

Survey Education at Lund Technical Institute – A Success!

Boo G. LILJE, Sweden

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SUMMARY

Education of surveyors started in Sweden 1628. The education was organised by The National Land Survey. In 1936 the first surveyors graduated with an MSc from The Swedish Royal Institute of Technology, Stockholm (KTH). Education is from 1992 conducted even at Lund Technical Institute (LTH).

The occupation was entirely male until 1963 when the first woman graduated. From the beginning of 1990:s the number of girls are around or above 50%.

The education in Sweden combines engineering, law and economics and results in a MSC from Technical University without being too technical.

A new educational model was introduced at LTH in 2001.

The reasons for a new model were

- demands for a higher number of graduates,
- needs to increase the number of applicants for seats at the education,
- wishes of a cost-effective education,
- needs for a modern pedagogic approach.

The education consists of 4½ years of studies, corresponding to 180 credits (equivalent to 270 ECTS credits). The compulsory education consists of 120 credits (180 ECTS credits).

After the first semester, comprising of basic mathematics and laws, five theme-semesters follow. During these semesters, different courses are integrated into a theme. Each semester consists of readings, but foremost of a project work.

The semesters deal with:

- Land and Environment,
- Geomatic,
- Land Information,
- Real Estate Economics and
- Spatial Planning

During the fourth educational year, the students can specialise in different subjects, such as:

- Spatial Planning
- Real Estate Economics,
- Real Estate Enterprising and
- Geomatics.

The studies end by a thesis of half a year.

The outcome of the new model has been a success. The number of applicants has increased. Even the standard of the accepted students has increased. The students produce better examination results. A new pedagogic approach to the education has been introduced.

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1. SURVEY EDUCATION IN SWEDEN

As the Swedish king Gustav II Adolf during the war against Poland in the beginning of the 17th century found it necessary to employ German land surveyors in the Swedish army, he asked the mathematician Anders Bure to educate some persons in land surveying. The National Land Survey of Sweden started on the 4th of April 1628. From the very beginning, six surveyors were educated by Anders Bure to form the staff. Their task was to map the landscape, so called geographic maps, and the villages, so called geometric maps.

During the first half of the 18th century no major changes in the education of surveyors occurred. But in 1757 re-allotment of agricultural land was introduced. The agricultural development forced changes in land allocation. This meant that the surveyors needed education and examination in how to grade the land. It was found out that this part of the re-allotment was the most difficult one.

In 1827 a new law about re-allotment was decided by the Parliament. This meant that the surveyors would be active to change the structure of the Swedish rural area. The instruction for the National Land Survey declared that examination to become a Land Surveyor should be public and the students should be examined in

- geometry, trigonometry, levelling, map-construction, etc,
- chemistry, mineralogy, geology,
- agriculture, forestry,
- economy especially about interests, taxation, buying and selling of land,
- all laws in respect.

Due to the re-allotment activities, the geographic mapping in the beginning of the 19th century was organised within the Swedish Army. It thus continued during the whole century. In 1894 a new civil mapping organisation was organised.

With the beginning of the 20th century a new era started for the Swedish National Land Survey. Thus even the survey education was developed, but still under the responsibility of the National Land Survey. The education was divided into two courses with a practical period in between. The first course contained education in Mathematics, Geodesy, Practical land surveying (map construction, area calculation, grading of land), Legal knowledge, Understanding of old documents, Geography and Archaeology. The second course contained education in Farming, Grading of agricultural land (Physics, Chemistry, Mineralogy, Geology, etc), Forestry, House- and bridge-building, Road-building, Urban planning.

In 1932 the education started at the Swedish Royal Institute of Technology in Stockholm (KTH). The education was completely unison with almost none possibilities to specialisation

and mostly geared at working for the National Land Survey and with tasks related to real estate formation and land administration.

At the moment a new curriculum is introduced at KTH. A close cooperation started 2002 with the Civil Engineering Program. Thus the two programs will have a joint admission to the education. The first year the students will have the same courses. Thereafter nine specialisations will occur, among them “Land and real estate techniques”, “Building and real estate economics” and “Geographical information techniques”.

