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Some strategic national initiatives for the Swedish education in the geodata field

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Abstract

This paper describes national cooperation in Sweden launched by its universities and authorities, aimed at improving geodata education. These initiatives have been focused upon providing common access to geodata, the production of teaching materials in Swedish and organizing annual meetings for teachers. We argue that this type of cooperation is vital to providing high quality education for a poorly recognized subject in a country with a relatively small population.

Keywords: GIS, geodata, education, teaching material, spatial data infrastructure

1 Introduction

This paper describes some strategic national initiatives that have advanced Swedish geodata education during the last decade. The aim of these initiatives has been to improve cooperation between universities that provide geodata education, as well as between universities, authorities and the society. We argue that these cooperative initiatives are necessary to sustain the continuing development of a poorly recognized and financed subject in a country with a relatively small population.

Most universities in Sweden provide short introductory GIS courses. In 2006 the total number of courses were 145 [3], and it is estimated to be similar today. Four universities have study programmes where GIS is a core subject: Lund University (Master's programmes, both campus and distance learning), Karlstad University (Bachelor's programme), the Royal Institute of Technology (Master's programme), and University of Gävle (Bachelor's and Master's programmes).

Besides the specifically GIS-oriented programmes, closely related programmes offered in Sweden are programmes in land surveying, spatial planning, geography and landscape architecture. In land surveying education Lund University and the Royal Institute of Technology have engineering programmes (5 years), and University of Gävle and University West have bachelor of science/engineering programmes.

In addition to the traditional university programmes, there are several shorter GIS and surveying programmes of one or two years in length with the aim of developing professional and practical skills.

Overall, the number of courses in the geodata field has certainly increased during recent decades. But this increase mainly consists of an extensive number of basic GIS courses in programmes where it is not a core subject, and in shorter practical programmes. In education at the master's level, where geodesy, photogrammetry and cartography are the core subjects, availability in Sweden has decreased.

Some trends during the last 15 years that have triggered the national initiatives described in this article are:

- a rapid increase of the utilization of geodata in society
- an increased need in society for competence within GIS, geodata and related topics
- the Bologna process induced student mobility
- the EU directive INSPIRE.

2 National cooperations

2.1 An Educational section in the Swedish Cartographic Society

In 2006 an educational section within the Swedish Cartographic Society was formed. The aim was to fulfil the need for a common platform for educational matters at all levels, and for increased student recruitment within the areas of interest for the Swedish Cartographic Society, such as land surveying, spatial planning, geography and geomatics [4].

An important issue encountered during the first years of the educational section was the operationalization of the Bologna model in 2007. The purpose of this initiative was to make higher education in the EU member states comparable in terms of levels, credits, grades, etc., in order to facilitate mobility of students between universities. In this respect, GIS, being a broad and young subject, is apparently "problematic". As shown in [3], many universities in Sweden at that time provided both GIS-related courses and complete study programmes at both bachelor's and master's level. If and when students wanted to switch programmes or continue their studies at another university, the validation of syllabi in relation to prerequisites for further studies was often difficult. Therefore, in an attempt to improve both cooperation between universities and to produce GIS course syllabi in line with the new Bologna rules, the educational section of the Cartographic Society decided to develop a harmonized syllabus template (see [5]). This template can be used for any subject area where GIS is given as an introductory course. Thanks to the specified learning outcomes, it is now much easier for the receiving university to decide if a student can be admitted to their more advanced courses.

The educational section of the Swedish Cartographic Society also arranges an annual conference for teachers at all levels as well as other interested parties. Here educational matters pertaining to land surveying, spatial planning, geography and geomatics are discussed. The aim of the conference is to facilitate the sharing of experiences, to improve collaboration opportunities, networking and competence development, and to enhance course quality and recruitment of new students. The conferences usually have a special theme each year; recent examples include "the job market and education", "open geodata for education and research", "remote sensing in bachelor and engineering programmes", etc. The conference attracts mainly teachers with GIS interests, which is also reflected in the conference programme.

In order to reach new participants, the location and hosting educational institution of the venue has changed each year. Since 2012, the conference is arranged to coincide with Swedish Map Days every second year, in order to highlight the importance of education at the largest national event within the field. The presentations are normally published on the website of the Swedish Cartographic Society and a short summary of the educational conference is published in the Society's journal Kart & Bildteknik [2, 6, 10].

