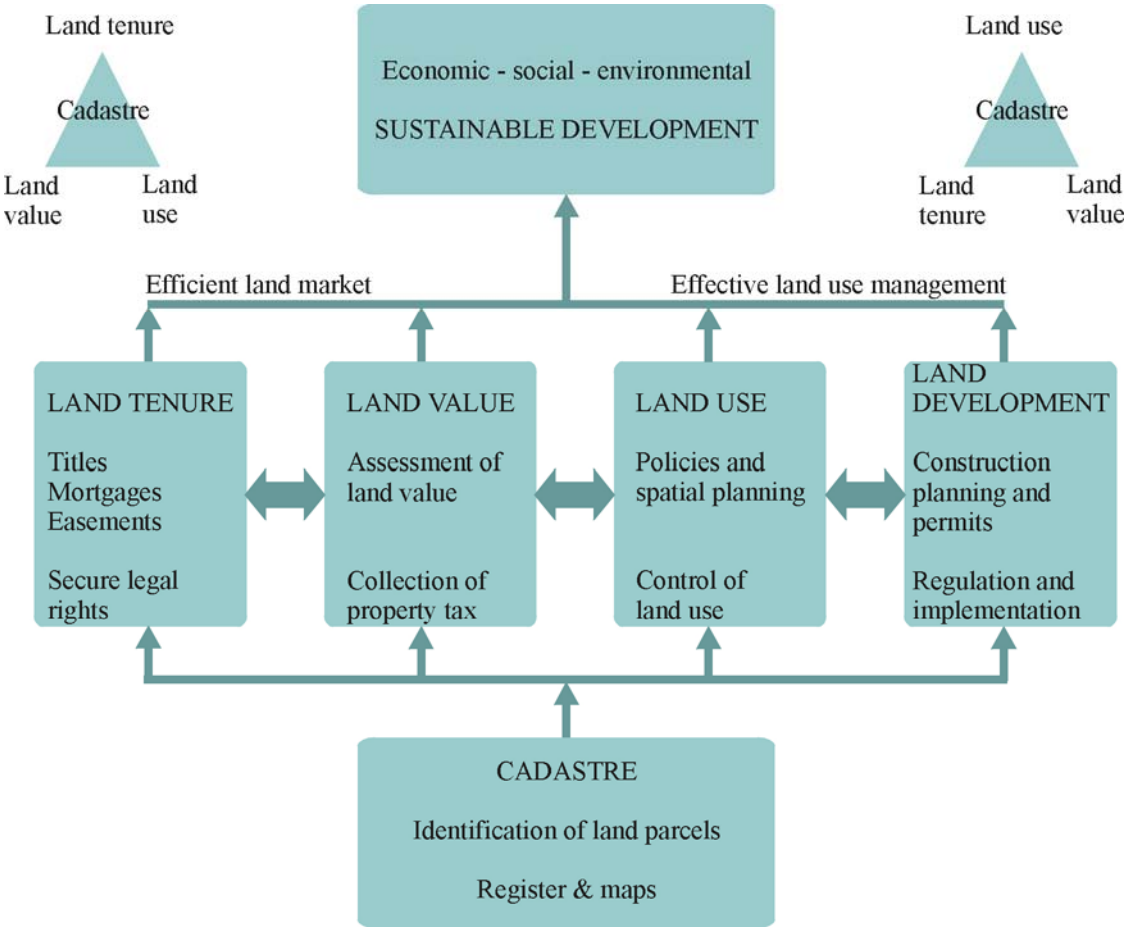

Figure 1. The role of the cadastre to facilitate an efficient land market and effective land use administration (Enemark and Sevatdal, 1999)

The systems supported by the cadastral infrastructure are:

- Land Tenure System, to secure legal rights in land such as titles, mortgage and easements
- Land Value System, to assess the value of land and properties and to levy land taxes
- Land-Use Control System, to enable comprehensive and detailed land use planning
- Land Development System, to enable regulation and implementation in change of land use.

These systems are interrelated. The actual economic and physical use of land and properties influences the land value. The land value is also influenced by the possible future use of land as determined through zoning and land-use planning regulations. And the land-use planning and policies will, of course, determine and regulate the future land development.

The design of adequate systems in the area of Land Tenure and Land Value should lead to the establishment of an efficient land market; and the design of adequate systems in the areas of Land-Use Control and Land Development should lead to an effective land-use administration. The combination of an efficient land market and an effective land-

use administration should then form the basis for a sustainable approach to economic, social and environmental development.