	KTH/L			LTH/L			
	2000	2001	2002	2000	2001	2002	2003
	%	%	%	%	%	%	%
Skåne				58	46	36	40
South Sweden	1	11	4				
Blekinge				3	9	3	2
Småland				13	17	13	13
Halland				15	6	8	10
Gothenburg with surroundings				5	6	18	4
Västra Sverige	7	5	6				
Östergötland/Småland	6	7	10				
Södermanland/Västmanland	6	3	1				
The middle of Sweden				5	6	13	13
Stockholm with surroundings	65	61	71	3	11	10	15
Uppsala with surroundings	4	2	0				
Gästrikland/Dalarna	4	4	4				
South and middle North	6	5	1				
Noth of the North	2	1	1				
North				0	0	0	4
Number of answers	107	94	69	40	35	39	48

Figure 1 – The hometown of the students

From the beginning of the 1980:s, the students tended to study at the university closest to their hometown. This was more important than to choose a certain education. Thus, those studying the survey programme mostly came from the area around Stockholm. And after graduation, the students tended to remain in Stockholm. As the rest of Sweden faced a shortage of surveyors, it was decided to start up survey education at Lund Technical Institute (LTH). The education started in 1992 and the curriculum was more or less copied from KTH but adjusted to the competence and resources of the University. The technical specialisation was not geared towards geodesy and photogrammetry but instead towards GIS. With the increase in competence and of staff etc, the curriculum is changed from 2001.

2 FEMALE GRADUATES

From the very beginning, a land surveyor should be a man. In the instruction from the 17th century it says that the existing land surveyors should “to land surveyor educate sons to honourable men”. It was also stated that university exams in certain subjects were required to be educated to land surveyor. And matriculation examination was needed to enter university studies. Not until 1870 were girls given the right to get a matriculation exam. But still the girls had a minor role in the society. Thus it was not until 1945 that women got an equal position as men to posts within governmental organisations.

However, girls were not “supposed” to study technical subjects. In secondary schools the girls should concentrate on languages, while boys should study technical subjects as mathematical, chemistry and physics. To enter a Technical University, matriculation exam with these technical subjects were required. It took quite some years to change this habit.

The first female Land Surveyor graduated in 1963. Thus it took 335 years before Sweden got its first female Land Surveyor. Other male occupations were Forestry Officer and Veterinary Surgeon. It was for the next ten years (1962 – 1972) still unusual with female students at the Surveying Program. Only 13 females graduated out of a total number of 338 (3,8%). The number of female Land Surveyors increased considerable during the next ten years (1973 – 1982) and out of 467 graduates all together, 107 were females (22,9%). This development continued during the next ten years (38,9%) and nowadays the female Land Surveyors are in majority. During the last ten years the female graduates are 52,6% out of all graduates.

3. A NEED OF RENEWING

As the resources of teachers increased in the surveying education at Lund, a discussion started to renew the education. The reasons were several.

3.1 The “flow through”

The number of students who graduate was and is low. This is not valid only in the surveying education but in all education at Universities and Technical Institutes. The studies are estimated to last 4½ years. But after ten semesters (5 years) not more than one out of five has graduated. After 16 semesters (8 years of studies), the graduation number has increased to a little more than 60%. The number of students who graduate is never above 70%. This figure was compared with the graduation number in Denmark, who reaches at least 90%. The reasons for the low graduation are several. We point out three main groups:

1. There is always some students who after a relatively short period of time notice that they have chosen the wrong education and leave the education.
2. The second group consists of students who get employment before they have completed their studies. The work, sooner or later combined with establishing a family with children, makes it difficult to get time and concentration to complete the studies. The longer from Lund the student is living, the less inclined is the student to complete the studies.

3. The third group consist of students who want to complete the studies, but can not, that is they are unable to pass all the exams. The biggest obstacles are the six courses in mathematics.

3.2 Number of applicants

A high number of applicants give the educational programme a good reputation. More and more students consider the programme interesting to study. And a high entrance point also gives the educational programme a good reputation. If it is difficult to get a seat, the state is high. So especially if the entrance point is above 16, is the situation for the programme good (16 means “Well done” in all subjects).

The educational programme has had a low number of applicants. This was merely due to the fact that the education has been unknown to the students.

3.3 A cost-effective education

It is expensive to carry out courses with a few participants. The cost for a full year student is about 50 thousand Swedes crowns (7 thousand dollar/5500 euros). This cost will cover the salary of the teacher, the hire of lecture halls, and other costs. The wish was to reduce the over all costs and bring down the cost per student.

3.4 Modern pedagogic approach

One of the most important goals with the renewing of the survey education at LTH was a pedagogic development. The aim was to go from the traditionally education to give knowledge in different subject (to know how) to a more problem solving knowledge (to know why). Professional and technical knowledge can always be acquired later in a the career. But knowledge to solve problems and knowledge to how to learn how to learn can only be obtained through academic training.

The education was therefore changed from courses with examples and training to education in a project work completed with courses. Or with other words – text-book knowledge was replaced with needed knowledge to solve theoretical problems. The education should go from lectures to project work or problem oriented learning. The work by the students will be in focus.

