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## LAND ADMINISTRATION SYSTEMS -a major challenge for the surveying profession

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### SUMMARY

The paper presents a global model for understanding Land Administration Systems in support of sustainable development. The evolution of these systems is described as a respond to the dynamic relation between humankind and land. The Nordic evolution is described with a focus to understand that any national land administration system is embedded in the cultural and judicial setting of the country or jurisdiction.

The issue of Spatial Information Infrastructures is discussed as an increasingly important component of achieving sustainable development in developed as well as developing countries. The conceptual, political and economic mechanisms are discussed and examples are given with regard to the Danish conceptual approach in this area.

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. It is argued that a future educational profile should be composed by the areas of Measurement Science and Land Management, and supported by and embedded in a broad interdisciplinary paradigm of Spatial Information Management.

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.

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.

## 1. INTRODUCTION

The last decade has seen moves towards establishment of fully digitised cadastral systems throughout the world. It is recognised that cadastral systems are not ends in themselves. They are key components of more global land administration systems. These systems are tailored to facilitate an efficient land market as well as effective land-use administration and thereby, more generally, promote economic development, social cohesion and sustainable development. Digital cadastral systems thus must serve a multi-purpose use and thereby meet the challenge of a modern GIS and IT environment.

New communication technologies and the WWW have a dramatic effect on the evolving spatial information marketplace. The use of GIS in modern land administration and decision-making require standards and access tools that guide the multipurpose use of the data. Adoption of policies on Spatial Information Infrastructures provides such guidance through design of adequate concepts for data sharing and management.

The evolution of modern land administration systems is seen as a major challenge to the surveying profession. The institutional impact is significant. Governments recognise the importance of spatial information to economic development and environmental management and government institutions as well as large private sector companies continue to evolve.

The spatial information revolution has also had many influences on educational and professional structures. Professions such as surveying are being re-engineered and re-invented to accommodate the spatial information revolution while endeavouring to maintain traditional services. At university level the impact on surveying has been very significant.

The challenge of the future will be to implement this new IT-paradigm and this new interdisciplinary approach into the traditional educational programmes in surveying and engineering.

## 2. 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 will be to integrate modern surveying technology into a broader process of problem solving and decision making.

### **3. A GLOBAL LAND ADMINISTRATION PERSPECTIVE**

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 countrywide 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 (Williamson, 1997).

A vision for the future role of the cadastre in a global land management perspective should reflect this scenario of IT development, and the design and maintenance of cadastral systems must reflect this multi-purpose use. In Figure 1, the cadastral system is seen as the basic infrastructure to support the different systems in the area of land management.

