DEVELOPMENT OF CURRICULUM OF PHOTOGRAMMETRY AND REMOTE SENSING IN HELSINKI UNIVERSITY OF TECHNOLOGY, FINLAND

Koistinen Katri[a], Rönnholm Petri[a], and Haggrén Henrik[a]

[a]Helsinki University of Technology, P.O. Box 1200, FI-02015 TKK, Finland – first.lastname@tkk.fi

KEY WORDS: Curricula, Bologna Declaration, Photogrammetry, Remote Sensing, Academic Education

ABSTRACT:

The Bologna declaration has inflicted on several reformations of curricula among European universities. Since 2005, Helsinki University of Technology (TKK) in Finland has implemented the common European curriculum according to the Bologna declaration. In this paper, we have compared our national implementation with other universities from Austria and Sweden and found that there are some differences in both the amount of courses and the points of time when studies of our special field are started. In our opinion, the ongoing trend towards the generic degree of Bachelor of Science is not pedagogically rational. It is essential to study the own professional discipline from the beginning simultaneously with the basic courses of mathematics, physics and information science. The comparison between TKK and other universities revealed that TKK have managed to maintain a comparative amount of teaching on photogrammetry and remote sensing. Even if the final effect of reformation can be seen only after the system has been working several years, we are confident that teaching and research of photogrammetry and remote sensing at TKK will be lively and attractive also in the future.

1. INTRODUCTION

The ambitious goal of the Bologna declaration (*European Ministers of Education, joint declaration, 1999*). is to harmonize all national systems of higher education in the European Union. In principle, the Bologna declaration increases transparency of curricula and enables easier student exchange. The Bologna declaration has inflicted on several reformations of curricula among European universities (Eurydice, 2007).

Since 2005, Helsinki University of Technology (TKK) in Finland has implemented the common European curriculum according to the Bologna declaration. All degree programmes of TKK were changed to the two-cycle academic programme structure (TKK, 2005) consisting degrees for Bachelor of Science (B.Sc.) and Master of Science (M.Sc.) in Technology. Prescribed times for completing these degrees are three years for the B.Sc. and two years for the M.Sc. Thereafter the 3+2+3 scheme of Bologna declaration includes the option of three year's continuation study in order to complete the Doctor's degree.

The implementation of two-cycle academic programme structure has lead to different solutions in European level. The main differences can be found how studies of engineering basics (mathematics, physics, computer science etc.) and specialization areas such as photogrammetry or remote sensing are arranged. One trend is to teach several years' general engineering subjects and then a compact package of subjects relating to the professional specialization. Another trend is to teach subjects relating to the specialization area already from the first year so that the amount of specialization studies is increased. The former could be described as a Master's learning model whereas the latter can be described as a Progressive learning model (Fig. 1).

This paper discusses following themes: how the Bologna declaration has changed teaching at the university level in Finland, how we see the benefits of transition, and what kinds of threats the progress may cause. We also compare our teaching with some other European universities.

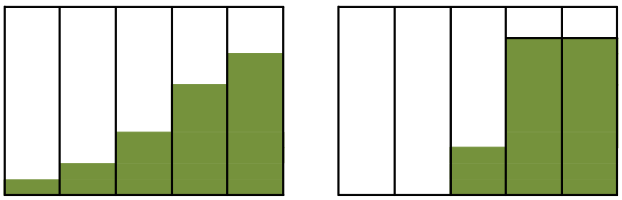

Figure 1: Progressive learning model vs. Master's learning model. The annual distribution of professional studies within the degree is different. Images are created for illustrative purpose only and do not follow exactly any existing curricula.

2. PHOTOGRAMMETRY AND REMOTE SENSING AT THE HELSINKI UNIVERSITY OF TECHNOLOGY

The Department of Surveying at TKK provides currently two degree programmes: Geomatics and Real Estate Economics. Institute of Photogrammetry and Remote Sensing contributes primarily to the teaching of Geomatics. The degree of B.Sc. in Geomatics has two options for major: either Geoinformatics, or Geodesy and Photogrammetry. The M.Sc. in Geomatics has three options for a major: Geoinformatics, Geodesy, and Photogrammetry and Remote Sensing. Students are accepted to the M.Sc. programme, if the required B.Sc. degree is completed from a relevant subject area. If the B.Sc. degree of foreign student is directly comparable with the TKK's B.Sc. degree for surveying sciences, the student may join the M.Sc. level courses. In other cases, some supplementary studies are required before starting the Master's courses. (TKK, 2008a)

In addition to the above mentioned degree programmes, the Department of Surveying currently offers two international Master's programs: Master's Programme in Real Estate

Investment and Finance as well as Master's Programme in Geoinformatics (TKK, 2008b, TKK, 2008c).