2.2 Common access to geodata

The production of geodata in Sweden is, as of February 2014, only partly financed via taxes and hence the responsible authorities partly rely on fees to defray costs. With the increased utilization of geodata it was quickly realised that easy access to data for education and research purposes was needed at low cost. Between 2004 and 2011, universities had access to basic geodata for a highly reduced fee through an agreement between the National Library of Sweden and Lantmäteriet (the Swedish mapping, cadastral and land registration authority). Because of organisational and legal changes, this agreement ceased to be in effect in 2012.

In response to the changed situation and ongoing developments regarding data access, both at the European and national levels (EU directive INSPIRE), the Association of Swedish Higher Education and the Swedish Research Council jointly sought a national solution that would ensure that all universities would have continued, easy access to various types of spatial data from national data producers.

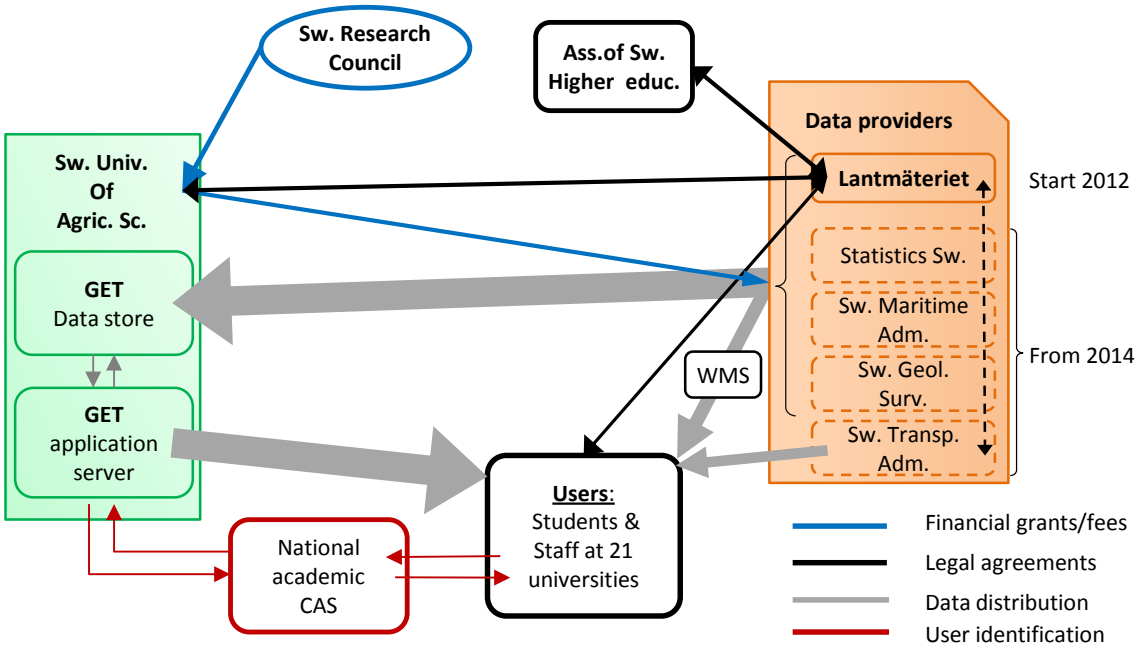
A growing awareness of the importance of geodata resulted in the Swedish Research Council, as part of a national investment in research infrastructure, granting financing for the years 2012-2016. The grant covers data licence fees, distribution service development and the assessment of long term solutions. The basis for implementation is cooperation and the development of common national solutions. It was agreed that the Swedish University of Agricultural Sciences would develop and operate a distribution system that would serve all universities. A prerequisite was the utilisation of existing national infrastructure for user authentication to which almost all universities are connected.

During the initial two years, data from Lantmäteriet, e.g. digital general maps, elevation data, and aerial photographs were included. The distribution system, GET (Geographic Extraction Tool), was successfully developed and made available in 2012 and the service has found widespread use. During the first 16 months of operation the service had about 5,000 unique users from 21 different universities, and the number of downloads were about 1,000 per week. Data and distribution are, among other subjects, discussed in academic users meetings organized by Lantmäteriet and a hosting university twice per year.

During the period 2014-2016 the aims are to (i) enhance and expand the GET service, (ii) incorporate more licensed data, and (iii) evaluate different long-term administrative and financial solutions.