The cadastral identification of land parcels permeates through the land administration and land management systems and provides the basic infrastructure for running the interrelated systems within the areas of Land Tenure, Land Value, and Land Use. As a result, the traditional surveying, mapping and land registration focus have moved away from being primarily provider-driven to now being clearly user-driven. However, each of those systems includes tasks and processes that impose quite different demands on the cadastral system. The success of a cadastral system is a function of how well it achieves these broad social and economic objectives

A GLOBAL LAND MANAGEMENT APPROACH

Throughout the world, the cadastral concept has developed significantly over the past few decades. During this time these systems, whether developed from a land market or a land taxation perspective, have increasingly played a multi-purpose role. The most recent examples are current world concerns of environmental management, sustainable development and social justice. Due to this, multi-purpose cadastres are increasingly seen as fundamental to economic development, environmental management and social stability in both the developed and developing worlds (Williamson and Ting 1999). The cumulative evolution of the humankind/land relationship and the consequent developments in the evolution of cadastres towards a global land management approach are shown in Figure 2.

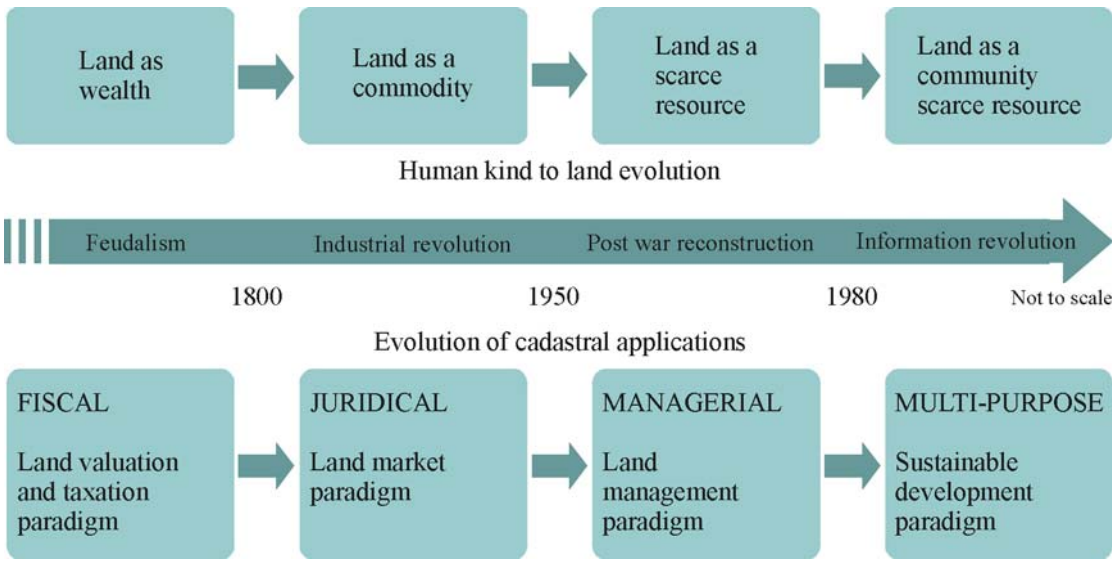

Figure 2. Evolution of Western Land Administration Systems (developed from Williamson and Ting, 1999)

THE DANISH EVOLUTION

The Danish cadastre, which derived from the results of the enclosure movement, was established in the year 1844. The main purpose was the collection of land taxes from the agricultural holdings based on a valuation of the yielding capacity of the soil.

From the beginning the cadastre consisted of two parts: the cadastral register and the cadastral maps. Both of these components have been updated continually ever since. As a result, the cadastre was also used to support the land ownership and land transfer system. The Land Registry System was established in 1845 at the local district courts for recording and protecting legal rights of ownership, mortgage and easements.

In the late 1800´s the cadastre changed from being a fiscal cadastre primarily as a basis for land valuation and taxation to a legal cadastre supporting a growing land market. This evolution was completed in the first years of the 1900´s when taxation became based on the market value. Simultaneously, in the 1920´s a new Land Book System was established. The new system was based on the cadastral identification and a close interaction between the two systems was established.

