

# **Building the Competences of the Future Designing and Implementing a New Curriculum in Surveying at Aalborg University, Denmark**

**Stig ENEMARK, Denmark**

**Key words:** Surveying Education, Competence Development, Curricula Development

## **SUMMARY**

What competences will be needed in the future? What kind of skills should belong to the surveyor of the future? How can the curriculum be organized to meet these demands? These questions must constantly be on the agenda to be dealt with by the university as well the profession. Competence development and capacity building are not only buzzwords – they represent the real demands to be met by today's the surveying programs.

This paper presents the latest revision of the surveying program at Aalborg University, Denmark. The revision is an answer to the so-called Bologna Agreement, while it is also an adaptation to international trends. Finally, the revision is based on a survey around the competences of the graduates, and whether these competences are in line with the demands of the employment areas.

The competences of the future are not established solely through the university program. Even if university education is of course the foundation, professional competence cannot be achieved until the academic and professional skills are merged with experiences obtained through professional practice. Therefore, it is crucial to establish an ongoing dialogue between the university, the profession, and the employers or the costumers. The Danish experience in this regard has been to establish a Surveyors' Advisory Board with representatives from the key employment areas to discuss the educational issues in a visionary perspective.

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## **1. INTRODUCTION**

The curriculum in Surveying at Aalborg University is relatively well known within the international surveying community due to a number of conference presentations throughout the years, and especially because of the educational model based on project-organized and problem-based learning. This educational model provides for a high degree of adaptability. The profile and the contents of the lecture courses are easily adapted according to the changes taking place within the professional areas in within society as such. Therefore, there has been no need for changing the current curriculum for a period of more than 12 years. And, in fact, the curriculum is still serving us well.

The demand for change comes from the government in terms of demands for implementing the so-called Bologna Agreement. We then decided to take a lead in designing the new curriculum rather than waiting for the government to command. At the same time we decided to adjust the curriculum wherever needed in order make the best possible match between demand and supply, and in order to adapt the profile of the curriculum to the international trends. The new curriculum is presented in a new educational brochure that is available on [www.blivlandinspektoer.nu./uddannelse/blivlandinspektornu.pdf](http://www.blivlandinspektoer.nu./uddannelse/blivlandinspektornu.pdf)

## **2. UNIVERSITIES IN TRANSITION**

The universities in Denmark are in a process of transition. The Danish universities have traditionally been governed by democratically elected leaders such as the Rector (Head of the University), the Deans (Head of the Faculties), the Heads of the Departments, and the Heads of the Schools. However, the Parliament has recently passed a bill saying that the universities must be headed by a board (the Senate) with a majority of external representatives coming from the trade and industries. The Senate will then employ the Rector, who will employ the Deans, who will employ the Heads of Departments. University government is thereby changed into a traditional business model. The Heads of the Schools will, however, still be elected as part of the process for establishing the Study Boards composed by an equal representation of faculty staff and students (normally 10 in total). The Senate must establish a by-law that constitutes the governmental rules and responsibilities within the various levels of administration.

At the same time a new departmental order determines that all university programs must be organized using the so-called 3+2+3 principle as determined in the Bologna Agreement. The structure consists of a three-year Bachelor program followed by a two-year Masters program and with an option for a three-year Ph.D. study on top of that. Furthermore, the Master

programs must be organized in a way, so that they can be followed also by students who have not followed the related bachelor program. For example it must be possible for a student with a Bachelor Degree in say Civil Engineering or Geography to follow the Master program in Surveying as the last two years of their studies.