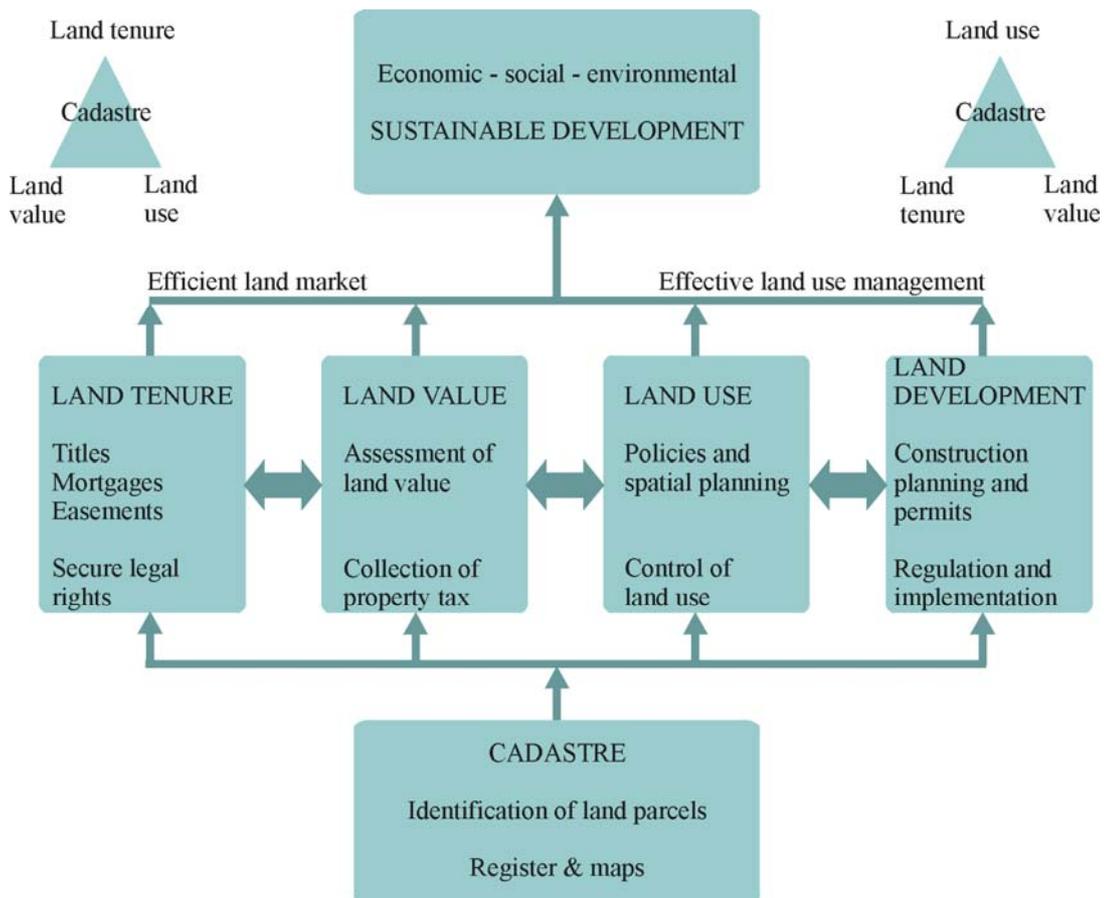


Figure 1. Land Administration Systems – a global approach (Enemark and Sevattal, 1999).

The systems supported by the cadastral infrastructure are:

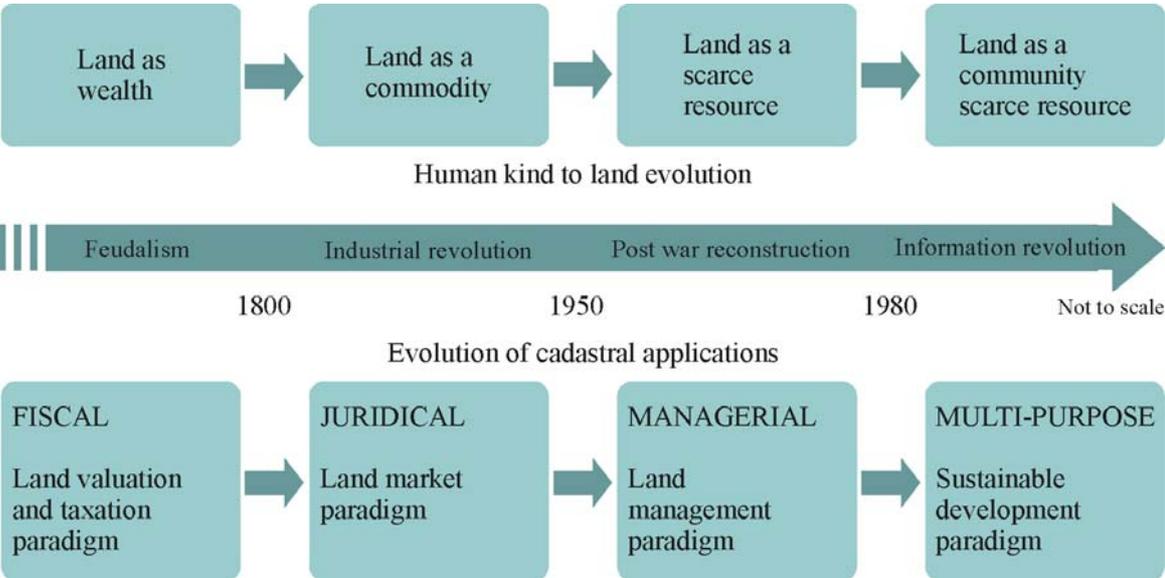
- Land Tenure System, to secure legal rights in land such as titles, mortgage and easements
- Land Value System, to assess the value of land and properties and to levy land taxes
- Land-Use Control System, to enable comprehensive and detailed land use planning
- Land Development System, to enable regulation 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 success of a cadastral system is a function of how well it achieves these broad social and economic objectives