During the first half of the 1900´s land was increasingly seen as a commodity and the focus was on agricultural production and industrial revolution. Land-use regulations were introduced to improve agricultural productivity and at the same time sustain the social living conditions in the rural areas. These regulations were based on the cadastral information. The yielding valuation unit was used to control development in the rural areas until the late 1960´s.

The 1960´s introduced a close interaction between the cadastral process (e.g. subdivision) and the relevant land-use regulations. Any property formation or change of property boundaries must include the necessary documentation showing the approval of the future land use according to relevant planning regulations and land-use laws. The cadastral process performed by the private land surveyors this way must include a pre-approval of the future land use.

An administrative reform was adopted in the early 1970´s to reorganise regional and local administration. The reform reduced the number of counties from 25 to 14 and the number of local authorities from almost 1,400 to 275. The reorganisation created the basis for transferring a number of responsibilities and decision-making power to the counties and especially to the municipal councils by means of decentralisation. Each authority levies taxes (income and land taxes) and the elected councillors are responsible for utilising the revenue. Today, the local authorities administer more than 50 % of the total public expenditure.

Land was increasingly seen as a community scarce resource and zoning and planning regulations were introduced to control land development. Environmental concerns appeared in the late 1970´s and have developed to be the major issue through recent years. Today, comprehensive planning and environmental protection is seen as the main tools to secure sustainable development. Cadastral information based on the modern IT-opportunities has evolved to support these processes of sustainable land management.

THE NORDIC WAY

Cadastral systems have a long history in the Nordic countries. Historically the purpose of the cadastre was to collect land taxes. Today the cadastre has a much broader objective, and it is accepted that when cadastral information is a part of integrated information systems, it can improve the efficiency of the land transfer process as well as the overall process of land management.

The structure of the cadastral systems, however, varies between the Nordic countries according to the cultural and judicial setting of the individual country. (Enemark, 1998). The Norwegian cadastral system is presently being revised. A new cadastral law is under preparation to come into force by the year 2001/2002. As a result of the new law the Danish and Norwegian systems are now coming closer together, just like the systems in Sweden and Finland are rooted in the same tradition. However, as a common trend in all the Nordic countries there is a development towards a multipurpose use of computerised cadastral information through interactive GIS-systems and through the Internet.