Some examples of geodata that will be incorporated and made available are quaternary deposit mapping from the Geological Survey of Sweden, hydrographical data from the Swedish Maritime Administration, gridded population data from Statistics Sweden, and the National Road Database from the Swedish Transport Administration. In the future, the plan is to further develop the GET application so that service providers can choose between open source and proprietary software when deploying the service.

Figure 1: Technical and organizational outline of data provision via GET and WMS



Looking ahead, the INSPIRE directive will require Government authorities to publish download services for many of their geodatabases. If the GET service is modified to incorporate these download services as data sources, end users would be able to benefit from a familiar interface and access to even more information.

2.3 Facilitating GIS training in schools and innovations based on geodata

Lantmäteriet is leading a project together with the municipality of Västerås with the aim of integrating the use of geodata and spatial analysis in high school education. Since 2010, the national curriculum of geography states that pupils should develop skills related to GIS, and this is therefore the focus of the project's first phase. There is a general lack of knowledge of GIS among upper secondary school teachers, to help support them, the project will provide a website containing both data from national authorities and local municipalities, as well as tutorials and exercises directly related to learning outcomes in the curriculum. A prototype for the site will be available in spring 2014 and will then be tested by teachers.

Thirteen of the national spatial data producing authorities have worked together to plan a public hackathon event, "Hack for Sweden", which will be held in March 2014. The target groups are students, developers and data journalists, who could create new smart services based on spatial data (www.hackforsweden.se).

3 Teaching material in Swedish

Two examples of Swedish literature in the geodata field are described below. The main audience of this literature has been university students but it has also attracted a professional audience, and. is e.g. currently recommended reading Lantmäteriet's "Handbok i mät- och kartfrågor", which is a series of guidelines for surveying and mapping aiming to facilitate standardized handling of geographical data.

3.1 Text book in GIS

In 1995 the first GIS book in Swedish was published [9]. This book, together with English literature, was used in GIS courses in the late 1990s. However, there was a need of a more comprehensive book in Swedish. In 1999 Byggforskningsrådet (a research foundation), ULI (the association for geographic information in Sweden) and the GIS Centre at Lund University published the first edition of the book *Geografisk Informationsbehandling* [7]. The book had nine authors from three universities and the national mapping agency.

The book has since the first edition went through several major and minor revisions. The sixth edition was published in 2013; now by a commercial publisher (Studentlitteratur) [8]. The number of authors had increased to nineteen representing three universities, the national mapping agency, two private companies and one municipality.

There are advantages and disadvantages to having the large number of authors that collaborate to produce this book. The main advantage is that many perspectives are included in the book. This is especially important as the book is used in

courses with diverse student groups (engineers, geographers, forestry and agriculture students, etc.). The main disadvantage is the effort required to reduce heterogeneities in the book concerning content, structure and language, which has made the editing process significantly more difficult.

An important question is whether it is economically viable to publish a comprehensive GIS book in Swedish when there are English alternatives. To make economic sense, the book must be used by all, or at least most, universities that provide basic GIS courses. In this respect, the book has been successful. It has been used by most universities and university colleges in Sweden for more than a decade. The book has sold around 1000 copies each year. This has not been particularly profitable, but it has given the authors and their employers fair compensation for the significant time and effort that has been devoted to the book project.

We believe that there are two strong justifications for continuing to produce a national GIS book. The first is to create and maintain a national, in this case Swedish, vocabulary in the field. Of course, such a vocabulary is also promoted by the Swedish Standards Institute, but our experience is that it is important that a proper vocabulary is provided in basic university education. This is facilitated by the current situation at Swedish universities, where bachelor's education is principally given in Swedish, and subsequent master's education in English.

The second reason to have a national GIS book is that some of the pertinent content is truly national in nature. For example, the book has one chapter describing Swedish geographic data infrastructure and another contains description of the national geodetic reference systems. Also, a substantial part of the practical examples in the book are nationally-sourced; this familiarity of context has pedagogic value for Swedish students.

3.2 National compendium in geodesy and photogrammetry

There are several types and levels of education in Sweden, such as vocational training, bachelor's and master's programmes, where surveying courses are part of the curriculum. In many cases, older or obsolete literature has been used, which does not reflect the latest trends and technical innovations in surveying. Moreover, the terminology and level of detail are different in different programmes. This situation provided the main motivation to write a new compendium [1], covering the most important topics in surveying. There are eight authors; four of them are active lecturers at Swedish universities (Royal Institute of Technology, University of Gävle and Lund University), two authors work at Lantmäteriet and two are working at private companies (Blom and Tyréns). The production of the compendium was financed by the employers of the authors and by a contribution from the Swedish Cartographic Society.