**4. EVOLUTION OF LAND ADMINISTRATION SYSTEMS**

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 the below.



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

## 5. 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).

Country	Denmark	Norway	Sweden	Finland
<i>Area</i>	43,000 sq. Km	324,000 sq. Km	450,000 sq. km	337,000 sq. Km
<i>Population</i>	5.2 mill	4.2 mill	8.6 mill	5.0 mill
<i>Properties</i>	About 1,5 mill	About 2 mill	About 3 mill	about 2 mill
<i>National cadastral authority</i>	National Survey and Cadastre under the Ministry of Housing	National Mapping Authority under the Ministry of Environment	National Land Survey under the Ministry of Environment	National Land Survey under the Ministry of Agriculture
<i>Cadastral surveys</i>	Licensed surveyors in private practice	Municipal Survey Authorities; Licensed surveyors in private practice will be introduced	State Survey Authorities at county level; and some Municipal Survey Authorities	State Survey Authorities in rural districts; and some City Survey Authorities
<i>Property Register Authority (land parcels)</i>	National Survey and Cadastre maintaining the cadastral register and the digital cadastral maps.	Municipal Survey Authorities; and the National Survey Authority maintaining the GAB-register	County and Municipal Survey Authorities; and the National Land Survey maintaining the Land Data Bank System	District and City Survey Authorities and the National Land Survey maintaining the Real Estate Register
<i>Land Register Authority (title and mortgage)</i>	Local district courts (Ministry of Justice)	Local district courts (Ministry of Justice)	Local district courts (Ministry of Justice)	Local district courts (Ministry of Justice)
<i>Land Information System</i>	Interactive subsystems linked together through a Cross Reference Register	GAB – register linked with the Land Book	Land Data Bank System	Central Information System on Real Estate Data

Figure 3. Key characteristics of the cadastral systems in the Nordic countries.

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.

