Evaluation of study programmes in Geomatics offered by Department of Mathematical Sciences and Technology at Norwegian University of Life Sciences (UMB)

EXTERNAL EVALUATION REPORT

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1. INTRODUCTION

The evaluation of the Bachelor and Master Programmes in Geomatics at the Norwegian University of Life Sciences (UMB) was initiated as a result of the application of the Quality Assurance System created by the University. The main goal of this process is to receive information and feedback from students, teaching, management and administrative staff, alumni and employers to identify strategic weaknesses and strengths and to improve the educational process.

The External Evaluation Committee (EEC) received the Self-evaluation report by the 1st of October, 2007, having sufficient time to read it and analyse it before the visit to the UMB campus. The Self-evaluation report was well prepared and extremely useful, particularly in order to have a general background of the programmes evaluated, providing additional specific information in the form of appendices and virtual links.

The visit to the UMB campus was made from October 29th, 2007 to November 2nd, 2007, being perfectly organised by the responsible team for quality assurance at the University, and the EEC found a very open and helpful attitude from all of the people interviewed during the week. The EEC interviewed to the following stakeholders: Management staff and Heads of the IMT Department and the Education Committee, the Rector of UMB, the Study Counsellor, Teaching staff representatives and the people responsible for the Self-evaluation report, Bachelor and Master Students in Geomatics, and a User Panel composed of Alumni and Employers from the Private and Public sectors.

The interviews were combined with visits to the IMT Department, laboratories and classrooms, follow-up meetings, and committee's own work meetings. At the end of the week, a presentation with the preliminary conclusions was made to different members of the university community.

The EEC members were able to work, debate and exchange different viewpoints about the principal aspects related to the Geomatics programmes. The elaboration of the evaluation report includes the opinions of the five members, and all of them have participated in all sections, wishing that the comments and recommendations gathered in this report be useful to improve the quality of the programmes and contribute to the sustainability of Geomatics education at UMB.

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2. EVALUATION OF THE PROGRAMMES

2.1. EDUCATIONAL PROGRAMME

Learning goals

Evaluation of Geomatics programmes must be made in a historical perspective and related to the general development in European universities. In the following there is a short discussion about the development of the university education of "surveying and mapping" as well as a brief reference to general European trends in the organizational changes of universities.

In general, the history of the educational programme and the developments made since the beginning of the teaching of land surveying at the university is very similar to the history and development of most of the universities in Nordic countries and in Europe. In the "history" (about a hundred years ago) surveying (Geodesy) was one of the core and more respected topics in technically oriented colleges and polytechnic schools. Until the 1970´s the situation was almost stable and surveying sciences (Geodesy and Photogrammetry) had a relatively good position in academia and in practice. Then during the development of IT technology (1970-80), that also came to be a part of surveying science, the position of Geodesy and Photogrammetry was partially taken in by new fields like Remote Sensing (RS) and finally Geographic Information Science (GIS). The role of the traditional part of surveying and mapping sciences has become smaller if compared to the number of courses given in the educational programmes. However, from a substantive point of view, theoretical basis of measurements is still very important as such and sets the foundation for newcomers like RS and GIS, as well as acts as the scientific basis for modern positioning and data collection methods like GPS and laser scanning.

At the same time as the consequences of the technical development, organizational development of universities has taken place. The tendency all over Europe has been to improve the economy of the universities by decreasing the amount of departments and decreasing the autonomy of lower level organizational units at universities (professors and the laboratories led by professors). In practice this has also led at UMB (as well as in many other universities) to the need to analyze the economy of each educational programme and based on strict, established rules. Additionally, this has led to decisions about the educational courses that should no longer be lectured, because of a lack of sufficient students. The need for efficiency in the educational system has led to a reduction in surveying (Geodesy and Photogrammetry) in many universities and this seems also

to be the future at UMB, if no changes are made. There are, in practice, too few students in the courses of surveying, too few graduate, and there are practically no postgraduate students at all at the moment.

Admission profile

The 3 year bachelor programme is very adaptive towards admission requirements with the different approaches for different skills in mathematics and physics. The approaches lead to different specializations for the bachelor with courses in the general study plan being exchanged with mathematics and physics courses necessary for acquiring the needed basic skills. It is recommended to reconsider the adaptive approach for the admission requirements and offering pre-courses in mathematics and physics prior to the study programme – resulting in a quite uniform programme for the 3 year bachelor.

Considering the master programme, given that students with different backgrounds, including potential international students, may be recruited to the last 2 years of the master programme, it is necessary to provide an adaptive admission policy.

Structure of the programmes

The courses offered in the field of Geomatics are highly adaptive in content and teaching methodology, as a result of the low number of students involved in the courses, and it is considered as satisfactory. In the master programme, the students have several different specializations to choose from and can compose their own set of courses freely with limited restrictions. Students find this satisfactory, however, it is recommended that the limitations be formalized more strictly.

The contents of the Geomatics programme have been developed according to the trends of technology, also adapting quite well to the needs of society. Course contents, in general, are comprehensive and the programme structure is well planned, though some changes could be made in order to avoid overlapping between B.Sc and M.Sc degrees, and to differentiate clearly between the degrees with regards to goals and identity, in terms of specialization of the students.

The analysis of the educational programme and the learning goals at the B.Sc and M.Sc levels raises some questions: Why is there a separate B.Sc programme that enables and even supports the student to finish only the lower level degree? Having these two overlapping study options decreases the efficiency of teaching resources, and there may be too much emphasis on the

orientation towards practical training during the first years. The question is whether a university and the teaching should be focused on a scientific level and aim towards a M.Sc degree instead of a B.Sc degree. The students feel that they can get good enough jobs and salaries after B.Sc studies, and there is not much additional value to continue studies to the M.Sc level. However, from both a societal and scientific perspective, the Master students are more highly appreciated and needed. This makes the situation difficult, and it should be changed.