This new approach also has consequences on the examination. The mark-setting of the project work will have great significance when the qualifications of understandings by the students are tested. The control of the knowledge the students have or their ability to learn will remain to a certain extent.

The integration between different subjects will also have great importance. A good example is “mathematics statistics”, which has great importance within the subject “geodesy”. Thus is mathematics statistics and the courses in geodesy, GIS, mapping technique will in the future be integrated.

4. THE EDUCATION

The survey education at Lund Technical Institute is since autumn 2001 organised in a new way. A great part of the education is built up around project works, for which both theoretical knowledge and practical ability to solve problems are demanded. In this way the theory is connected to the practical work. The different subjects are tied together within the project work. The students are thus developed in problem solving in an independent way in a group. The students are also trained in presentation of the project task and analysis and criticism of the work done by other groups.

The education in different semesters in the 4½ years long education is:

	Year 1	Year 2	Year 3	Year4	Year 5
Autumn semester	Basic semester Mathematics Civil right/ Real estate laws	Geomatics Geographical Information Systems Geodesy Mapping techniques Mathematics statistics	Real Estate Economics Political economy Business economy Real Estate valuation	Free choice Geomatics Economy Law	Thesis Within chosen subject
Spring semester	Land and environment Geology Road construction Environmental laws Environmental knowledge Mathematic	Land Information Geographical Information Systems Real Estate Infor- mation Techniques Global Positioning Systems Programming Mathematic	Spatial Planning Comprehensive planning Real Estate Laws Real Estate Techniques	Free choice Geomatics Economy Law	

Figure 2 – Educational model

During the first semester the students study basic courses in mathematics and laws. The aim is to give the students knowledge in analytically and in logically thinking.

After this first semester follows five semesters with a special theme. The autumn semester gives totally 18 credits (equivalent to 27 ECTS credits), while the spring semester gives totally 22 credits (33 ECTS credits).

The first semester has got the name “Land and Environment”. During this semester the subjects “environmental knowledge”, “building- and environmental laws”, “technical geology” and “construction techniques” are joined. The four subjects are integrated. To facility the understandings of the complex connection existing between the different aspects within the theme “Land and Environment”, the education, literature and other tasks within the semester will be connected to a project work going through the whole semester. The project

is this year to locate a factory for producing gas and roads to the factory. The students shall look into the geological assumptions for the location of the plant and the roads. Furthermore the location shall be determined from legal aspects as well as environmental. Finally the students shall in the project locate the roads considering the nature, the technical assumptions and even dimension the roads. The knowledge is controlled by an examination and the reports from the project work.

In this semester also starts training in human relations such as appraisal, team building, oral communication. This training will continue through all the years. Also, the students will be given training in written communication.

During the first part of this semester, the students also study a separate course in mathematics.

The first semester in year 2 has been given the name “Geomatics”. The aim with the course is to give the students basic knowledge about the theory behind geodetical measurement techniques and geographical information systems (GIS) including data-capture, construction of databases and presentation of data. The course will also give the students practical knowledge how geodesy and GIS can be used especially in the land survey field. Within the project, the students carry out some field work and capture geographical data by measurements. This data is used to construct a database. Thereafter different methods are used to present the database in the form of a map. Small analysis are carried out.

Together with this course the students study mathematic statistics.

The fourth semester is named “Land Information”. The course deals with the design and the content of the Swedish real estate data base system. But knowledge is also given about the real estate data base systems in other countries. Technical demands on an information system, where knowledge and skills in modelling, programming and data bases are included. The students shall be taught how real estate information can be connected with other geographic information, for instance when constructing a cadastral map. Finally the students shall learn the most common applications of real estate information today, for example within real estate formation and credit matters. Within the course, knowledge is given in the curvature of the earth, scale variations in map projections and transformation of coordinates between different coordinate systems.

During the project the students shall collect data and construct a database concerning information regarding allotment gardens.

Together with this course the students study one course in programming and one course in mathematics.

The fifth semester is named “Real Estate Economics”. The aim with the semester is to give the students basic knowledge in political and business economy and, with this knowledge as a base, in a more deeper form describe and use the real estate economic theories and methods. Especially shall the course give skills in analysis of the value of real estates, of the

apartments-to let-market and the real estate market and of the investments in real estates. The course shall provide the fundamental principles of the political economy and analysis of the real estate market. And the course shall describe as well how the political economy affect the real estate market as the importance of the real estate market on the political economy. Fundamental principles of the business economy are included as well as elementary techniques for accounting and capital planning. The real estates are studied as economical objects especially in regard to the formation of prices in different real estate markets, the importance of the real estate taxation on the market and different methods of valuation of real estates. The project work consists of three moments; an analysis of how investments in real estates is suitable in a municipality, a valuation of a smaller house (cottage) and finally, an analysis of investment in land and building for commercial purpose.