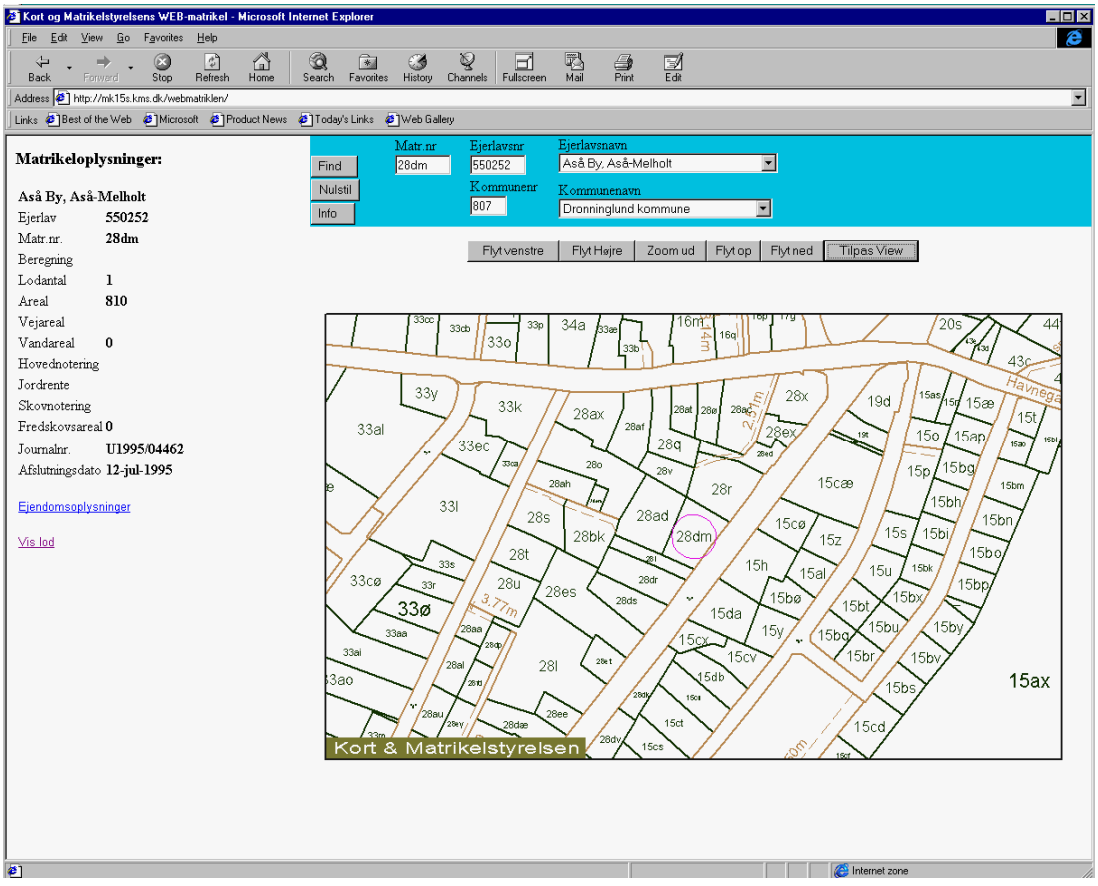

Figure 3. The Danish cadastral information system on the Internet. The textual information is presented on the left side of the screen by pointing on the relevant property (circled) in the map or by asking for this property by cadastral number or address. Zoom facilities etc. is available as well.

INTERNATIONAL TRENDS IN SURVEYING EDUCATION

Management skills, versus specialist skills. The changes in the surveying profession and practice and especially the development of new push button technologies has voiced the need for including the core discipline of management as a basic element in today's surveying education. Traditional specialist skills are no longer sufficient or adequate to serve the client base. Surveyors need to have the skill to plan and manage diverse projects, including not only technical skills, but those of other professions as well. In short, *the modern surveyor has to be capable not only of managing within change but managing the change itself.*

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 of the project work is "learning by doing" or "action learning". The project work is problem-based meaning that traditional textbook knowledge is replaced by the necessary knowledge to solve theoretical and practical problems from the society/reality. *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. In 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). The basic principles of this project-oriented educational model are presented below using the surveying programme at Aalborg University as an example.

Virtual academy, versus classroom lecture courses. There is no doubt that traditional classroom lecturing will be supported by or even replaced by virtual media. The use of distance learning and the www tends to be integrated tools for course delivery, which may lead to the establishment of the "virtual classroom" even at a global level. 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.*

A LAND MANAGEMENT APPROACH TO SURVEYING EDUCATION

Taking a land market approach to surveying education, 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 as a basis for developing and running adequate systems of land administration.

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 systems of land administration have moved away from being ”provider” driven to now being “user” driven. They are interdisciplinary by nature and they will require skills for management and problem-solving in order to serve their clients. The ability to access, to interact with and to contribute to a wide range of public and private databases at a distance will become the norm in many areas of surveying. Again, this will change the skill-base of the surveying workforce, the structure of the organisation and, especially, the tasks of those surveyors holding managerial responsibilities.

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 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.

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.

LEARNING TO LEARN – THE DANISH EXPERIENCE

The educational base must be flexible and easily adaptable. Management skills and skills for learning to learn is a must.

As mentioned and proved above, the graduates must possess skills to adapt to a quickly changing labour market and they must possess skills to deal even with the unknown problems of the future. This demand for adaptability can only be provided through skills for learning to learn. In this sense, the project-organised educational approach at Aalborg University has proved to be very successful.

Recent studies (Coleman, 1998) have confirmed that students retain only 10% of what they read and only 20% of what they hear. However, if a problem is simulated, then up to 90% of the lessons learned may be retained. This is one of the major pedagogical ideas beyond both project work and problem-based learning. It emphasises 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.

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 to learn.* The project work also has a pedagogical point. Each student must be able to explain the results of his or hers studies and investigations to student colleagues in the group. This demand may be the clue 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 mainly restore knowledge presented by the teacher. By using the project organised model the knowledge is established through investigations and through discussion between the students in the project group, and mainly without the presence of the teacher.

The basic principles of PROJECT-ORGANISED education

Project-organised means that traditional taught courses assisted by actual practice is replaced by project work assisted by courses. The concept moves the perspective from description and analysing into synthesising 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 supervisor.

Problem-based means that traditional textbook-knowledge is replaced by the necessary knowledge to solve theoretical problems. The 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 organised by using a "know-how" approach for training professional functions, or it may

be organised by using a "know-why" approach for training methodological skills of problem-analysis and application.