## 2.1 Consequences for the Surveying Program

The surveying program has to face a number of problems related to implementation of the new 3+2 structure. The problems relate to the fact that the existing surveying program is a full five-year course leading to the graduation as surveyor. This five-year course is the basis for entering the surveying profession in Denmark, just like the similar courses leading to graduation as a veterinary or a lawyer. The problems for the surveying program are threefold:

*Firstly*, it will be difficult to produce bachelors having the necessary skills for undertaking relevant tasks within the public or the private sector. The professional profile of the program is very wide and includes aspects within technical, natural, and social science disciplines. Recognizing the necessity of this broad approach, the first three years of studies are designed using a “know-how” approach, while the last two years of studies are based on science, theories and problem solving using a “know-why” approach. Consequently, after three years of studies the students will possess all the necessary professional knowledge within all the disciplines, while the scientific skills for problem solving - such as the use of theories and methods for solving also the unknown problems of the future - will be established only through the final two years of studies. Furthermore, at the technical colleges there is already a program in surveying and mapping producing surveying technicians. And the companies are not likely to employ a bachelor, when one can have a master for almost the same costs in salary but having much higher academic qualifications.

*Secondly*, it is necessary to focus the program on producing the master graduates. It is a basic precondition in the existing program that all graduates will have the opportunity to obtain a license for cadastral surveying after three years of employment in a private surveying firm. This is decisive for survival of the program in the long term. If this focus is not maintained, the program may easily be overruled and divided into a number of directions within the technical and natural science disciplines (measurement, mapping and GIS) and the social science area (land law, land management and spatial planning).

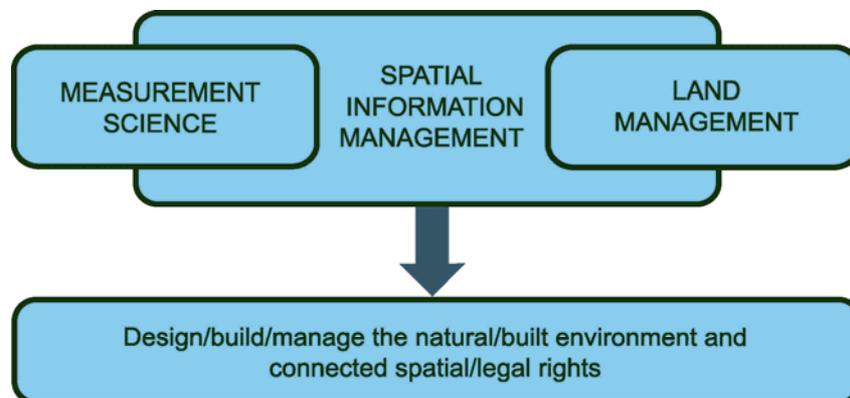
*Thirdly*, there is problem with regard to the title of the graduates finishing the master program. The governmental intention is, however, that the future graduates will receive the title of the relevant masters program even if they have now followed the related bachelor program. This does not work well for a program being the basis for a profession, where the title Surveyor (cand.geom.) should only be used for graduates having completed the whole program of five years. This problem may, hopefully, be solved in an adequate way, e.g. by using the title cand.scient.tech for such graduates who complete a bachelor degree within say civil engineering or geography followed by a master program in surveying. The general problem in this regard is that the competences of the graduates should be obvious on the basis of the title. This, of course, applies especially to the program aiming at a specific profession.

On this background, we decided to use an offensive strategy. Instead of waiting for the political command, we developed our own vision for the surveying education of the future – which is of course within the overall legal framework for implementing the Bologna Agreement. We intend thereby to maintain the professional perspective within the new framework, and, at the same time, we use the opportunity to adjust the profile in order to better meet the demands for the competences of the future. This adjustment relates to two issues: adaptation to the international trends and adaptation towards providing “the competence of the future”. This is further explained below.

### 3. INTERNATIONAL TRENDS

Traditional education of surveyors has focused on geometry and technology more than on land use and land administration. 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 management.

A future educational profile for land administrators should be composed by the areas of Measurement Science and Land Management and supported by and embedding in a broad interdisciplinary 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 worldwide. The profile is illustrated below (Enemark and Prendergast, 2001).



*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.