Another aspect of the educational system that needs to be faced is the lack of cooperation with other departments at UMB. Geomatics and its technological potential is not known within the university. As an example, GIS is taught in other departments as well. However, GIS is not only a technical tool but has a deep scientific basis in Geographic Information Science, as a part of Geomatics. In the Geomatics Section there is a well designed set of courses on Geographic Information Science, perhaps some extensions to the direction of application development and GIS software engineering might give it more projection and usefulness. Other departments should realize the importance and possibilities of GIS and spatial analysis techniques in their own research, and the Geomatics Section should demonstrate to them that GIS is more than a tool. The GIS teachers in the programme are internationally known academics, and they should be able to support other departments and research groups. All GIS education should be integrated and geomatics should have a leading role in that. The practical use of different geomatics disciplines in research at other departments should be supported by the Geomatics Section.

2.2. TEACHING ORGANISATION

Management and Planning of the educational programme

The study programmes at UMB belong to, and are managed by, the respective departments. The departments are responsible for providing the professional and scientific content and structure of the programmes, while the UMB Education Committee ("Studienemnda") must formally approve the programmes. Within a department, the local education committee ("Undervisningsutvalget") has the responsibility for the programmes of the department, while the practical work is delegated to a programme committee.

There are a number of rules and regulations regarding form and contents of programme descriptions at UMB. Among those are rules to ensure that a minimum number of credits from courses at different levels, as well as an adequate number of programme-specific courses.

To assist the students in choosing courses and specialisation, there is a Study Counsellor. His task is to ensure that each student has a study plan in accordance with the rules and regulations. He should also guide the students to combine courses that fit logically together. However, there seems to be a reluctance in denying the student's choice, as long as it meets the general rules. It is unclear whether this is based on the regulations (lack of authority to deny), or if it is only based on a wish to not be "rude", and thus keep the student in the programme. Anyway, this may have the consequence that a student enters a course without the necessary knowledge base, which leads to further negative consequences for the student, his fellow students, and the teachers. This can be avoided if the prerequisites proposed in each course are used as argument to refuse unwanted combinations of courses, and the Study Counsellor has the authority to better make the students follow the advice given, which will then be well founded.

Communication and Dissemination of the programme

The two study programmes in geomatics are communicated to the public in several ways, such as distribution of brochures, advertising in newspapers and professional journals, and on the web pages of the university.

It seems, however, that the term and subject "geomatics" is more or less hidden or even absent in material from the university that gives general information about the studies at UMB. Therefore, the geomatics studies are not visible to most prospective students who have not decided their goals of study yet. The term geomatics is not yet well known among the general public. Also for this reason, it is important that the university makes their study programmes and other activity in this field visible in all relevant material. As mentioned above, other departments at UMB need the geomatics technologies (GPS and other positioning methods, aerial and satellite images, and GIS tools), so the communication and dissemination should be additionally done at this local level. These departments could be advised to encourage their students to participate in the courses organised by the Geomatics Section, instead of organising their own courses.

On the web pages of UMB, it is relatively easy to find the study programmes in geomatics – if entering the pages for study offerings. The Geomatics Section, the research activities, and the staff, are somewhat more difficult to find. This is relevant, because prospective students may want to explore the environment and their potential future teachers before making their decisions. Thus, the web pages should be modified to make it easier to find the geomatics environment at UMB.

In the official Study Guide (“Studieguide”) and Course Catalog (“Studiehåndboken”) the study programmes in geomatics as well as all relevant courses are properly described, similar to any other programme.

Members of the staff at the Geomatics Section have been in the media with examples of geomatic applications, thus conveying knowledge of geomatics. However, there is a potential for increasing this kind of activity, and it is a challenge to include the term “geomatics” in a way that makes it known to the general public as the general term for popular topics like GIS, maps, GPS, etc. Geomatics staff should make their personal activities more well-known and also give the possibility to the students to be involved in them. In addition to personal projects and private visits abroad or to companies, professors and senior teachers could organize projects with students on research and education. Students should be more informed about these activities.

There are also other outward activities: Students from UMB go to secondary schools to talk about what geomatics means. There are also arrangements for students from schools to visit UMB and the Geomatics Section. The staff at the Geomatics Section has created a “Geomatics Toolbox” for teachers in secondary schools, and also a related course for teachers is offered. This type of activities should be continued and improved.

As indicated in the above descriptions, “geomatics” as a term, as a profession, and as study programmes, is not sufficiently brought to the public, and it still needs some time to be properly disseminated, so it is advised to be used together with other more popular expressions, such as 'Mapping sciences' (or 'Karttekniske fag'), 'GPS and Positioning', GIS, etc.. It even seems that the term, as well as the offerings of the Geomatics Section, are not well known within UMB itself. “Geomatics” should be made more visible in all relevant material from UMB, internal as well as external. Those making the informative material must be aware of the existence of geomatics, and then they should solicit the information to be filled in at relevant times, and not rely on information to be “pushed” from Geomatics Section. In the end, it is a responsibility not only of the Geomatics Section, but particularly of the central management at UMB, to ensure that relevant information is present in dissemination material from the university, and to arrange for a cooperative environment at the university.

In general, the organisation processes such as registration, timetable planning, calendar of tests, etc., are properly managed and efficiently coordinated, and no complaints have been made by teachers or students.

International mobility

In principle, UMB and IMT are positive to student exchange. There are however few formal specific agreements concerning geomatics between UMB and other universities. Students go abroad on individual arrangements. The central international office at UMB advises about administrative procedures and destinations, but further information regarding geomatics topics is required by students, in order to organise their study plan. Much is based on personal relations between teachers (the teachers' personal acquaintances). Exchange may also be based on students' own research among universities.

UMB is urging students to go abroad for one or two semesters. The department also says that they support this. At the Geomatics Section, some teachers have occasionally experienced practical problems with students taking a year or a semester abroad, and seem to be somewhat reluctant. However, they try to support those who wish to go, by conveying contacts to places they know. Over the last four years, six students have spent one or two semesters at a university abroad. In this sense, it seems to be necessary to offer specific destinations in the field of geomatics, knowing in advance the type of courses and practices that the students can expect. This could be improved with a co-ordinator for international exchange at the department level, or involving teaching and research staff as moderators of international mobility. International acitivities (guest lecturers, international research projects, etc.) should be visible and tangible for all students from the first year to the postgraduate students. In addition, these specific agreements would help to increase the rate of incoming of students.