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"

The curriculum for educating Chartered Surveyors

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.

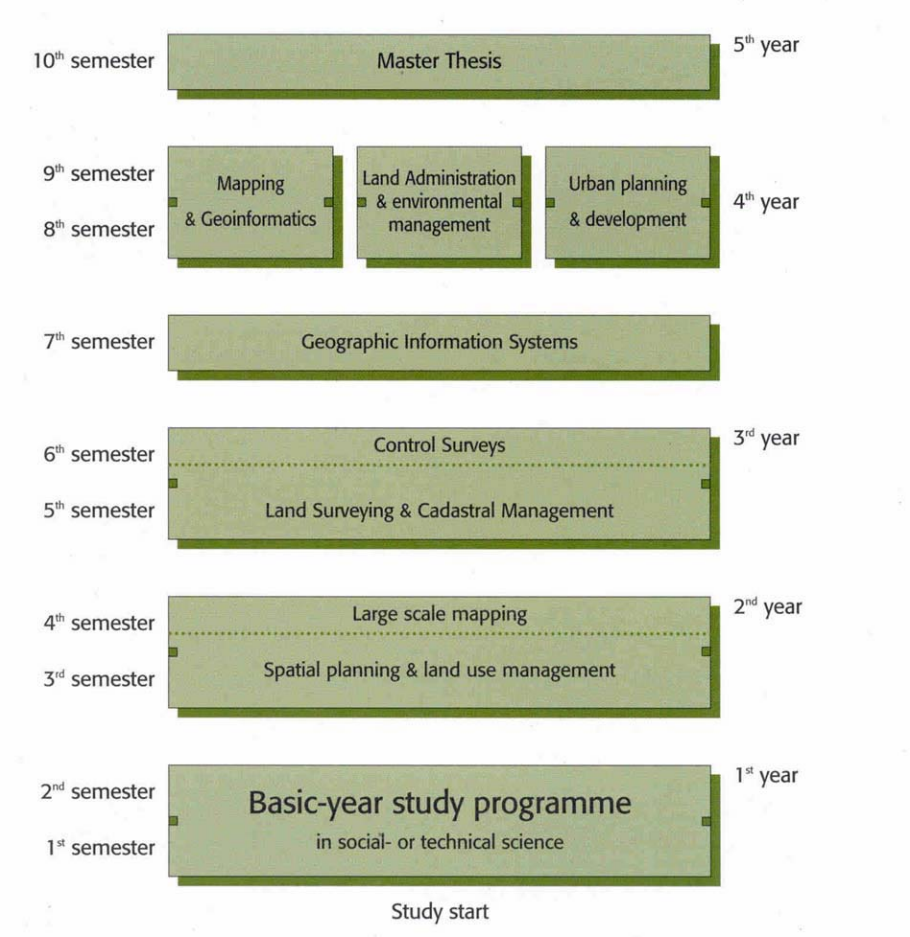

Figure 4. The curriculum for educating chartered surveyors.

The *first* phase, 1st and 2nd semesters, includes one year of basic studies within Engineering Science. The studies include courses on the fundamentals such as mathematics, physics, computer science, foreign languages, etc., and the basic skills for carrying out the problem-based project work are trained.

The *second* phase, the undergraduate studies at 3rd to 6th semesters, includes two years of studying the main professional areas for surveyors. The themes provide for teaching the necessary disciplines through lecture courses and for training the professional functions through the project work. This phase therefore is characterised by a *"know-how"* approach.

In the *third* phase, the graduate studies at 7th to 9th semester, the curriculum provides for the possibility of specialisation. This third phase of the curriculum therefore has a more scientific approach, based on *"know-why"*. The themes will provide for teaching the necessary theories within the specific professional areas, and for training the methodological skills of problem-analysis and application.

The *fourth* phase, the 10th semester, is only for preparing the master thesis, which is carried out as a project-work dealing with a problem chosen by the student group themselves. The master thesis then will prove the professional insight as well as the theoretical and methodological skills possessed by the graduate student, in principle just like a Ph.D. or Doctoral Thesis.

Flexibility and adaptability

The flexibility and adaptability of the educational structure may be explained under three headings:

- The adaptability of the *individual theme*. This means that the focus on subjects presented in the courses and dealt with during the project work are easily updated or changed according to the current technical and professional development in society. The subjects and contents of the courses given will be planned in advance before starting the semester, and will then reflect the most topical issues within professional practice.