The last theme semester is called “Spatial planning”. The aim with the semester is to give basic knowledge about real estates and the judicial roles and technical and economical presumptions existing for rural and urban planning and change of the land use and the real estate division. The course contain four main areas; Rural and urban planning and realization of these plans, cadastral surveys, real estate laws and principles for economic compensation in connection with cadastral survey. During the semester, four projects will be carried out – design of an urban comprehensive plan, the effect on the real estate division by a new road, cadastral survey and, finally, compensation to the owner of a real estate when land is expropriated.

These six semesters of the education is compulsory. The compulsory education has thus been prolonged with half a year and consists nowadays of 120 credits. The reasons are several. The “Bologna-agreement” talks about 3 + 2 + 3. A “Bachelor”- examination (BSc), which is so far not existing in Sweden but well in many other European countries, comprise of studies during three years. The new education at university colleges has a basic education during three years. It is common that other educational programmes at Lund Technical Institute prolong the compulsory education to 120 credits. Therefore it is easy to join the Institute from a College or change between different programmes. Finally, it is easy to adjust the education to the Bologna-agreement.

5. THE FOURTH YEAR

At the moment a lot of efforts are paid to the final 1½ year.

After the three compulsory years the educational programme terminates with a competence concentration consisting 50 credits, divided into 30 credits on courses and 20 credits on the thesis. The students can freely choose courses equivalent to ten credits.

The competence concentrations discussed are:

- Spatial planning
- Real estate economy
- Real estate enterprising
- Geomatics.

Each concentration has its own profile. Thus the concentration in Spatial Planning can be like this:

Autumn 1	Real Estate Valuation VFT 043 5 credits	Real Property Formation VFT 011 5 credits	Real Estate Taxation VFR 160 5 credits		Comprehensive Planning VFT 131 5 credits	Urban Planning and Urban Design ASB 170 5 credits	Urban design ASB 190 10 credits
Autumn 2		Common Property VFR 130 5 credits	International Real Estate Law VFR 071 5 credits	Seminars in Real Estate Science VFT 181 5 credits		Urban development ABV 060 3 credits Shelter – AAU 260 2 c	
Spring 1	Archives VFR 150 5 credits	Rights in real estates 5 credits	Real Estates Contracts VFR 065 5 credits		Environmental Law TEK 255 5 credits		Urban Renewal ASB 060 5 credits
Spring 2	Agriculture and Forestry VFT 171 5 credits	Land Use Law VFR 180 5 credits	Exploiting 5 credits				

Figure 3 – Concentrational profile for Spatial Planning

The thesis can be carried out within the concentration in one of the following subjects:

- Real Estate Formation,
- Real Estate Registration,
- Real Estate Laws,
- Rural Planning or
- Urban Planning.

The thesis shall be a deepening of the knowledge in the subject. The student therefore shall choose courses accordingly. The student has an instructor during his/her work with the thesis. The instructor shall approve the courses chosen.

A student who wants to do his/her thesis within the subject “Real Estate Formation” may choose to study as is shown in picture 4 below.

To inform the students a popular description of the subjects and the courses is produced. Also recommended study plans like the one in picture 4 are produced. The students will by these documents easier do the right choice. And complete their studies successfully.

Autumn 1	Real Estate Valuation VFT 043 5 credits	Real Property Formation VFT 011 5 credits
Autu,m 2	Common Property VFR 130 5 credits	
Spring 1	Archives VFR 150 5 credits	
Spring 2	Land Use Law VFR 180 5 credits	

Figure 4 – Recommended curses for thesis in Real Estate Formation

6. OUTCOME

6.1 Number of applicants

As shown in Picture 5 the number of first hand applicants have increased from around 50 to above 80. This is a good development, even considering that the last year there was a drop in the total number of applicants to Universities and Colleges by more than 10%. Even the total

	1997	1998	1999	2000	2001	2002	2003
First hand applicants	38	33	46	50	59	88	81
First hand applicants per seat	1.3	1.2	1.5	1.7	2.0	2.2	1.8
Total number of applicants	387	356	395	386	443	405	378
Total number of applicants per seat	13	12	13	13	15	10	8
Entrance points				13.42	15.84	16.16	16.35

Figure 5 – Number of applicants

numbers of applicants are satisfying. But most satisfying is the increase in entrance points. It is nowadays difficult to get a seat in the Survey Educational Programme. Only four other Programmes at LTH have a higher entrance point. (Highest is the entrance point to “Architecture”, followed by “Fire and Risk” and “Industrial Economy”.) The high entrance point means that the Educational Programme gets a high state.