2.3. HUMAN RESOURCES

The committee interviewed key staff members and met most of the staff briefly (annex 1). Information about staff was also available in the Self-evaluation report and on UMB web-pages.

The average qualification level of staff is high and specialized. With the low number of students this gives a very high teacher per student ratio and a good learning environment. The teaching staff has a good attitude for improvement of knowledge, showing potential and a positive attitude towards teaching in English when necessary. This is an open door for incoming students (Erasmus, etc), and to promote international activities.

The staff is mainly oriented towards Geodesy and GIS, with only one person on the more traditional side of mapping, such as Photogrammetry. This makes this field particularly

vulnerable. Information Technology, Mathematics and Statistics are covered by other sections in IMT.

Most of the scientific staff has taken courses in university pedagogy (ref. Self-evaluation report). The evaluation from students is reported to be somewhat lower than the average for the University, on a satisfactory level (~4) on average, but with significant variations between different courses.

The teaching staff has made a remarkable effort over the last several years, improving their research results by increasing their publications in impact journals. However, in general, the working culture in the Geomatics Section seems to be individually oriented and not focused on collaboration and sharing. This is reflected in the low attention to common strategies and actions (e.g. marketing strategy) and also in the fact that collaboration in other GIS-activities at the University is poor (as mentioned in section 2.1).

Strengthening the field of photogrammetry, possibly through more formal collaboration with other photogrammetric environments in Norway like NTNU, is recommended.

It is important to start working with the culture in the Geomatics Section through management actions, and making it more oriented towards collaboration and sharing.

On an individual basis, the teachers include their own research in the programme well. However there seems to be a lack of transversal projection in the university and a lack of collaboration with other groups from the university. This situation leads to an internal isolation, not being understood from other groups or departments at UMB.

The administration and services staff belongs to the IMT department. There is no lab-technician dedicated to the Geomatics Section. In some cases, this leads to a situation where the scientific staff must employ part of their time to do practical work in setting up computers, preparing for exercises etc. The students do not perceive this as a problem, but it may decrease the efficiency of the teachers work. One way of solving this could be to involve the students more in this practical work.

2.4. MATERIAL RESOURCES

Classrooms and working **spaces** are, in general, adequate to the expected standards and to the current number of students registered in both programmes, BSc and Ms. The working spaces for

students are divided into several categories: Computer labs for individual use and group rooms for collaborative work. The computer labs are in general shared among the UMB in addition to one lab specifically for the Geomatics Section. Both are well equipped and students seem to be satisfied with them. As for group rooms there are no specific rooms dedicated to collaborative work among students. However, shared rooms at IMT and specific labs are used for this by the students and serve as a replacement, so it is not a problem considering the current number of students. Hence, there is not an explicit need for rooms dedicated to the Geomatics Section among students.

Laboratories provided by the Geomatics Section are in general adequate. The computer lab has sufficient and updated materials both with respect to hardware and software. All laboratories are used in the educational process and this is considered to be a good approach for both quality of education and good use of resources.

Libraries are in the form of physical material and subscription to electronic versions. Students seem, especially at the bachelor level, to not be using the libraries much. One reason for this seems to be the lack of need to use additional resources in the learning process. With respect to the content of the libraries, they are considered to be updated and therefore in a good state.

Materials used in the teaching process consist, in general, of printed material, books and handouts. Additionally an e-learning, web-based, system is used for communication and distribution of files among students and teachers. The web system works well according to its intention, but could be more integrated with the actual lecturing and teaching methodology used. However, both students and teachers seem to find the system adequate. The quality of the printed material varies among the different sub-disciplines and courses. Sometimes, students find the books and defined syllabus to be difficult to assimilate and prefer the printed lecture slides and handouts in their study process. In these particular cases, the adaptation of materials to the contents of each course is recommended. However, this should not be of first priority since the students are generally satisfied with the handouts and lecture slides.

2.5. EDUCATIONAL PROCESS

Recruitment and Sustainability

The Recruitment rate for both study programmes offered in Geomatics is very low. Effort has been made in an attempt to increase the number of students, but they have had little or no effect.

In the bachelor programme there have been a fair amount of students but that number has been decreasing over the last several years. In the 5 year master programme there has also been a fairly low number of students. A crucial problem lies within the bachelor programme, which is intended to be a starting point for the master programme. There are very few students that transfer to the 5 year master programme after completing the bachelor degree. One factor that affects on this is the very good labour market found in Norway – resulting in students preferring to get a job quickly rather than aiming for a master degree. There seems to be a lack of information and differentiation among the two degrees. The differences should be emphasized more; especially the benefits achieved by a master degree.

The strategy for recruitment should be focused on attaining qualified students or in qualifying the students before admission. In addition, the strategy should emphasize on the recruitment for the 5 year programme and the recruitment of international students for the last 2 years of the programme. This would result in less emphasis on the 3 year bachelor with the rationale that this is an additional entry point for the 5 year programme and not a preferred way of studying Geomatics. The strategy should be based on the future needs posed by the labour market, as well as on the overall intention for the 3 year bachelor programme, being an entry point for the last 2 years of the master programme.

Concrete approaches for a recruitment strategy could rely on elements discussed in sections 2.2 (Teaching Organisation) and 3.2 (Recommendations). The competition is fairly low in Norway for master studies in Geomatics, with NTNU in Trondheim as the main alternative for a 5 year master programme. Competition for the scientific 3 year bachelor programme is somewhat higher, however there seems to be some confusion on what the 3 year bachelor programme is focusing on – leading to competition from 3 year studies (bachelor and non-bachelor), often in land-surveying, given by university-colleges. The differences should be, as mentioned, emphasized in the recruitment strategy.

The economic sustainability is partially based upon the number of students and their achieved ECTS, and it is clearly suffering because of the lack of students admitted, which is threatening the continuity of the programmes. However, the potential for economic sustainability is very high, due to a high demand on professionals in the country; the ideal number of students is considerably higher than what is now produced.