#### 4. THE COMPETENCES OF THE GRADUATES

As a basis for revision of the program we conducted a survey to assess whether the competences of the graduates are in line with the demands of the industries/customers. The survey included the graduates from the last ten years. The reply was around 75%, which equals about 300 graduates replying. The survey includes five areas:

- *The overall assessment of the program.* 83% assessed the program as good or very good, while only 2% meant that the program was bad or very bad. Around 85% said that they certainly or most properly would choose the program again based on the knowledge and experience they have today.
- *The professional qualifications.* The survey shows, that there is a fine match between the professional qualifications obtained through the education and the competences asked for within their areas of employment. However, a few areas should be refined with regard to the content and emphasis in the program.
- *The general qualifications.* These are about interdisciplinary skills, problem solving skills, communication, management, etc. Also in these areas there is a fine match. In fact, in some areas the graduates seem to be overqualified. In other areas, such as management and economics there is a need for a more detailed analysis of the demands.
- *Mobility and types of job.* The mobility of the students is very low when it comes to the choice of studies. One third of the students come from the region of the university and about half of students come from the broader region of the northern half of Jutland. Only very few students come from the Copenhagen region in the opposite part of the country. The graduates, on the other hand, are more mobile and accept to find a job without geographical restrictions. The first job obtained by the graduates is divided into one third in surveying practice, on fourth in regional and local authorities, about ten per cent in the state agencies, and the rest within other private companies, utilities and businesses.
- *Demands for revision of the program.* Three out of four graduates indicated that the opportunity of doing internship would improve the quality of the program. And about half of the graduates indicated that a new route of specialization in GIS and Spatial Information Management would be beneficial. Both of these suggestions are now implemented in the new curriculum.

Through the survey a number of key questions have been answered in relation to achieve a better match between the professional competences and of the graduates and the demands within the employment areas. This provides a good basis for the ongoing work of developing the quality of the program. Furthermore, we are now able to document the quality of the

program against the faculty and also externally against the costumers within the various areas of employment. We intend to make an ongoing update of this survey.

## **5. THE EDUCATIONAL MODEL – PROBLEM BASED LEARNING**

The educational model used at Aalborg University emphasizes group project work as the key method of learning. 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 applied at Aalborg University when it was established 1974. 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.

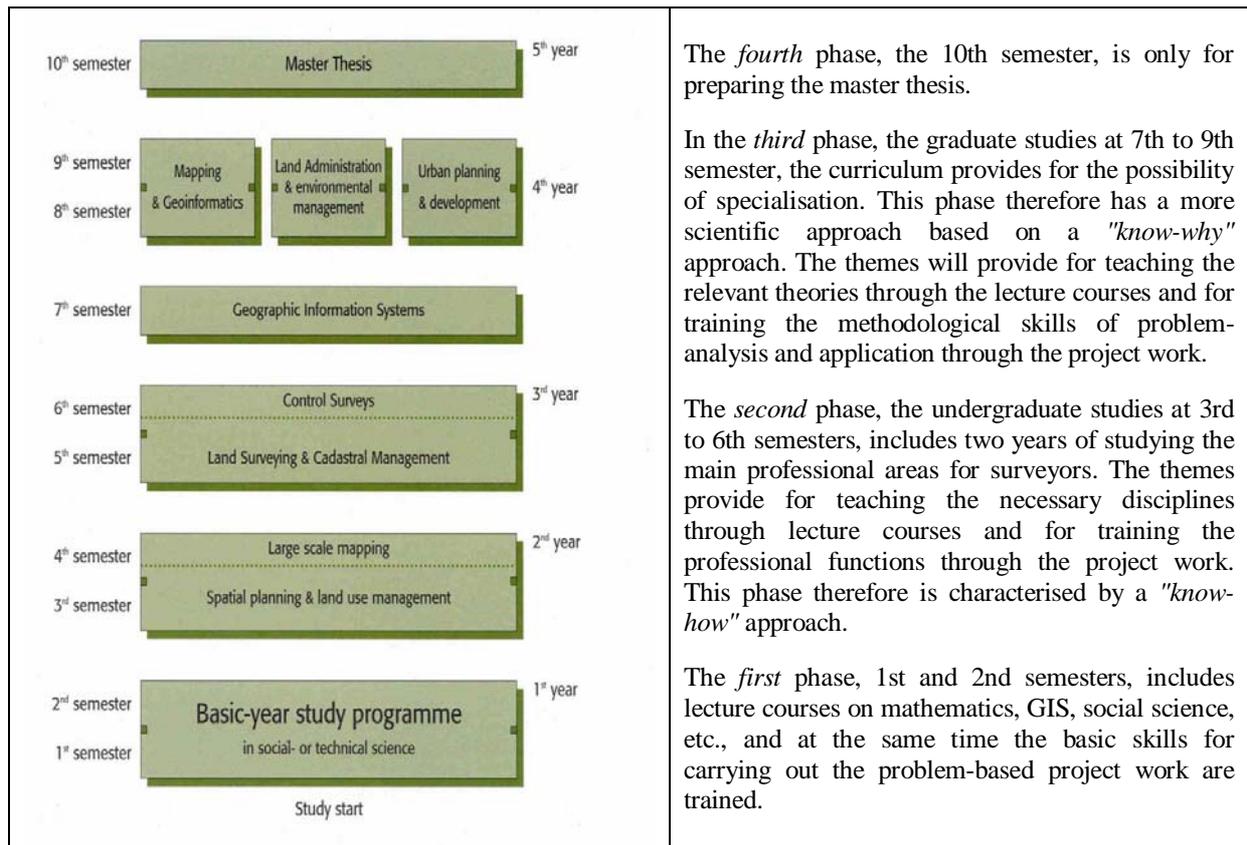
*Project-organized* means that traditional taught courses and labs is replaced by project work assisted by lecture courses. The project-organized concept moves the perspective from description and analyzing into synthesizing and assessment. The concept is based on a dialectic interaction between the 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.