- The adaptability of the *total curriculum*. This means that the focus of the themes in total may easily be adjusted or changed according to the needs and development of professional practice, and consistent with the current technological development

- The adaptability of the *graduates*. This means that each graduate will possess specialised knowledge within one of the three main areas (Mapping, Land Management or Spatial Planning). However, due to the basic knowledge established during the second phase of the curriculum and due to the methodological skills established during the project work, the graduates will also possess the insight to understand and adapt the interaction between the three main areas in total. (Kjersdam and Enemark, 1994).

Consequences of the project-organised model

The consequences of this educational model is, that the new graduates are less experienced in solving standard everyday problems as they will appear in a further

employment. On the other hand, they are expected to be much better qualified to undertake large and complicated tasks, to combine insight from different fields, to analyse new problems and to make themselves acquainted with new fields to which the problems of practice are related.

The aim is a broad insight into and understanding of the connections between different fields and skills, in order that the graduates may be able to function in a society, which is increasingly becoming more complicated. In principle it can thus be ensured that the graduates have obtained the skills and experience to enable them to solve also the unknown problems of the future.

LIFELONG LEARNING

University graduation is not the end in itself but only the fist step in a lifelong educational process.

There was a time when one qualified for life, once and for all. University graduation was the ticket for a lifelong professional career. This is no longer true. Today, one must qualify constantly just to keep up. The idea of "learning for life" is replaced by the concept of lifelong learning. The response of many professions to this challenge has been to promote the concept of Continuing Professional Development (CPD).

It has been estimated that the knowledge gained in a vocational degree course has an average life span of about four years. While this will vary according to the discipline it does nevertheless highlight the increasing need to maintain an active interest in keeping up to date with changing technology, legislation and operational procedures. If at the same time professionals have expectations of increased managerial responsibility the need to acquire new skills and knowledge is even more acute (Kennie and Enemark, 1996).

The Danish Way

In 1989 the Danish Government introduced the concept of Open Education and the system is now used widely by the universities - as well as many other educational institutions - to provide training courses for adults. The courses are heavily subsidised by the state for about two thirds of the costs. The universities have developed a number of courses to serve the need for further education of the graduate engineers within areas that recently have developed rapidly. The need for this kind of programmes is assessed in co-operation with the industry and the professional institutions (Enemark, 1997).

Distance Learning Course in Geographic Information Management

Within the area of Surveying, a post graduate course at Aalborg University was established in Geographic Information Management, starting September 1996. The course was developed in co-operation with the surveying industry and the Danish Association of Chartered Surveyors. The course is offered as a one-year part time study lasting for two

years, and it is organised as distance learning using an electronic classroom for teaching and communication. About 45 students (half of them surveyors) enrolled September 1996 and the programme is ongoing.

The course combines lecture courses (distance learning) with supervised project work based on professional problems identified by the practitioners within their respective employment areas. The students take part in four week-end seminars organised each year on campus to have class-room lecture courses and to discuss and develop their project work. Furthermore, the concept of distance learning provides the opportunity for the students to master communication through a fully digitised environment. By passing the final examination the students will obtain a degree as Master of Technology Management in Geographic Information Management.

In general, the concept seems to provide an innovative interaction between university and industry (Enemark, 1997). It is argued that the challenge of the new millennium will be to establish a new balance between the universities and professional practice. This new balance should allow the professionals to interact with the universities and thereby get access to continual updating of their professional skills in a lifelong perspective.

CLOSING REMARKS

Even if the content of surveying curricula may vary between countries, some general trends may 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 team-work, co-operation and communication. And web based learning tends to become an integrated tool for course delivery .

These trends seem to be consistent with the trends within development of adequate and efficient land administration systems. These systems have moved away from being ”provider” driven to now being “user” driven. They are interdisciplinary by nature and require skills for management and problem-solving.

The challenge of the future will be that the only constant 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. Skills for learning to learn become increasingly essential. In this sense, the project-oriented educational model at Aalborg University has proved to be successful.

The constant change will also underpin the necessity for an interaction between the design of university curricula at graduate level, and the design of adequate courses in the area of lifelong learning. This, again, underpins that University graduation must be seen as not the end in itself but as only the first step in a lifelong educational process.

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