Socialization Strategy

Socialization strategy for admitted students focuses mostly on students admitted to the first year in both the 3 year bachelor and 5 year master programme. The strategy consists mostly on the first few weeks of the study, with social activities in groups to get to know each other. These activities work well and introduce the students to each other and to the field of Geomatics as well as for the university as a whole. However, the existence of social strategies further on in the studies seems to be missing. In the first year the students have several courses shared by other study programmes which lead to a lack of a sense of belonging to the section of Geomatics. It is advised to reinforce the identity of the Geomatics Section throughout the first year and possibly in later years. As mentioned, the socialization strategy is mostly focused on first year students. This should be modified in a way that comprises all new students admitted to the programme of Geomatics, specifically including (international) students admitted to the last 2 years of the master programme.

The use of student assistants acts partly as a socialization tool and it is encouraged that this aspect be maintained and refined. This is further discussed later in this section.

Professional Orientation Strategies

Professional orientation strategies for the students aim at preparing the students for real-life work. Considering the professional orientation, with respect to real-life application and preparation, the mechanisms provided are more or less on an ad-hoc basis. Collaboration with industry is on an informal level, with some guest lectures, master thesis and visits to industry. The collaboration with industry is recommended to be strengthened and formalized through formal agreements. The rationale should be to emphasize on practical applications and orientation towards applications in industry – especially for the master programme. Some mechanisms informing the students about their future professional career should be prepared through the educational process, in order to motivate the students and make them aware of the usefulness and applicability of the knowledge and skills learned in the courses.

Tutorial Action Programme

Tutorial action programme for the study program is in general satisfying. The strategy mainly consists of an official study counsellor, responsible for the department, and the “open-door policy” found at the Geomatics Section. Both students and staff seem satisfied with this

approach. The result of this is that the students themselves are responsible for obtaining information and the information provider is the staff at the Geomatics Section. The main challenge with this approach is that the information does not reach all students. Additionally, it results in no official guidance programme for the Section, which could decrease the level of information obtained by external channels – such as the public, potential students etc.

Teaching-Learning Methodology

Teaching-learning methodology consists, in many courses, of traditional approaches, including lectures, individual assignments etc. Since the proportion of the teaching staff related to the number of students is high, the overall quality is increased and, as mentioned, the degree of adaptation for the lecture is improved. Exercises given to the students seems to be mostly individual or as a group-assignments. There is little use of project- and problem-based learning methods, and this could be enhanced. Recommendations include: Team-work with real-life applications, as mentioned earlier, collaboration with industry, and, in general, more emphasis on team-work.

The educational programmes as such (including the contents of the courses) are quite adequate. The shortcomings in teaching are in the lack of formal contacts with the “real world”, organizations and private companies in the field. In many universities project oriented and problem-based learning (PBL) has been found to be a very good educational method. The teachers contact companies and organizations and get topics for projects. The students have to contact the companies, visit them and interview the employees. They have a problem to solve and this work is done under the supervision of the university professor. The results of the work are then presented to the organization/company. This kind of cooperation (in which no money is transferred) can lead to cooperation in research and real contracts. Example: municipal geodetic network measurements can be organized as a project in which the university provides the contract, the teachers take the responsibility and the students do the work. Students can get the feeling of doing a “real project” and the university is paid so that at least the costs of students and teachers are covered. If the project is on GIS development there can be some continuation that can lead to a research project and contract. This situation makes it possible to employ a paid postgraduate student at the university. It keeps the educational contents of courses updated and introduces some teaching methodologies that increase the motivation of students. Like in all other universities the government budget funding has been decreasing and that trend will most likely continue. The contract based cooperation with companies and other institutions is

currently the only way to keep the university activities alive. This may be a very strategic point to be developed in the educational system of geomatics at UMB.

External lecturers are being used. However, external participation could be exploited more intensively, with emphasise more towards a collaborative setting and not purely motivated by staff-shortage. It is recommended that formal collaboration be formed with industry with the rationale that both parties are benefitted from the collaboration.

Learning Environment

Psychosocial learning environment at the study programmes is, in general, very good. The interaction between students and teachers/staff is mostly based on students' individual initiatives and relies upon the "open-door policy" that most of the staff have, as discussed previously. In general, students are satisfied with this method of interaction. An element to emphasize is that the students are very satisfied with the social environment found at the Geomatics Section and at UMB in general.

However, the students seem to be somewhat less integrated with formal decision making at the Geomatics Section. It is recommended to focus more on the formal integration of students in the Section.

The use of student assistants is encouraged and could be exploited even further. Primarily student assistants are used to provide guidance in assignments. This could be scaled up to include assistance on several levels, for example as technical assistants. The primary issue with student assistants is the difficulty for recruitment, mostly caused by the few students available and probably a lack of information on the benefits achieved by being a student assistant.

Evaluation Methods

Evaluation methods used in assessments of the students are, in general, quite traditional, mostly consisting of one final written exam. There is some use of other evaluation methods, such as oral examination and evaluating the final exam together with assignments carried out during the semester and weighing them typically at 80% for the final exam and 20% for the portfolio. The use of project-based evaluation is limited and should be considered together with the, already mentioned, project- and problem-based methods. The students seem to be fairly satisfied with the current evaluation method but also show an interest in new methods. As a recommendation, a

continuous student evaluation schema could be introduced in a progressive manner in the future, by means of assignments, lab exercises, case studies, interactive seminars, partial tests, etc., in a way that the student could realise his/her performance along the course, being able to rectify and focus the effort in those aspects that may need to improve.

Mobility and External Practices

Mobility and external practices are limited at the Geomatics Section and are mainly on an informal and ad-hoc basis. Education offered by means of external practices has been attempted but is considered expensive for the Section and with very low return on the investment. Additionally, the effort put into mobility for the study programme seems to be limited and could be emphasized more with the incentive of attracting more external and distributed students. It is recommended to focus more on feasible and economically sustainable offerings to external practices with the motivation of dissemination and economic income.

The international projection of the programme could improve by enhancing the participation of students in mobility programmes (Erasmus, etc.), providing clear and systematic information about exchange possibilities, and formalizing strategic agreements with universities and institutions in the Geomatics field.

External practices in co-operation with companies are encouraged to provide professional orientation to the students, to reinforce the links with the private sector and to contribute to the dissemination of the Geomatics programmes outside the university.

