FACULTY OF GEOMATICS AS THE FOCAL POINT IN GEOMATICS EDUCATION IN SRI LANKA

H.M.I.Prasanna

Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, P.O.Box 02, Belihuloya 70140, Sri Lanka.

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ABSTRACT:

The Faculty of Geomatics is one of the nine faculties of the Sabaragamuwa University of Sri Lanka. It offers high quality geomatics related degree programmes, and consists of a well-qualified staff and latest technological resources. It delivers highly job oriented programmes and the curriculums of these programmes have been developed to meet various national and international standards and the requirements of professional bodies. As the first time in the history of the Sri Lankan university system, the BSc in Surveying Sciences Degree Programme was introduced by the Faculty of Geomatics established in 2004. This was an essential requirement for the country due to the high demand of surveying industry. Throughout the past decades it is being greatly developed both in infrastructure and human resources. Presently, the faculty has a student population of about 500 with the aim of producing about 150 graduates annually. Geomatics graduates have a variety of rewarding local and global employment prospects as land surveyors, land administrators, site managers, or site engineers in both the public and private sectors, including cadastral, mining, hydrographic surveying, and any other remote sensing and GIS-related disciplines. Graduates with knowledge in the geospatial stream could work as GIS analysts, image analysts, image interpreters, and in other positions in the business. Graduates of the program can take on useful tasks in their field with ease.

1. INTRODUCTION

1.1 History of the Geomatics Education in Sri Lanka

In Sri Lanka, surveying activities were officially commenced after the establishment of the Sri Lanka Survey Department (SLSD) which was founded by a governor's proclamation dated August 02, 1800, just four years after the British occupied the island's coastal sector; as a result, the Sri Lanka Survey Department is the oldest civil state department in the nation.

On October 20, 1896, the Govt. Technical College in Colombo, Sri Lanka, began the first systematic training program for surveyors. Later, departmental officers took over the training. Due to this, in 1912, the Sri Lanka Survey Department established its own training facility in Modara, with the practical training taking place in Padukka, which is located closer to Colombo. The training school moved to its current site in Diyatalwa, Sri Lanka, in 1924. The United Nations Development Program (UNDP) helped to improve it in 1968, and an Act of Parliament No. 21 of 1969 founded the Institute of Surveying & Mapping Diyatalwa (ISMD). Initially, the training activities were purely confined to the training of surveyors for Survey Department, and later has gradually taken over almost all the basic training needs of the Survey Department and some other organizations at their request.

In 1990, the ISMD was upgraded as a degree awarding institute by a gazette notification No. 620/4 under the section 25A of the Universities Act No. 16 of 1978. Again, UNDP played a prominent role by making necessary funds to strengthen ISMD physically. Since then, the ISMD conducts a four-year degree course in Surveying Sciences in addition to diploma courses for the government surveyors.

1.2 Faculty of Geomatics

The Faculty of Geomatics (FOG) was established in 2004 as one of the nine faculties of the Sabaragamuwa University of Sri Lanka (SUSL). It is the successor to the Department of Surveying Sciences, which introduced the Bachelor of Science in Surveying Sciences degree Programme in 1997. This was the first time in the history of Sri Lanka's university system that a university established a degree program in this scientific field, meeting a pressing demand for the nation. The Degree Programme is a four-year course leading to an honours degree in Surveying Sciences, subsequently becoming the first such degree awarded in Sri Lanka under the purview of the University Grants Commission (UGC). The first batch of students admitted to the degree programme in 1997 and graduated in 2002.

The Department of Surveying and Geodesy (DSUGEO) and the Department of Remote Sensing and GIS (DRSGIS) are the two departments that make up the Faculty. The first five semesters of the degree program are jointly conducted by the two departments as a Foundation Course (FC), and the final three semesters of the program offer five areas of specialization in surveying and geodesy, hydrographic surveying, land management, remote sensing, and geographic information systems (GIS). The final semester is allocated for the industry based training.

Principles of surveying sciences, geodesy, adjustment theory, cartography, photogrammetry, remote sensing, geographic information systems (GIS), cadastre, hydrographic surveying, as well as mathematics, physics, computer applications, economics, management, and environmental science are all included in the four-year degree program. The improvement of English proficiency has been given more of a focus in the course's design.

The program's goal is to produce a graduate with the academic

credentials and technical know-how needed to work in the field of Earth and space measurements. A component of industrial training is included in the degree program to help students develop their practical skills in gathering and evaluating data related to geography and the land, and using that data to plan and carry out projects while ensuring effective management of the land, the sea, and the structures thereon.

The courses are created to prepare students to handle all land-related issues, including Land Development, Land Settlement, Land Reclamation, Irrigation, Hydrography, Town and Country Planning, Forestry, Environment, and all phases related to the establishment of the Cadastre. They also aim to provide qualified professional surveyors to the public and private sector as well as foreign employment. Practical work using modern tools, computers, and software is given more importance. The majority of contemporary geomatics technologies are covered throughout the course.

Since there are only few studies can be found in the literature, the main scope of this article is to show the role and the involvement of the Faculty of Geomatics in Geomatics education in Sri Lanka.