In Finland, the recommended amount of annual studies is 60 ECTS credits, which is equivalent to the workload of 1600 hours. ECTS stands for the European credit transfer system. Currently, all degree programmes at TKK are based on modular studying. The individual modules are composed from several courses and the teaching is organized during four teaching periods within one study year. Depending on the selection of Minor and Major subjects, students have some options to combine the modules. The popularity of various modules at the Master's program level is to be seen in near future.

Next, we will look more closely at the Geomatics studies at TKK from the point of view of photogrammetry and remote sensing.

2.1 The degree of Bachelor of Science in Geomatics, TKK

The degree of B.Sc. requires 180 ECTS credits (Figure 2). In the degree program of geomatics, students complete a basic module of 80 ECTS credits in technical, natural and information sciences and a common module of 20 ECTS credits in land surveying. The module A1 is common for all Geomatics students. It contains the basics of geodesy, positioning, navigation, photogrammetry, remote sensing, cartography, and geoinformation techniques, which every geomatics student at least must know. It also gives an insight into mapping processes. (Junnilainen et al, 2006).

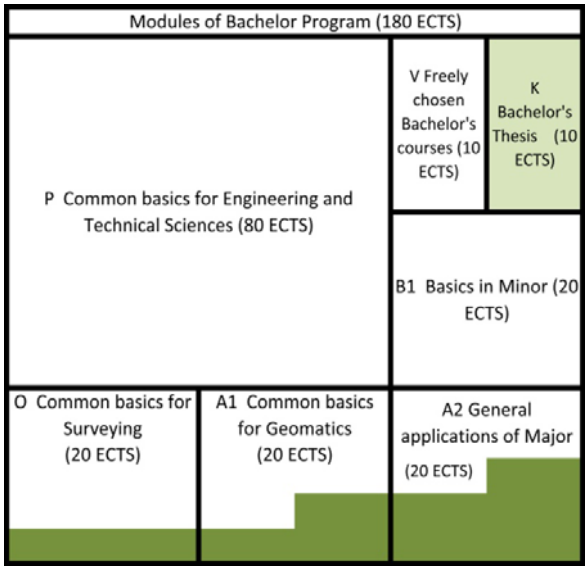

Figure 2. Modules of the degree of B.Sc.in Geomatics at TKK. The amounts of photogrammetry and remote sensing, when the Major is Geodesy and Photogrammetry are visualized with colors.

The selection of a Major in Geomatics at the B.Sc. level is done in a module A2. Students have two options: to choose A2 in Geodesy and Photogrammetry or A2 in Geoinformatics.

The degree of B.Sc. in Geomatics contains a minimum of 10 ECTS and a maximum of 20 ECTS of studies on photogrammetry and remote Sensing courses. In addition, it is possible to do the Bachelor's thesis (10 ECTS) from relating subjects. The maximum amount of photogrammetry and remote sensing is selected, if the A2 module is "General applications on Geodesy and Photogrammetry". It has to be remembered that some students can also select this module as their Minor, in which case the same module is called as B1.

The module A2 builds up to the major subject for the Master's program. Together with the thesis K, it will complete the B.Sc. degree. At this point, a good insight into essential tasks of surveying is given. Students might not have detailed knowledge on surveying expertise, but they should be competent on finding out necessary information to carry out the tasks. The module V is reserved for freely chosen courses.

The new structure of studies leaves less room for the professional subjects during the B.Sc. studies than the previous structure of the curriculum. The basic module of 80 ECTS credits is meant to be more academic than previously, and it would provide a generic foundation for further scientific and technical studies on the M.Sc. level. At the same time, the amount of optional and freely chosen studies has been increased. The students can select e.g. minor subject of 20 ECTS credits and 10 ECTS credits even from other than technical universities. It is obvious that the amount of photogrammetry and remote sensing during the B.Sc. studies is small. The remaining modules of surveying count for 60 ECTS credits, and include necessary basics in geomatics and the fundamental for alternative M.Sc. subjects.