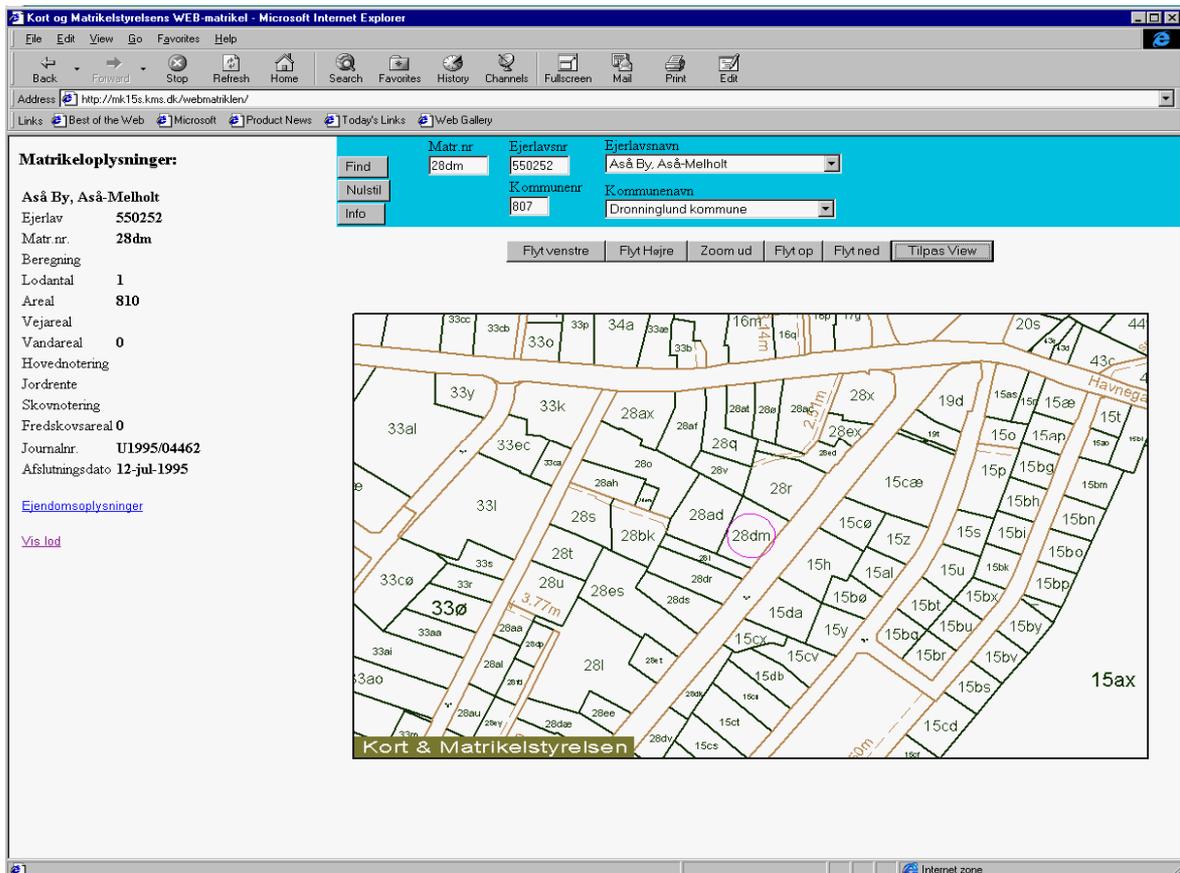


Figure 4. The Danish cadastral information system on the Internet. The textual information is presented on the left side of the screen by pointing on the relevant property (circled) in the map or by asking for this property by cadastral number or address. Zoom facilities etc. is available as well.

The cadastre is increasingly used as a basic instrument in the planning process. Some local authorities use the cadastre map as the basic layer in the municipal structure planning. This digital process provides a number of opportunities. The land-use regulations are easily identified on the relevant properties with links to the addresses and name of the owners. The detailed regulations such as zoning and building restrictions can be identified on the relevant properties and located according to the property boundaries. This facility is also used when presenting the planning regulations on the Internet. The citizens can then achieve any relevant planning information just by asking for the specific property.

The WWW is increasingly seen as the best alternative to delivering spatial information. Some government organisations are increasingly seeing their information strategy based on the WWW. The decentralised databases and map servers now allow government institutions to combine cadastral information with different kind land and property information that in an interactive way show the legal situation of land to any kind of Internet users.

The Danish municipal and county administrations increasingly present all relevant land use information including restrictions and responsibilities on the WWW. This trend is becoming vital to the management of land resources and it contributes to sharing also the democratic process of political decision-making regarding land use issues.

## 6. 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* (Hoogsteden, 1998).

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. *The aim is broad understanding 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. 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.*

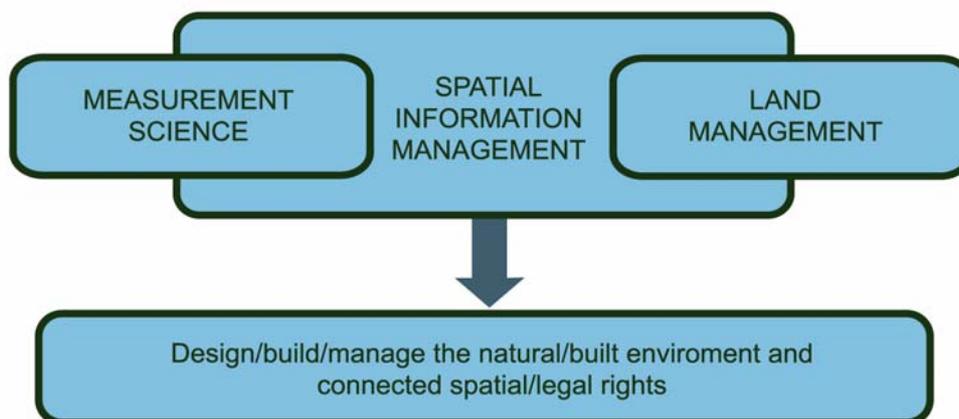
## 7. A LAND MANAGEMENT APPROACH TO SURVEYING EDUCATION