A lot of efforts are paid to market the Education. A pamphlet is produced by LTH and sent to all students in upper-schools in the Southern part of Sweden. Another pamphlet is produced by an organisations working within the field of cadastral surveys and land management and is sent to all students in upper-schools in the whole of Sweden (43 000 pamphlets were distributed in 2003.) Articles are written to market the name Land Survey and Land Management as only 13% of the students choose the Programme out of interest - to get an MSc without having to study too technical subjects and the width of the education (technique, laws and economy) is selling. Students visit their “old schools” and inform the students in upper-school about the Programme.

6.2 Result of the studies

It is too early to establish if the new model gives a better result. However, it can be noted that the group starting the studies autumn 2002 had the best result of all first year students at LTH. The average credits taken by the students from the Surveying Programme was 34 out of 40. This shall be compared with the lowest average being 22. The figure for all the Programmes at LTH was 31. (The figures include all students starting their studies at the Programme. It is natural that a few finish their studies after a short period. They notice for instance that they have chosen the wrong Programme.) According to the students the reasons for the good result are:

- high entrance point,
- the study plan meaning that the students can concentrate on one exam at a time and
- the theme semester with its combination of lectures and project work.

6.3 Pedagogic development

6.3.1 Integration of subjects in the theme semester

The semesters in year 1 –3 in the Survey Programme is organised in semester-long theme-courses. A basic thought with the new educational model is that there shall exist a main thread with a survey profile successively built from the different theme-semesters. The main thread will give the students a better understanding why a certain subject is studied and how they can use their knowledge in the future studies and as professionals.

The development of a theme-semester demand cooperation between the different subjects and the teachers. Thus, 3 –4 teachers have to coordinate their subjects and together organise the project work. This is a new pedagogic approach at LTH.

The students have through the theme-semesters got a more homogeneous structure in their studies. This means a greater concentration to one area. The connection between the different subjects in the theme-area is emphasized.

Some subjects have not been integrated in the theme-semesters. They are the courses in mathematics, mathematics statistics and programming. One reason being that the courses are studied together with students from other Programmes. A second reason is that two courses are studied the first basic semester. A third reason being that the courses in especially

mathematics are difficult to integrate with the theme-semester “Land and Environment”. However, there is a wish to integrate mathematics statistics with the theme-semester “Geomatics” and the course in programming with the theme-semester “Land Information”.

6.3.2 The role of the groups and the instructors

The groups doing the project work have a strategic role in the work. The size of the groups has been 3 or 4 students. The size is depending on the task. The size is at the moment discussed. It is proposed that 5 students per group is the most effective number. With an increased number of students accepted per year, it will be necessary to increase the number of students per group.

The work in groups stimulate good learning and good cooperation between the students. It is important that no one will be so called “free-riders”, students that take less or no part in the work than the other group members. To strengthen the group and the build good teams, training in inter-human relations start in 2004.

An active instruction is of great value to guide the students in their project work. This is demanding on the teachers. To help the teachers, students doing their final years are employed to assist the teacher. This has been successful.

6.3.3 The project work

There have been some changes in the project work during these first three years. It has been difficult to find realistic project works without having to place too big a burden on various persons outside LTH.

There have also been discussions if the project work should be “passed” or should be given testimonials 3, 4 or 5 as is done in a written test.

The project work has not been considered as the only way to pass judgement on the skill of the student. Therefore a written test is carried out. However, it is important to continue the development of the examination and find alternative ways.

7. CONCLUSIONS

The new model of Survey Education at LTH started in 2001. Therefore the students who started in 2001 will by the spring semester have finished their compulsory studies. At the same time the theme-semester “Land and Environment” has been given three times. The development differ among the semesters.

The outcome so far has been good. A lot of improvements can, however, be done. This is especially geared towards the integration among the different subjects.

But the aim with the change has to a great extend been fulfilled. The students are satisfied. The study result is good. The understandings of the education have improved.

The new pedagogic approach has also meant that the teachers understand each other better and how their subject fit into the education of land surveyors.

Finally, the new model gives the students a better ground to stand on when they chose to specialise their studies the last 1½ year. Irrespective of the competence concentration chosen all students with a MSc in Land Survey and Land Management from LTH have a basic knowledge about technique, laws and economy related to the area.

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BIOGRAPHICAL NOTES

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