2.6. RESULTS AND QUALITY ASSURANCE

Results of the Educational Programme

The received material does not give a background for stating any average time the students spend to complete the programmes. According to the Self-evaluation Report, it is difficult to measure the learning results against the study programmes, because the stated learning goals of the programmes are (deliberately) quite open. The learning goals should be stated in a way that makes it possible to measure the results against them.

There are in fact several types of Bachelor degrees in geomatics at UMB, due to the diverse intake requirements. Students with the various intake requirements are given different mixes of

courses. They never become “synchronized” to a common basis, so they continue to receive different educations throughout their study. This comprises part of the learning goal problem.

The students seem to be basically satisfied with the education and the teaching. Some of them feel that the studies are too theoretical, and that there could be more practical training. There is no formal instrument to follow the students after entering the labour market. An ”Alumni UMB” exists, and this entity might be utilized by Geomatics Section to keep in touch with the students after graduation.

There is no specific instrument to measure the satisfaction among the academic staff.

Based on the User Panel for this evaluation, employers are very satisfied with the candidates from the Geomatics study programmes. This applies mostly to Masters, as the Bachelor degree is relatively new at UMB. Potential employers also embrace the new Bachelors, just because there is great need for professionals in geomatics. However, there are some comments as to the Bachelor programme stating somewhat ambivalent goals. And it is clear that Masters, or even PhDs, are preferred among the employers in the User Panel.

The education appears to be directed towards Norwegian companies. The programme offers the possibility to spend a period of study abroad, and this option is well appreciated by former students, who manifest that that experience has been useful for their professional careers. Many companies have activities in other countries, and the knowledge of the culture and market in those countries is well recognised by employers. Specific measures to prepare the graduates for an international job market and the acquisition of an international perspective should be enhanced by offering the students better organised possibilities to study abroad, establishing formal agreements with universities, joint degrees or practical training opportunities in foreign companies or institutions.

It is difficult to make a statement on the actual learning results at UMB and how they correspond to international standards. In general, the learning results seem to fit with the Norwegian requirements of geomatics professionals. Perhaps, from international point of view, the teaching should be more directed to research, without forgetting the society needs and applications.

Quality Assurance Practices

UMB has defined a Quality Assurance program, with comprehensive activity plans for evaluations and corresponding actions. On the UMB web pages, the following text is found (http://www.umb.no/?viewID=4350):

> *The Norwegian University of Life Sciences (UMB) has defined clear objectives for its quality assurance system: The system shall guarantee that students spend their time at UMB effectively and receive an education of high academic quality*.

All regulations regarding the studies are reviewed critically and revised every three years. Among the activity plans are procedures for approving study programmes, evaluation of study programmes, and evaluation of single courses.

A study program belongs to a department (See also section 2.2.). On behalf of the department, a programme committee prepares the programme description, assures it according to given criteria, recommends it to the Education Committee of the university, which approves it based on additional criteria. The University Board decides the study programmes that are offered each academic year. A study programme has to be evaluated and approved each year by the same bodies.

According to the web pages for Quality Assurance at UMB, each year the students in the final stage of all study programmes shall evaluate their programme, and web based surveys are to be organised for this purpose. There are also activity plans for how the gathered information shall be fed back and used to improve the programmes. The committee has not been able to verify to which extent this evaluation is accomplished.

Each course does also belong to a department. According to the relevant activity plan, each course is approved by the education committee at the department level. The approval is valid for three years. A web-based survey is done among the students of each course every year. There are activity plans for how the gathered information shall be fed back and used to improve the teaching of each course.

The numerical results from surveys are publicly available, but comments are kept confidential. This committee has not been able to explore to what extent the feedback procedures work. According to students they do cause improvements, but some improvements may disappear after some time.

The current evaluation of the Geomatics programmes is a part of the UMB quality assurance system. It is remarkable and very positive the effort made by UMB in organising all the evaluation activities to improve the efficiency of the programmes.

2.7. SOCIETY NEEDS AND RELEVANCE OF THE PROGRAMME

From the Self-evaluation Report, the "*Current challenges and societal needs in the fields in the regions where students will work after obtaining their degree*" are described as follows:

"Analysis shows that 70-80 percent of all activities in our society are carried out on the basis of geographical information. A well developed infrastructure for geodata is necessary to use modern geographical information technology in the most efficient way. This implies challenges, needs and not least possibilities in almost every part of society. The mapping and consulting companies are responsible for the geodata production and the value added services in Norway and need updated competence as a base for their activities. In parts of the private sector like telecom, energy supply, property trade and administration, fishery, farming and forestry, geodata is a necessity. The use of geodata is central in most planning, building and construction work, which are sectors with currently high activity. The offshore companies have needs for both navigation and data processing of their vast amount of data.

Geodata is a considerable part of the information base of the public sector. This includes among other the military defence, the rescue services, administration of nature resources, communication and transport, cadastre and land registry, land use planning and local authority administration.

Both the Bachelor's and Master's programmes in Geomatics are degrees that are relevant both for production and management in relation to the use of geodata. The high rate of technological developments in the sector is one of the main challenges in the field, and newly graduated geomatics candidates are attractive and widely spread over the whole range of the current labour market."

The committee supports these viewpoints and sees Geomatics as a rapidly growing field with a high demand for candidates with this type of education. Employers from companies which are potential future working places for the candidates also clearly show a great need for people. Their experiences with previous candidates are good, and they want to employ more, but claims there are too few in the market. The employers highlight skills in maths, IT, geodesy and GIS as most important. The fact that the master students can specialise in one or more fields, but most could still be considered as "geomatics generalists", is appreciated.

There seems to be little knowledge among the students and the staff about the opportunities for work after studies. There are no organized alumni or other structures to take care of feed-back

from former students. There are few formal agreements between the Geomatics Section and public and private companies. There are some collaborative projects with the professional sector, but this could clearly be reinforced.

Overall Strategies

There are no national strategies specifically for the field of geomatics. As mentioned in the Self-evaluation Report, not even the recent government white paper "*Norge digitalt*" included anything about education in the field.

Expected new regulations in law on property registration will probably have an effect on the need for professionals, and the Geomatics Section seems to be well prepared to include this in their offering and, if needed, to prepare a new programme in this field together with the Department of Landscape Architecture and Spatial Planning, at UMB.