Taking a land management 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.

One of the main challenges of the future will to implement this new IT-paradigm and this new interdisciplinary 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 interdisciplinary paradigm of Geographic Information Management. Such a profile is illustrated in figure below.



*THE EDUCATIONAL PROFILE OF THE FUTURE*

Another 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.*

## **8. LEARNING TO LEARN – PROJECT INNOVATION**

**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 (Colemann, 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 at Aalborg University

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.

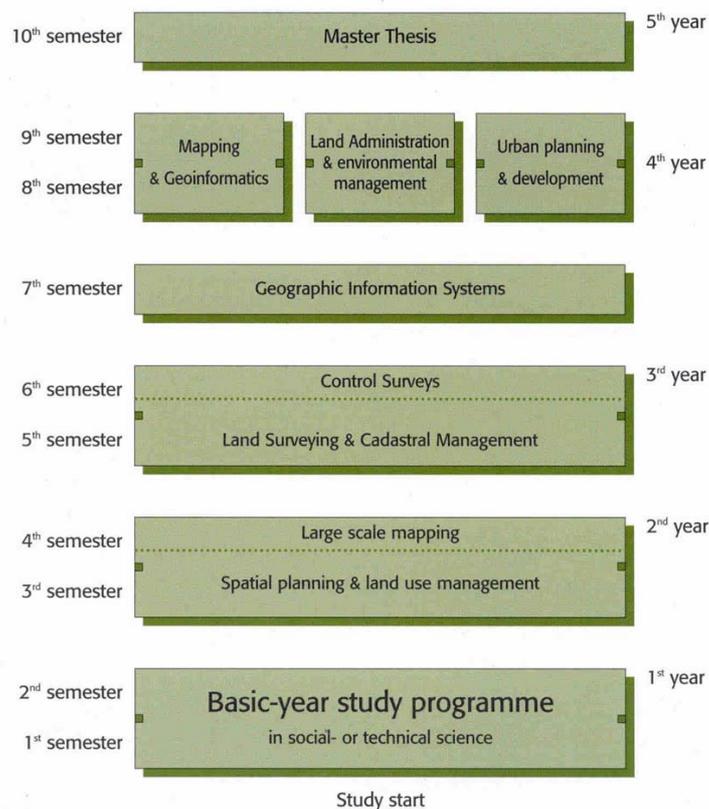


Figure 6. The curriculum for educating chartered surveyors.

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.

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.