2.2 The degree of the Master of Science in Geomatics, TKK

The degree of the M.Sc. requires 120 ECTS credits (Figure 3). Those who specialize in photogrammetry and remote sensing, complete three modules of 20 ECTS credits each. These modules define the major subject and include subsequent modules in 1) geomatics, 2) geodesy and photogrammetry, and 3) photogrammetry and remote sensing. If students have the degree of B.Sc. in Geomatics studied at TKK, they have normally chosen the modules of "Geomatics" and "Geodesy and photogrammetry" during the B.Sc. studies.

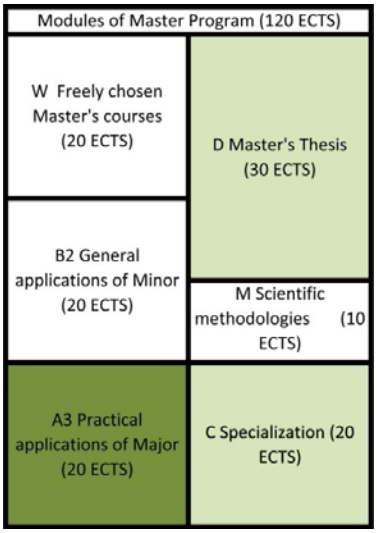

Figure 3. Modules of the degree of M.Sc. at TKK. The amounts of photogrammetry and remote sensing, when the Major is Photogrammetry and Remote Sensing, are visualised with colors.

The degree of M.Sc. contains minimum of 20 ECTS of Photogrammetry and Remote Sensing studies (A3 module), and Master's thesis (30 ECTS) can be done relating to the subject. However, it is possible to read additional 20 ECTS of Photogrammetry or additional 20 ECTS of Remote Sensing, if students select so called specialization module C. Using freely chosen studies (W), it is possible to read even both specialization modules. However, in practice it might be too demanding to arrange the studies of two specialization modules within one M.Sc. degree. In reality, C modules will most likely become a part of post-graduate studies.

3. THREATS AND ADVANTAGES OF RENOVATION OF CURRICULUM

Because of the new structure of curriculum, the studies of professional subjects start later than previously. This has not been favorable for smaller disciplines, as the number of students within the M.Sc. level has decreased. In addition, some of existing courses – in fact the most advanced courses – have to be moved later within the studies. They have now become a part of post-graduate studies, as there was no more space for them within the degree programs. The worst scenario is that the most advanced courses of photogrammetry and remote sensing will disappear from TKK because of the lack of students. In this scenario, teaching would focus on basic and generic theories at the B.Sc. level. At the M.Sc. level, we should then focus teaching merely on applied sciences and practices. Therefore, the teaching of advanced knowledge would be in the danger to become depended on international co-operation.

One principle of Bologna declaration includes that the student exchange is recommended. To make this easier the common structure of academic training programme (3+2+3) and comparable credit system (ECTS) was developed. Unfortunately, new training programmes all over Europe were founded with rapid schedule that has caused great differences in details among curricula of different countries. Also, the rapid change of technologies within surveying sciences has influenced to the development of training programmes. For example, information sciences have become as a part of teaching and research and new sensors have caused previously unseen research areas.

If and when the effects of the Bologna declaration function as expected, especially, universities with high-quality programs for M.Sc. will most likely get more international students than before. Because TKK provides advanced courses in photogrammetry and remote sensing, we expect that the international interest about our M.Sc. programmes will increase. Partially, this could solve our difficulties to get enough native students to take part in our M.Sc. programmes.

4. COMPARIZON OF IMPLEMENTATIONS OF PHOTOGRAMMETRIC CURRICULUM IN TKK WITH OTHER EUROPEAN UNIVERSITIES

In order to understand our situation among other European universities better, we checked what kind of teaching some other European universities currently offer to their students. We compared our degree programme with universities from Austria and Sweden. We used mainly information that universities provide within the Internet. Especially, we were interested in the amount of teaching of photogrammetry and remote sensing, and how the courses were distributed along the degree programmes.