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) as well as exploring (through the project work) the application of the subjects in professional practice.

## **6. THE CURRENT CURRICULUM**

The current curriculum is organized as fully integrated five-year course for a Master in Surveying, Planning and Land Management. It is organised as follows:



The *fourth* phase, the 10th semester, is only for preparing the master thesis.

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

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.

The *first* phase, 1st and 2nd semesters, includes lecture courses on mathematics, GIS, social science, etc., and at the same time the basic skills for carrying out the problem-based project work are trained.

The current curriculum has served us well through a long period. It is well appreciated by the students as was documented through the survey of the graduates mentioned above. The reason for changes is therefore mainly initiated in order to apply with the new regulations for implementing the Bologna Agreement and its 3+2 approach.

## 7. THE NEW CURRICULUM

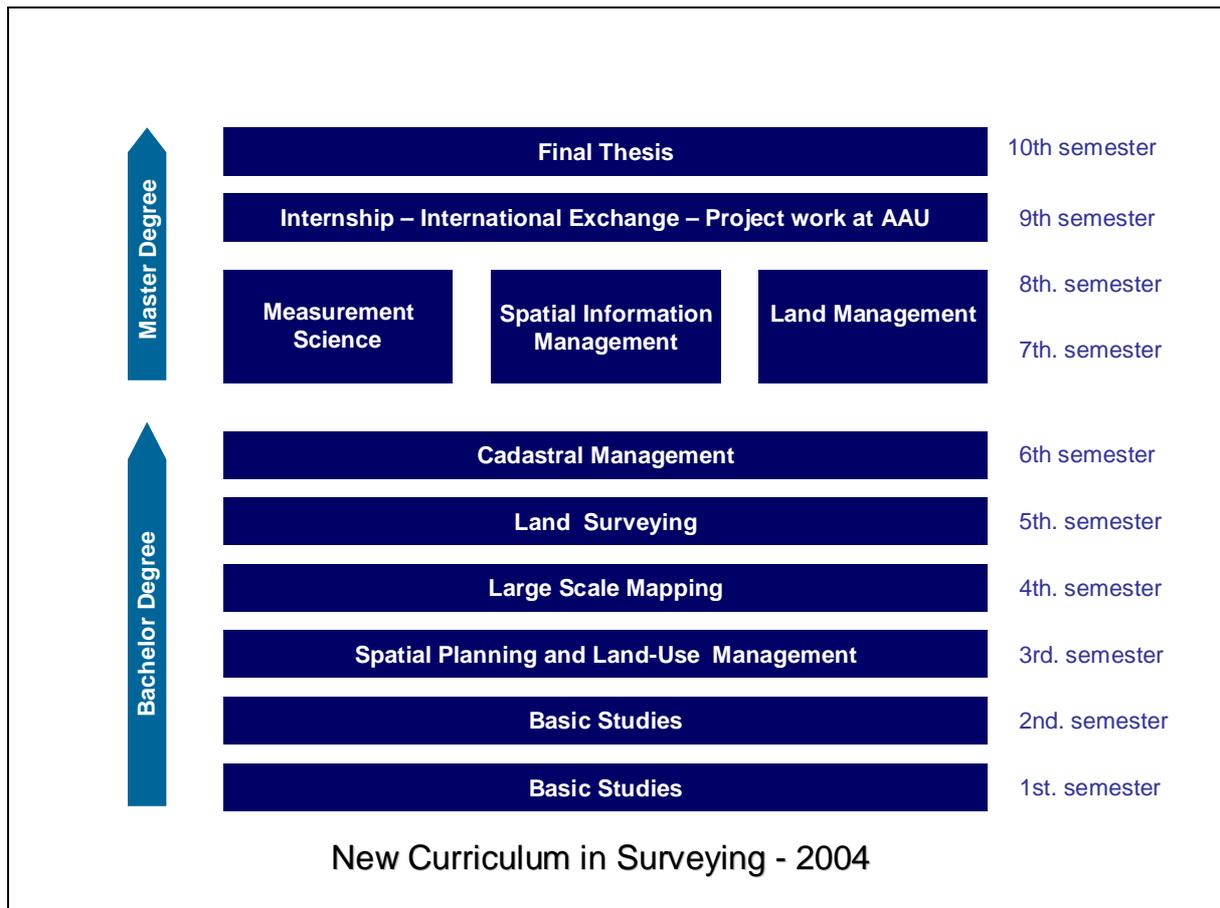
The major change applied in the new curriculum is that the five-year program is divided into a three year Bachelor course followed by a two-year Masters course. The contextual changes, however, relate mainly to the Masters program, while the Bachelor program is maintained in an almost identical design. The changes are as follows:

- The existing 7<sup>th</sup> on geographic Information systems is deleted and the tools are integrated into the subjects dealt with in the Bachelor program. The specialization then starts at 7<sup>th</sup> semester offering three routes: Measurement Science, Spatial Information Management, and Land Management. The two existing routes of specialization in Land Administration & Environmental Management and Urban Planning & Development are merged into one area of Land Management. The new specialization within Geographic Information is also aiming at students in Geography. The programs will, in turn, be offered in English and will be open also to foreign students.