The link between UMB strategy and the field of geomatics seems to be missing. There is no mention of the field in overall UMB strategies, and very little about technology or related areas that could explain to the general public why there is an education in geomatics in the university. This causes a severe communication problem for the Geomatics Section in getting out the message of geomatics through the "green roof of Life sciences". It also makes it difficult to get help from UMB's marketing and promotion units.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1. GENERAL ASSESSMENT OF THE PROGRAMME

The overall conclusions of the External Evaluation Committee (EEC) are summarized as follows:

The admission profiles are well defined, with an indication of the basic requirements in Mathematics and Physics, and the degrees needed to enter in the programmes. The information related to these profiles is available and clearly exposed to the students and general public through the website, books and brochures. However, the learning goals should be more specific, as a defined collection of knowledge and skills that the students must have at the end of the training period. In this sense, a more accurate differentiation between bachelor and master

degrees and profiles should be stated and described, relating the applications in professional life and the usefulness for the society.

In the bachelor programme, there is a high degree of flexibility, both in the admission policy and in the study plans. This is a remarkable effort in organization that allows opening the range of students entering the programme,. At the same time, and due to the small number of students enrolled in the programmes, it may create too much diversity in the studies, increasing the cost and, therefore, reducing the sustainability. A similar situation occurs in the master programme, with the exception that the admission policy is much more restricted to external students. In general terms, there is a sustainability problem due to the low number of students registered in the programmes.

The UMB has several international contacts with other universities and programmes in Geomatics or related areas, with the possibility for the students to spend a period of training abroad. But the international dimension of the studies should be more formal and efficient in the specific area of Geomatics, with more information available, clearly defined exchange possibilities and making it more attractive for the students.

The University environment is attractive and friendly, enhancing the communication between students and teachers.

The Geomatics area is not properly understood by other areas or departments at the University. This creates a barrier in communication and dissemination of the possibilities of these techniques to other departments (isolation). Formal measures to enhance the communication and collaboration with other departments should be promoted, especially considering that geomatics and mapping sciences have many applications in environmental, agriculture, forestry and life sciences in general. This problem is particularly evident at the research level, where there is practically not connection with other groups in the University.

There is an efficient mechanism for the evaluation of the courses and programmes by the students, based on regular surveys. The teachers are aware of this process and usually try to improve based on this feedback. However, there are no formal mechanisms to incorporate the demands from society.

The average teaching staff is highly qualified and fits the educational goals of the programmes, being involved in research projects with the public and private sectors, but usually at an

individual level. Teachers have an open attitude towards new teaching methodologies and to improving their knowledge. In this sense, more emphasis should be given to new teaching methods, enhancing group participation, writing skills, continuous evaluation, case studies, etc. These methods could be generalized in all the courses in the programmes.

In addition, the teaching staff are open to lecturing in English when necessary, which is important in order to face international activities, opening the possibility of creating specific courses or modules for international students that could potentially attend the programmes.

The working spaces, laboratories, hardware and software licenses are adequate for the number of students and the requirements of the programmes. The electronic access to the University library and the possibility of ordering specific articles from other libraries or institutions allows for an adequate use of the resources.

The distribution of the budget of the University is partially based on the number of students, which contributes to increasing the gap between departments, making it more difficult for the departments with a lower number of students to adapt to the minimum sustainability levels imposed by the University.

The Geomatics Section is aware of the importance of the dissemination of the programmes in the society, and performs some periodic promotional activities, such as visits and conferences to high schools, preparation of informative brochures, etc. However, a more effective dissemination plan is required in order to attract potential students to the programme, and this should be faced through active co-operation with the private and public sectors, since they are demanding new professionals in the geomatics area.

Continuous education activities could be reinforced through courses and conferences offered to external and internal students. Some of them could be offered in combination with other departments from UMB, with private companies and institutions. This would enhance the collaboration activities, help to disseminate the geomatics in society, and increase the sustainability of the programmes. It is also important to improve the collaboration in research activities with other departments and groups in the UMB, since the Geomatics Section has much to offer in spatial analysis and mapping methodologies, and also much to receive in terms of the applicability of geomatics in other scientific fields.

External practices for students could be enhanced, in order to get companies and public institutions involved in the educational process, providing the students with a more integrated view about their professional career after the university training programme, and creating more formal links between the university and the private sector.

In general, there is a high degree of satisfaction of the students with the training they are receiving. If they were to start over again, the alumni or former students would repeat the same programme in Geomatics. The employers are very satisfied with the students recruited from UMB and, what is even more important, there is a very high employment rate for students of Geomatics. These are clear indicators about the society needs of this type of professionals, and UMB can play an important role providing qualified students that fulfil the necessities of companies, administration and society in general.

3.2. RECOMMENDATIONS

Considering the previous conclusions, the EEC proposes some recommendations following four main groups of ideas or activities:

- Dissemination
- Internationalisation
- Restructuring of the Programmes
- Projection to the Labour Market

- Geomatics is a term that is difficult to understand by society, and the number of students registered in the programme is decreasing critically. The first measure proposed is the definition and creation of a dissemination plan in which the university, the private and public sectors get involved, in order to increase the social awareness of Geomatics, and the recruitment of students in the two programmes. Specific actions could be the development of campaigns in communication media, websites, etc, using direct and effective language, enhancing everyday practical applications of geomatics (Annex-2). Visits to high schools and having an informative open doors day at the university for potential students, in tight co-operation with companies, is recommended.

- The globalisation and the European Area of Higher Education (EAHE) are changing the scope of education, opening borders and fostering the cooperation between countries. Therefore, it is important to provide an international dimension to the learning/teaching

process in the context of high education programmes. Measures to ensure the international training of students should be reinforced, such as formal agreements for the exchange of students and teachers, to create joint and dual degrees, specific courses, and to collaborate in research activities. Application to European funding could help on this endeavour, for instance through the Longlife Learning Programme (LLP) (Annex-3), and other local funding programmes, as well as to enhance the participation in international associations related to geomatics (FIG, ISPRS, EuroSDR, EEGECS,...).