4.1 TU Wien, Austria

As the first example, the studies of photogrammetry and remote sensing at TU Wien are highlighted (TU Wien, 2006). The curriculum at TU Wien fulfills also the requirements of Bologna declaration: 180 ECTS points for the degree of B.Sc. (three years) and 120 ECTS points for the degree of M.Sc. (two years). For the B.Sc. one curriculum, "Geodesy and Geomatics Engineering", is available. It includes total of 13.5 ECTS points of photogrammetry and remote sensing (Figure 4). The amount of mathematics and physics is 27.5 ECTS points and 71.5 ECTS points are reserved for other geomatics than photogrammetry and remote sensing. It is notable that mathematics and physics are customized to serve needs of geomatics. In addition, the degree includes Bachelor's thesis and presentation of 14.5 ECTS points.

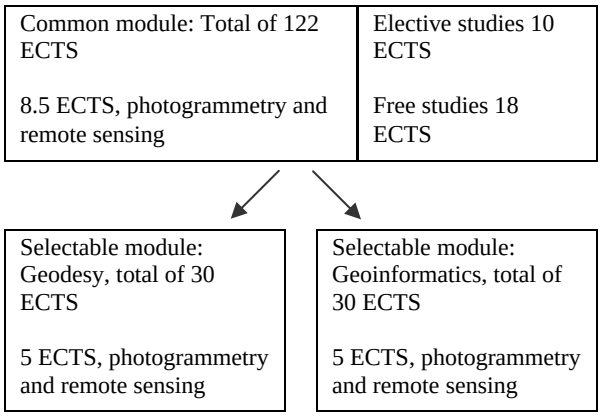

Figure 4. Photogrammetry and remote sensing within the studies for the degree of B.Sc. at TU Wien include 13.5 ECTS.

TU Wien provides three masters programs after the degree of B.Sc.: "Survey and Land Registration", "Geodesy and Geophysics", and "Geomatics Engineering and Cartography". The amounts of photogrammetric strudies are 6 ECTS for "Survey and Land Registration" and 9 ECTS for both "Geodesy and Geophysics" and "Geomatics Engineering and Cartography".

If B.Sc. and M.Sc. are both taken account, the total amount of photogrammetry can be 19.5-22.5 ECTS points, at minimum. In addition, the master's thesis can be done in the fields of photogrammetry and remote sensing. Photogrammetric studies are distributed quite evenly to cover all class of students.

4.2 KTH and Gävle, Sweden

In Sweden, photogrammetry and remote sensing are part of the university curriculum at the Royal Institute of Technology (KTH), for Master of Science in Engineering ("Civilingenjör") (KTH, 2007) and recently also for a Master of Science with major in Geomatics at the University of Gävle. (Gävle, 2007a, Gävle, 2007b)

The university degree programmes follow practically a 3+2+4 scheme. The basic level consists of 3 years of studies for a B.Sc. degree. The advanced level consists of 2 years for a M.Sc. degree, or alternatively, of 1 year for a "Magister" degree based

on a higher vocational degree. The research level consists of 4 years for a Doctor degree and 2 years for a Licentiate degree. (Högskoleverket, 2008)

The Master of Science in Engineering at KTH is scheduled for five years of studies and counts for 300 credits, which is equivalent for 300 ECTS points. The Master's program in Gävle is scheduled for one year of studies, based on three years of Bachelor's studies, and counts for 60 credits.

At KTH, courses in photogrammetry and remote sensing are given by the Geoinformatics division. The division belongs to the Department of Urban Planning and Environment, whereas the Geodesy division belongs to the Department of Transports and Economics. Both are parts of School of Architecture and Built Environment. At University of Gävle, the courses are given by the Division of Geomatics, which belongs to the Department of Technology and Built Environment.

At KTH, "surveying" can be found within the Department of urban planning and environment. There is a five year M.Sc. in Engineering degree programme, during which it is possible to specialize in Geomatic Engineering (*tekniskt lantmäteri* in Swedish). Courses related to photogrammetry and remote sensing are given during the third and fourth years, and count totally for 31.5 credits (Table 1). The international Master's program in Geodesy and Geoinformatics equals practically to the fourth and fifth year of the M.Sc. program, but has additional 7.5 credits of courses relating to photogrammetry and remote sensing (Table 2).