The compendium is written in Swedish and covers the following topics:

- geodetic reference systems
- cartographic projections
- terrestrial surveying instruments and methods
- uncertainty in measurements and the least-squares method
- GNSS surveying
- photogrammetry
- terrestrial and airborne laser scanning.

The compendium is published electronically and protected by a Creative Commons by-nc-nd license, which means that anybody can copy and redistribute the compendium for non-commercial purposes, but it must be properly referenced and is not allowed to be modified. There are two main reasons why it was decided to publish the compendium electronically: to maximize availability and flexibility. As the main aim was to produce a common textbook in basic surveying suitable for all relevant programmes in Sweden, it was a natural choice to publish it on Lantmäteriet's web page. Electronic publication also has the advantage of easy updating. All source files are available to all authors on-line via a cloud service. Currently the Royal Institute of Technology is responsible for update management.

We have strived to spread the compendium as widely as possible. Therefore, we have chosen to use a Creative Commons license, rather than a book with copyright. The market for literature in geodesy and photogrammetry is also considerably smaller than for GIS, and it would probably not have been economically feasible to spend the extra time to create a book based on the compendium.

4 Concluding remarks

Education in the geodata field has undergone some significant changes in Sweden. There are more universities providing courses in the field (mainly basic GIS courses) at the same time as education offerings on master's level are on the decline. Meanwhile there is an increased need in society for competent personnel. To cope with this situation, cooperation between the universities and with other national bodies, e.g. geodata producers, is vital. In this paper we have described some common initiatives, including teaching material, development of course syllabi, common portals and financial solutions for geodata access, as well as teachers networking. We believe that this cooperation is essential to maintaining the quality of geodata education in Sweden. One indication that geodata education has achieved a good level of quality was the quality assurance evaluation in 2012-2013 by the Swedish Higher Education Authority. In this evaluation, all science and engineering educational programmes were evaluated, and the results were overall good for the programmes related to geodata.

References

[1] B. Andersson, A Boberg, L Harrie, M. Horemuz, P.-O. Olsson, C.-G. Persson, Y. Reshetyuk, and H. Rost. *Geodetisk och fotogrammetrisk mätnings- och beräkningsteknik*. Nnational Swedish compendium in S urveying. KTH, Lantmäteriet, Högskolan i Gävle, Kartografiska sällskapet and Lund University, 2010.

[2] J. Bohlin. Rapport från årets utbildningskonferens (in Swedish). *Kart och Bildteknik (Mapping and Image Science)*, 2011(3):18, 2011.

[3] S. A. Brandt, J. M. Karlsson and P. Ollert-Hallqvist. Harmonization of GI educations in Sweden and the Bologna process - viewpoints of University of Gävle. In *Proceedings of the Fifth European GIS Education Seminar (EUGISES 2006)*. September 7-10, 2006, Cracow-Pieniny Poland, 2006.

[4] S. A. Brandt and A. Larsson. Kartografiska Sällskapets utbildningssektion – ett nytt tillskott i KS-familjen (in Swedish). *Kart & Bildteknik (Mapping and Image Science)*, 21(2):10-11, 2006.

[5] S. A. Brandt and W. Arnberg. A harmonized GIS course curriculum for Swedish universities. In *EUC'07 HERODOT Proceedings, ESRI European User Conference*, Stockholm, Sweden, 25-27 September 2007.

[6] S. A. Brandt. Rapport från Utbildningssektionens årliga utbildningskonferens (in Swedish). *Kart & Bildteknik (Mapping and Image Science)*, 2009(3):18-19, 2009.

[7] L. Eklundh, editor. *Geografisk informationsbehandling – metoder och tillämpningar* (in Swedish), 1tt edition. Byggforskningsrådet, Stockholm, 1999.

[8] L. Harrie, editor. *Geografisk informationsbehandling – teori, metoder och tillämpningar* (in Swedish), 6th edition. Studentlitteratur, Lund, 2013.

[9] B. Malmström, and A. Wellving. *Introduktion till GIS*, ULI, Gävle, 1995.

[10] R. Nyberg. Rapport från årets lärarkonferens (in Swedish). *Kart & Bildteknik (Mapping and Image Science)*, 2010(3):18, 2010.