- The combination of the international dimension with the recruitment of students can be possible by opening the Master Programme in Geomatics to foreign students (International Master Programme, 2 years after the Bachelor Programme). The advantage of teaching in English is the real potential for attracting foreign students. This means that the dissemination and marketing activities should be opened to different countries and continents.

- Considering the importance of the continuous adaptation of the higher education programmes to social evolution and to professional goals, we propose a renovation of the programmes in order to be more adapted to the social demands and to improve the recruitment rate. First, it is necessary to have a more accurate definition of the goals of the programme, defining the specific direction that the Geomatics Section wants to follow. Then, several structural changes are proposed (Annex-4)), with the basic ideas of clearly opening the Master programme to external students (non UMB and foreign), and defining some specialization paths that are more adapted to the social demand (Mapping sciences, Geodesy and positioning, Geoinformatics, or Imaging Technologies, for instance). It is also requested by students and employers to include some business management and software engineering courses in the curricula. In addition, progressive introduction of new teaching methods is important. Some are currently used, but formal mechanisms could be created in order that all the courses in the programme get involved. The central services of the University can play an important role in this process by providing necessary tools and support. It is also important to improve the culture of transverse collaboration in education inside the Section (by establishing internal working groups, etc.).

- There is a certain feeling among professionals and alumni that the Geomatics Section is somewhat “out of place” at UMB. This situation, together with the fact that the budget has been reduced during the last several years due to the low number of students registered in the programmes, creates a difficult position for the teachers and managers of the Section facing

the problem. However, this situation could be improved, since Geomatics has much to offer to life sciences such as Agriculture, Forestry, Environment and Land planning. The promotion and creation of internal collaboration links with other groups would be very positive for both sides. This collaboration can be at research level, but also by offering common courses for non-geomatics students and professionals.

- The projection to labour market is a way to attract the interest of future students and to involve the companies in the training process together with the university. Education must reflect the need for developing both professional and academic skills. This professionalisation of the programmes can be enhanced by formal agreements with public and private sectors (Memorandum of Understanding, etc.), increasing the research and collaboration projects, offering the possibility to the students to do external practices in companies as a part of the training process, or providing information tools about professional life for the students.

- Other strategic activities are related to continuous education, by increasing or regularising the offer of courses to professionals in order to update their knowledge and skills in new and coming technologies. This could be organised together with companies or other universities, and it serves as a dissemination activity as well as to increase the sustainability of the Geomatics Section, since it provides new sources of income and collaboration.

- The teachers and researchers of the IMT department have different professional contacts with companies, administration and other universities. A new and decisive step would be to formalise and increase this cooperation by the creation of a network or consortium between Universities, Private sector and Public sector, at a national level, with a clear definition of benefits and commitments from each part, with the common aims of (i) the dissemination of geomatics applications and possibilities in the society; (ii) the training of new professionals with quality criteria that respond to the dynamic needs of society; (iii) and the development of research activities, creating a synergy that impulses each particular sector to a more competitive position. In particular, the cooperation with NTNU in Trondheim is encouraged, since this university offers similar programme in Geomatics and is facing the same challenges in dissemination needs and sustainability.

- Finally, the differences in terms of efficiency (low rate of students) in relation to other departments should be reduced by the assignment of some financial support to specific

actions of the IMT department with the goal to improve the quality and the efficiency of the programmes.