Year 1	60 cr	Common courses with built environment program
Year 2	60 cr	One course in graphic information systems, 7.5 credits
Year 3	60 cr	34.5 credits of courses in geomatics, from which 16.5 credits in photogrammetry and remote sensing
Year 4	60 cr	Courses in geodesy and geoinformatics, from which 15 credits in laser scanning and digital image processing
Year 5	60 cr	30 credits for Thesis

Table 1. Bachelor and Master programmes in Civil Engineering, KTH Stockholm, in case of specialization in Geomatic Engineering,

Year 1	60 cr	common with Year 4 of the program for civil engineering (see Table 1)
Year 2	60 cr	30 credits for Thesis, 30 credits of courses in geodesy and geoinformatics, from which 7.5 credits in digital photogrammetry or advanced remote sensing

Table 2. International Master Programme in Geodesy and Geoinformatics, KTH Stockholm.

The B.Sc. program of Gävle includes 15 credits of studies on photogrammetry during the second and third year (Table 3). Remote sensing and GIS analysis are subjects within a 7.5 credit course on land management during the third year. An additional 7.5 credits course on remote sensing is included to the one year extension program aiming at Master's degree (Table 4).

Year 1	60 cr	22.5 credits of courses in geomatics
Year 2	60 cr	45 credits of courses in geomatics, from which 7.5 credits in photogrammetry
Year 3	60 cr	15 credits for Thesis, 45 credits of courses in geomatics, from which 7.5 credits in digital photogrammetry, 7.5 credits in remote sensing and GIS Analysis in Land Management

Table 3. Bachelor of Science programme in Geomatics, University of Gävle.

Year 1	60 cr	15 credits for Thesis, 45 credits of courses in geomatics, from which 7.5 credits in remote sensing.

Table 4. Additional Master of Science programme in Geomatics, University of Gävle.

5. RESULTS

In order to get overall picture of teaching of photogrammetry and remote sensing in chosen universities, the amount of credits in ECTS points were aggregated (Table 5). In addition, we were interested in the point of time when these studies are started within study programme.

University	Photogr. and rem. sens. in B.Sc	Photogr. and rem. sens. in M.Sc	Tot.	Photogr. and rem. sens. starts
TKK	20 cr + Thesis, 10 cr	20 cr + Thesis, 30 cr + selectable 20 cr	40 cr +Thesis (10+30 cr) +selectable 20 cr	1st year
TU Wien	13.5 cr + Thesis, 14,5 cr	6-9 cr + Thesis, 30 cr	19.5-22.5 cr	2nd year
KTH	16.5 cr + Thesis	15 cr+ thesis	31.5 cr	3rd year
Gävle	22.5 cr + Thesis 15 cr	7.5 cr + thesis, 15 cr	30 cr + thesis (15+15 cr)	2nd year

Table 5. Comparison of teaching in photogrammetry and remote sensing. All credits are in ECTS points.

When the reformation to fulfill the requirements of the Bologna declaration was completed at TKK, our concern was that the amount of photogrammetry and remote sensing will inevitably decrease. Comparison with other universities reveals that our concern is justified and the same trend can be seen also in other universities. Our solution to this concern was to provide optional module of 20 credits, but only the future shows if we are able to get enough students to arrange these advanced courses.

6. REFORMATION OF TKK IN 2009

TKK will overcome major reformation during 2009. It has been decided that three universities from the capital area of Finland TKK, the University of Art and Design Helsinki and Helsinki School of Economics will integrate in order to create new competence center for education and research. The objective of the reformation is to increase multidisciplinary co-operation both in research and teaching and increase the competitiveness of the university.

The effects of reformation are still unknown. Unlike current system, the new university is not any more a governmental institute but an independent foundation. Government, however, will continue to finance the university. At the moment, it seems that the funding will actually increase, which hopefully gives more resources, especially for teaching.

A long term threat of the reformation is that combining three existing universities as one university will lead to reduction of subjects to be taught. In this process, all small curricula are in danger. Our best method to overcome these threats is to continue high quality teaching and research activities. In the fields of photogrammetry and remote sensing, however, the multidisciplinary co-operation has already been our strength and therefore we are confident that our curriculum will remain as interesting and attractive alternative for students.