- The new 9th semester offers a number of options including the opportunity for internship within a private surveying firm or any relevant public authority or private company in Denmark or abroad. The internship will be for around three months and must be approved by the Board of Studies. The content of the internship must be focused on investigating relevant professional problems within a certain area of practice. The internship is not considered to be just an employment for a short period. It is considered to be a learning activity that must be reported and examined based on academic criteria.
- The new 9<sup>th</sup> semester will also include the opportunity to follow a semester at a university abroad or at another university in Denmark. Or the student may just stay at AAU to do a normal project possibly as an introduction to the following final thesis, or even as a thesis covering both 9<sup>th</sup> and 10<sup>th</sup> semester. The student may also prefer to follow another theme as offered at the 7<sup>th</sup> semester in order to obtain a very broad professional profile.
- At the Bachelor Program only some structural changes will occur. The first year of basic studies will be more focused on the professional areas in Surveying. Modern IT tools and GIS applications will be fully integrated at the themes on 3<sup>rd</sup> to 6<sup>th</sup> semester. The existing combined 5<sup>th</sup>-6<sup>th</sup> semester will be separated into a 5<sup>th</sup> semester focusing on Land surveying and a 6<sup>th</sup> semester dealing with cadastral management and property data management. This should facilitate the consistency between the lecture courses and the project work carried out at these two semesters.
- The new curriculum will be implemented for 1<sup>st</sup> and for 7<sup>th</sup> semester per 1<sup>st</sup> of September 2004.