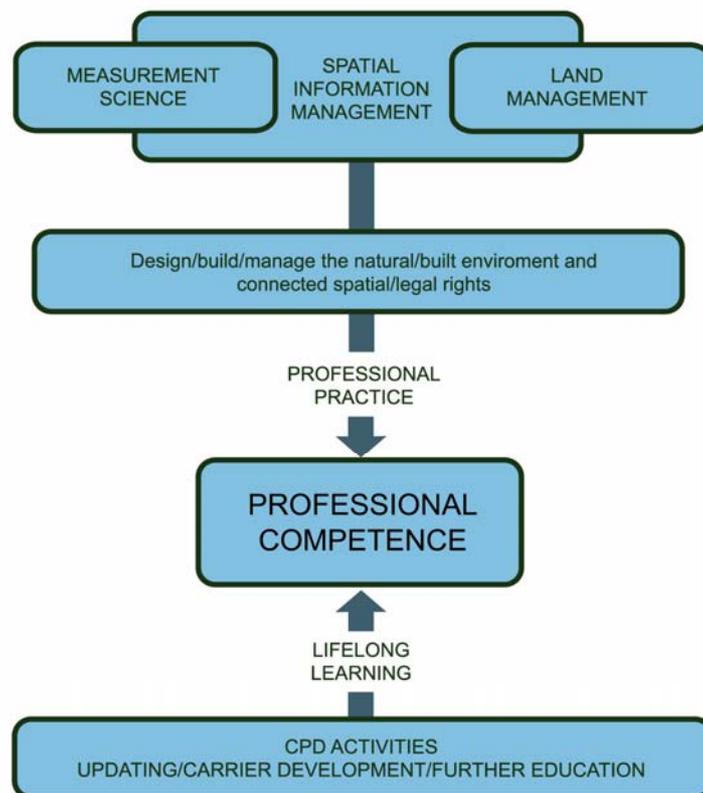
The aim is a broad insight into and understanding of the connections between different fields and skills, in order that the graduates may be able to function in a society, which is increasingly becoming more complicated. In principle it can thus be ensured that the graduates have obtained the skills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

## 9. LIFELONG LEARNING

**University graduation is not the end in itself but only the first 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 PROFESSIONAL COMPETENCE MODEL*

## **The Danish Way**

Open Education was launched by the Danish Government in 1989 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).

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 weekend seminars organised each year on campus to have classroom 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.*

## **Knowledge management – the challenge of the new IT-paradigm**

The role of the universities will have to be reengineered based on this new IT-paradigm. The key word will be knowledge-sharing. On-campus courses and distant learning courses will be integrated even if the delivery may be shaped in different ways. Existing lecture courses should always be available on the Web. Existing knowledge and research results should also be available, and packed in way tailored for use in different areas of professional practice. All graduates would then have access to the newest knowledge throughout their professional life.

A way forward could be establishment of web based platforms within the different professional areas. The content of these platforms should be peer reviewed just like the procedure for the professional journals. The platforms should be developed to include a local/national as well as an international approach. The international approach could be developed through agreements between leading universities throughout the world. This again could provide knowledge tailored for the international community and international aid organisations such as UN and the World Bank.

## 10. CLOSING REMARKS

The Bathurst Declaration (FIG/UN 1999) established a powerful link between appropriate land administration and sustainable development. This should also be seen as a result of the gradual evolution of land administration systems over time from a specific land tax and land market focus to a more managerial and multi-purpose role. This multi-purpose role should provide adequate spatial information infrastructures as a basis for sustainable decision making in all land-related matters. Sustainable development is not attainable without sound land administration.

It is recognised that cadastral systems are not ends in themselves. They are key components of more global land administration systems. These systems are tailored to facilitate an efficient land market as well as effective land-use administration and thereby, more generally, promote economic development, social cohesion and sustainable development

These developments have some significant educational impacts and, 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 teamwork, 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 to implement the new IT-paradigm and this 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 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. 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.

In this regard there will be a need 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 learning perspective.

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Prof. Stig Enemark is Head and Managing Director of the Surveying and Planning School at Aalborg University, where he is Reader in Cadastral Science and Land Management. He is Master of Science in Surveying, Planning and Land Management and he obtained his license for cadastral surveying in 1970. He worked for ten years as a consultant surveyor in private practice. He is Vice-President of the Danish Association of Chartered Surveyors and Invited Fellow of the Royal Institution of Chartered Surveyors, UK. He was awarded the Danish Real Estate Prize in 1991, and in 1994 he was appointed National Expert to the European Union within the areas of land management and spatial planning. He was Chairman (1994-98) of FIG Commission 2 (Professional Education) and in 1999 he was appointed an Honorary Member of FIG. His teaching and research interests are in the area of land administration systems and the application of cadastral systems for land management and spatial planning. Another research area is within project-organised educational and the interaction between education, research and professional practice. He has consulted and published widely within these topics, and presented invited papers at more than 40 international conferences.