7. DISCUSSION

Highly motivated students are able to learn more that unmotivated ones. During the B.Sc. studies, the trend is towards general subjects such as mathematics, physics and languages. Students often complain that it is frustrating to study mathematics and physics without understanding the relevance of these subjects from their viewpoint. If no professional subjects are taught during B.Sc. studies, the students have no contact to Master's subjects. In this case, studying mathematics and physics remain unconnected, which potentially reduces the motivation.

Both the amount of practicing time and motivation are important factors in learning process (Bransford et al., 2000). Time for learning is important in many ways. Even for highly talented students it requires a great deal of practice before they become experts. On the other hand, the length of the learning process can also be significant, because students are usually not able to adapt too much information at once.

It is also interesting that at the same time as the popularity of new technologies make our discipline familiar already among high school students and the children in elementary schools, we would refrain our students to learn the discipline during the first years at the university. On the contrary, we consider that having photogrammetry and remote sensing courses from the very beginning, the students will become more motivated to learn the mathematics, physics and information sciences. They see their relevance to the professional subject studies.

At TKK, students are selecting their majors during the third study year. By then, they should have a good understanding what the available Master's programs include. If the professional subjects are not taught enough before that, on what basis the students are able to make their selection? Most probably, the intuition would play the key-role in selection, in which case the most faddish majors get the majority of students. An example of such case can be found from KTH. When students were selecting the B.Sc. Major, less than 10 students chose Geomatic Engineering, which is practically too few for lecturing Master's courses. Before the selection of the Major, the only course dealing with surveying was "Graphic Information Systems". Photogrammetry and remote sensing had practically no possibility to attract students, because there was no teaching about them.

European-wide mobility of students has also influence on the language of teaching. If complete mobility is wanted, the teaching language of Master's studies should be uniform in all European universities to overcome language barriers. This vision is not necessarily optimal or realistic. Also, it might be against national interests not to provide teaching in the highest level in the native language (Ljosland, 2005). On the other hand, when international students participate in courses, practically, only alternative is to provide teaching in English.

The last 20-25 years of extensive research and development have practically joined the digital photogrammetric and remote sensing applications. Parallel to this, the technical developments within image acquisition have facilitated automatic generation of cartographic data both from air and space. The images are of high spatial resolution, they cover wide spectral range, and they are regularly updated. Most recently, laser scanners have extended the sampling rate of photogrammetric and geodetic points to a meter level.

Nowadays, there is no interest for academic education of such traditional concepts like photogrammetric triangulation or digital mapping anymore, to name two examples only. The mainstream within the university education is evidently on the economic side, i.e. in managing and analyzing available geographic data for various applications. This has increased the educational needs of photogrammetry and remote sensing clearly on the level of applied sciences.

On the contrary, we consider that there still exist significant scientific, educational and professional needs to include photogrammetry and remote sensing courses to the academic curriculum, both on Bachelor and Master levels. The scientific needs become evident if we only consider theoretical aspects like mathematical modeling of new sensors, dynamic registration of manifold spatial data, or understanding physical behavior of various imaging systems, etc. In order to facilitate efficient learning and motivate the students, the courses of the disciplinary subjects have to proceed progressively and become concurrent to the generic subjects.

Finally, professional aspects regarding the personnel at the academia require that the teachers are researchers, and vice versa. Then teaching would be an effective part of research in all levels of curriculum, and optimally this covers the entire learning curve from basic studies to post graduate studies. This

would be also necessary, in order to admire and keep talented and capable people within academia.

8. CONCLUSIONS

The curricula of TKK are successfully reformed to meet the requirements of the Bologna declaration. We have compared our national implementation with other universities from Austria and Sweden and found that there are some differences in both the amount of courses and the points of time when studies of our special field are started. As the result, the comparison revealed that we have managed to maintain a comparative amount of teaching on photogrammetry and remote sensing. Even if the final effect of reformation can be seen only after the system has been working several years, we are confident that teaching of photogrammetry and remote sensing at TKK will be lively and attractive also in the future.