The curriculum is thereby adapted to the new principle of 3+2, and it is consistent with the international trends for the surveying education of the future. At the same time the program is adjusted in some details according to the results of the survey of the graduates. We expect that that program thereby be secured for a period of about ten years ahead.

The educational model based on project work and problem solving will be maintained. We have about 30 year of experience with using this model, which is constantly adjusted and improved. There is no doubt that the graduates this way will achieve some basic competences that will not be established through traditional discipline-oriented learning approach. This is also widely recognized by the trade and industries in the Danish engineering sector.



The program will continually work to be at the forefront of the use and implementation of modern information and communication technologies. This goes for the lecture courses as well as the project work, and for facilitating the interaction between education, research and professional practice. This innovative approach is known as Learning Lab Geomatics and is presented in details in (Enemark and Sorensen, 2002).

## 8. THE COMPETENCES OF THE FUTURE

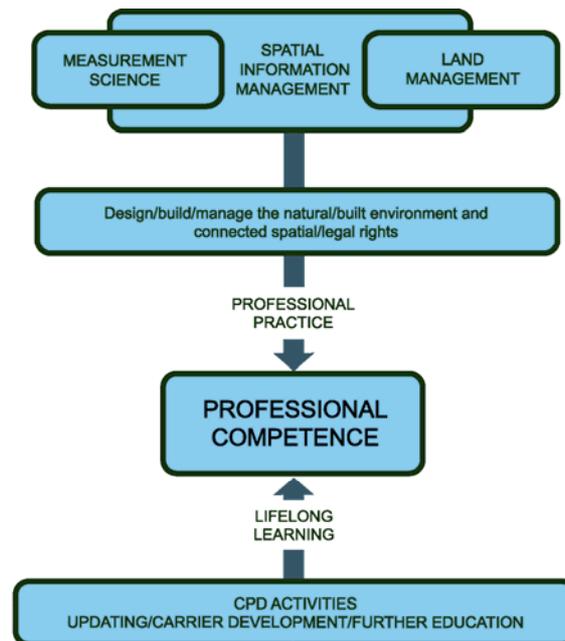
As a result of the revision the educational program is now fully up to date and on the forefront both nationally and in an international context.

However, the competences of the future are not established solely through the university program. They can only be established through an interaction between university education, professional practice and experience, and various activities of continuing professional development.

Therefore, it is crucial to establish an ongoing dialogue between the university, the profession, and the industries/customers. The Danish solution in this regard has been to establish a “Surveyors’ Advisory Board” with representatives from the key employment areas, representatives from the faculty staff, the students, as well the professional association.

This forum of 18 members in total meets once a year to discuss the competence of the future and the future educational demands in a strategic and visionary perspective.

Through this forum we have the opportunity to discuss the balance between the different areas in the program, and we are able to 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.



*THE PROFESSIONAL COMPETENCE MODEL*

## FINAL REMARKS

The surveying program at Aalborg University is unique in the sense that it is a separate program for surveyors, which is not a part of the engineering programs. The program is also the only one offered in the country. Consequently, the program has the face some special demands of development and innovation in order to be at the forefront both nationally and in an international context – and maybe even a little ahead. Of course, no one is able to identify the competence s of the future for sure. However, we believe that this revision is another step forward.

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## BIOGRAPHICAL NOTES

**Stig Enemark** is Head of the School of Surveying and Planning at Aalborg University, Denmark, where he is Professor in Problem Based Learning 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 currently the President of the Danish Association of Chartered Surveyors (since 2003). He was Chairman of Commission 2 (Professional Education) of the International Federation of Surveyors (FIG) 1994-98. He is an Honorary Member of FIG (since 1999) and he is elected Vice-President of FIG 2005-2008. His teaching and research are concerned with land administration systems, land management and spatial planning, and related educational and capacity building activities. Another research area is within Problem Based Learning and the interaction between education, research and professional practice. He has undertaken consultancies for the World Bank and the European Union especially in Eastern Europe and Sub Saharan Africa. He has more than 200 publications to his credit, and he has presented invited papers to more than 50 international conferences.

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