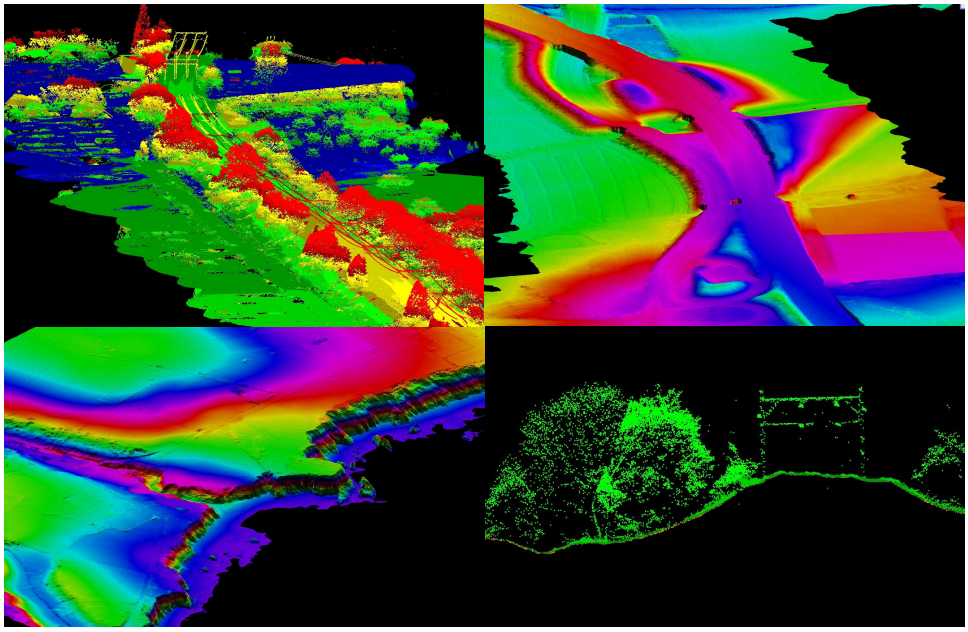
4. ANNEXES

Annex 1.- Teaching staff at the Geomatics Section

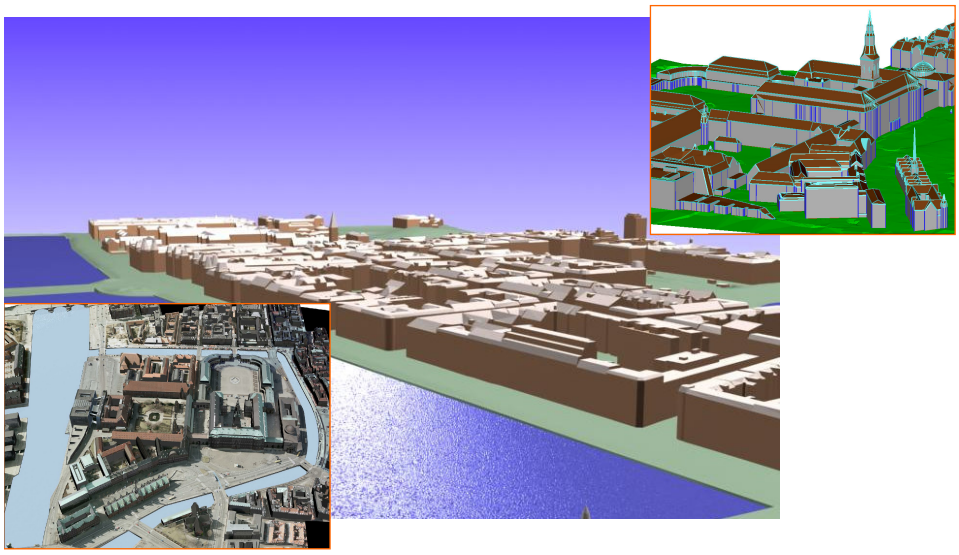
Name	Academic position	%Position	Topic
Kristiansen, Oddgeir	Adj. assoc. prof.	0,2	Geodesy
Gerlach, Christian	Assoc. prof.	1	Geodesy
Gjevestad, Jon Glenn Omholt	Assoc. prof.	1	Geodesy
Øvstedal, Ola	Assoc. prof.	1	Geodesy
Breili, Kristian	Ph. D. fellow	0,25	Geodesy
Lysaker, Dagny Iren	Ph. D. fellow	0	Geodesy
Pettersen, Bjørn Ragnvald	Prof.	1	Geodesy
Revhaug, Inge	Prof.	1	Geodesy
Mathisen, Olav	Prof. emeritus		Geodesy
Bjørke, Jan Terje	Adj. prof.	0,2	GIS
Strand, Geir-Harald	Adj. prof.	0,2	GIS
Tveite, Håvard	Assoc. prof.	0,7	GIS
Bruvoll, Bente	Ph. D. student	0,25	GIS
Løfman, Owe	Prof.	1	GIS (Health)
Chapius, Anne	Ph. D. fellow	0,25	Glaciology
Hulth, John	Ph. D. fellow	0,25	Glaciology
Rolstad, Cecilie	Prof. qualific. fellow	0,5	GIS (Glaciology)
Maalen-Johansen, Ivar	Amanuensis	1	Photogrammetry
Dalsrud, Per	Amanuensis	0,5	Satellite Mapping
Dick, Øystein B.	Prof.	1	Satellite mapping
#20	**Sum**	**11,3**	

Annex-2.- Examples of practical applications of geomatics.

Applications of LIDAR Techniques to Civil Engineering, Coastal Management, Forestry, etc.



3D Models. Application to Urban and land Planning




NOKIA
Connecting People
Velg sted
Nokia Norge
Hjem
Mobiltelefoner
Shopping
Support
Løsninger
Investorer
Om Nokia
Velkommen til Nokia i Norge!
Nokia 6110 Navigator
Innebygd GPS og talenavigator
Konkurrer og vinn!

Annex-3.- Longlife Learning Programme information

- **LIFELONG LEARNING PROGRAMME** (LLP, 2007-2013)
  Sectorial Programmes: ERASMUS- To support the European Higher Education Area.
  - **Multilateral projects**(2-3 years; 75% funding):
    - Development of Study Programmes
      - Joint development of study programmes (BSc, Ms, PhD)
      - Joint development of european modules
    - Virtual Campuses
      - To increase virtual mobility actions: content, services, pedagogies and practices. Prerequisite: technical infrastructure
    - Co-operation Universities-Enterprises
      - Enhance employability / argeements lifelong learning strategies / placement of students & teachers in industry and viceversa
    - Modernisation of Higher Education

  - Mobility of individuals (students, teachers, intensive programmes)
    - Intensive Programmes

      Short programme of study which brings together students and staff from different institutions and countries

      Priorities:

      - Integration of the IP in the study programmes
      - More than 3 countries
      - Rapidly evolving and new areas

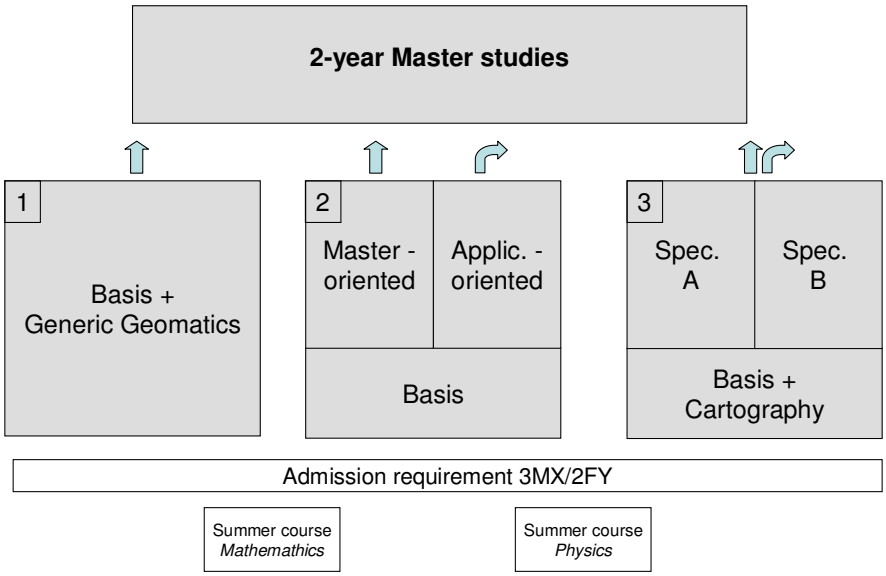
  - Networks (ETN)
  - Accompanying Measures

More information:

http://ec.europa.eu/education/programmes/llp/structure/erasmus_en.html

Annex-4.- Schemas of the proposed structure of studies: Bachelor and Master. Options 1, 2, 3 for Bachelor are different independent alternatives proposed. Options 1 (National) and 2 (International) for Master are also two independent alternatives. The committee encourages the creation of an International Master Programme.

Bachelor alternatives



2-year Master alternatives