In our opinion, the ongoing trend towards the generic B.Sc. degrees is not pedagogically rational. It is essential to study the own professional discipline from the beginning simultaneously with the basic courses of mathematics, physics and information science. Usually, students are more motivated to learn, if more connections between basic and professional studies are addressed. In addition, to get students for the M.Sc. level there must be possibility to familiarize and advertise photogrammetry and remote sensing to students. Otherwise, the selection of major is most probably done too much using own intuition or relying on the reputation of the discipline. We also feel that young students should be involved in the research activities from the beginning of the studies in order to strengthen professional identity, skills, motivation and international contacts.

The Bologna declaration is unique and major European-wide reformation of higher education. As always, reformations cause distress and resistance, but it is positive that so many European universities have already implemented the common frame for the structure of studies. The process creates also threats such as difficulties to get students in small disciplines and decreasing of credits of individual disciplines. The future will show how well we are able to take advantage of the reformation.

REFERENCES

Bransford, J., Brown, A. and Cocking, R., 2000. How people learn: Brain, mind, experience and school. National Academy Press, 374 p.

European Ministers of Education, joint declaration (1999): *The Bologna Declaration of 19th June 1999*. http://www.bologna-berlin2003.de/pdf/bologna_declaration.pdf (accessed 30 Apr 2008)

Eurydice, 2007. Focus on the Structure of Higher Education in Europe 2006/07 National Trends in the Bologna Process, 349 p. http://www.eurydice.org/ressources/eurydice/pdf/0_integral/086EN.pdf (accessed 30 Apr 2008)

Gävle, 2007a. Högskolan i Gävle, Department of Technology and Built Environment web pabe. http://www.hig.se/t-inst/english/index_e.htm (accessed 30 Apr 2008)

Gävle, 2007b, University of Gävle. Study programme for a degree of Bachelor of Science in Geomatics. http://www.hig.se/organisation/utbildningschef/programkansliet/Utbildningsplaner/Bachelorgeomatics2007.pdf (accessed 30 Apr 2008)

Högskoleverket. Swedish National Agency for Higher Education. 2008. The new structure of programmes and qualifications – webpage. http://www.hsv.se/highereducation/thenewstructureofprogrammesandqualifications.4.5ed111281136ce97c148000493.html

Junnilainen et al, 2006. Initiative for International Master Program in Photogrammetry at the Helsinki University of Technology. Shaping the change. XXIII FIG Congress. Munich, Germany, October 8-13,2006 http://www.fig.net/pub/fig2006/papers/ts34/ts34_01_junnilainen_etal_0732.pdf (accessed 30 Apr 2008)

KTH, 2007. KTH, Department of Urban planning and environment web page http://www.infra.kth.se/SB/index.php?LANG=eng&TB=2&T=2&L=2&M=0 (accessed 30 Apr 2008)

Ljosland, R., 2005. Norway's misunderstanding of the Bologna Process: When internationalisation becomes Anglicisation, Challenges and Future Prospects. Helsinki University 1-3 September 2005. http://www.palmenia.helsinki.fi/congress/bilingual2005/presentations/Ljosland.pdf (accessed 30 Apr 2008)

Studera.nu. Higher education in Sweden portal. https://www.studera.nu/images/18.240194d114444042dd80009314/utb_system.gif (accessed 30 Apr 2008)

TKK, 2008a, Department of Surveying - studies. http://maa.tkk.fi/en/studies/ (accessed 30 Apr 2008)

TKK, 2008b, Master's degree programme in Real Estate Investment and Finance. http://www.tkk.fi/Yksikot/Kiinteisto/opinnot/reif.htm (accessed 30 Apr 2008)

TKK, 2008c, Master's Programme in Geoinformatics. http://gip.tkk.fi/en/studies/mastersprogramme/ (accessed 30 Apr 2008)

TU Wien, 2006. Studienplan für das Bachelorstudium und die Masterstudien der Studienrichtung, VERMESSUNG UND GEOINFORMATION, 22. p. http://www.tuwien.ac.at/fileadmin/t/rechtsabt/downloads/GEO20060630Fr.pdf (accessed 30 Apr. 2008)

ACKNOWLEDGEMENTS

Our deepest gratitude to Hanne Junnilainen, who has done the great effort with the reformation of Photogrammetric and Remote Sensing curricula to follow the requirements of the Bologna declaration.