2. STANDARDS AND GOOD PRACTICES

2.1 National Standards of Curriculum Design and Development

According to the UGC standard, a student's program of study is an independently recognized curriculum they follow that helps them qualify for a degree from a given organization. The term "courses/modules" refers to the formalized, self-contained elements that make up a curriculum.

Academic programs of study should reflect the mission, aims, and goals of the university or HEI. They are provided in accordance with a needs analysis based on an examination of already offered courses and programs, market research, industry liaison, national and regional priorities, and established procedures. When creating the structure and content of a new degree program, Subject Benchmark Statements (SBS) and professional body criteria serve as helpful external reference points. Students are given the knowledge, abilities, and attitudes necessary to excel in the workplace and in lifelong learning through a curriculum that is outcome-driven (PR manual, 2015).

Beginning with a description of the program's graduate results, the course/module outcomes are then directly mapped to the program outcomes. The Sri Lanka Qualification Framework (SLQF) is used to establish and explain learning outcomes in relation to a specific level of study. Every program's objectives must to be explicitly in line with the course's objectives, content, teaching/learning methods, and evaluation techniques (constructive alignment). In order to establish compatibility between the curriculum, student-centered teaching strategies, and assessment processes, programs should aim to involve students in a variety of learning activities. These activities should encourage diversity, flexibility, accessibility, and autonomy in learning. The final curriculum is essentially the result of interactions between learning objectives, evaluation techniques, instructional strategies, and content.

In order to build a standard for each level of study, good practice is to take into account not only the curriculum areas of study but also the intellectual, practical, and transferrable abilities that should be developed and assessed at each level using the level descriptors in the SLQF. The design, development, and approval of programs should be regularly monitored and reviewed using an efficient method.

2.2 Sri Lanka Qualification Framework (SLQF)

Recent years have seen a substantial growth in the mobility of learners and educators between nations and regions of the world, necessitating the support and adaptation of national higher education institutions. Considering this, the Sri Lanka Qualifications Framework (SLQF) is a significant component of the development of systems in the higher education sector. It provides a clear and consistent framework for the learner to optimize his or her goal of learning throughout life, while also enhancing many essential aspects of learning and evaluating the learning process. The SLQF's establishment will contribute to various improvements in learning processes and aspects. Additionally, it will raise the standard of education in the country while simultaneously offering a clear method for establishing connections with higher education institutions outside.

SLQF Level	Qualification Awarded	Minimum Volume of Learning for the Award
12	Doctor of Philosophy / MD with Board Certification/Doctor of Letters/Doctor of Science	Minimum 3 years of fulltime or equivalent time of original research after SLQL 6 or above
11	Master of Philosophy	Minimum 2 years of fulltime or equivalent time of original research after SLQL 6 or above
10	Masters with course work and a research component	60 credits after SLQL 5 or SLQL 6 including a research component of minimum 15 credits
9	Masters by course work*	30 credits after SLQL 5 or SLQL 6
8	Postgraduate Diploma*	25 credits after SLQL 5 or SLQL 6
7	Postgraduate Certificate*	20 credits after SLQL 5 or SLQL 6
6	Bachelors Honours	120 credits after SLQL 2 of which 90 credits after SLQL 3, of which60 credits after SLQL 4, of which 30 credits after SLQL 5
5	Bachelors	90 credits after SLQL 2 of which 60 credits after SLQL 3, of which 30 credits after SLQL 4
4	Higher Diploma	60 credits after SLQL 2 of which 30 credits after SLQL 3
3	Diploma	30 credits after SLQL 2
2	Advanced Certificate (GCE A/L or equivalent)	
1	Certificate (GCE O/L or equivalent)	

Table 1: Minimum learning volume needed for each Level of the SLQF (Source: SLQF, 2015)

The SLQF serves as a uniform national foundation for all higher education credentials provided in Sri Lanka. All higher education institutions (HEIs), including public and private, that offer post-secondary education are subject to the SLQF. It acknowledges the amount of learning that students have done and lists the learning objectives that certification holders must meet. The SLQF consists of twelve levels, and each level's descriptors are fully stated (Table 1). The amount of credits students need to obtain for each qualification is also specified

because the SLQF takes the volume of learning into account. The designators and qualifiers of each qualification have been determined in the SLQF with the aim of establishing a uniform system for designating qualifications. To preserve uniformity, the acronyms for each qualification were also determined. The SLQF also lists the objectives, scope, and qualities needed for each qualification as well as the minimal entrance standards and potential advancement chances. (https://www.ugc.ac.lk/attachments/1156_SLQF_2016_en.pdf).

SLQF also contributes significantly towards strengthening quality assurance mechanisms of the entire higher education sector in Sri Lanka.

3. CURRICULUM DEVELOPMENT OF THE FACULTY OF GEOMATICS

The SLQF published by the Ministry of Higher Education of Sri Lanka in 2015 focuses on creating an integral national framework for learning achievements. Since this framework was built upon four (Australia, Ireland, Scotland and South Africa) National Qualification Frameworks of the world, it promotes national and international recognition of qualifications offered in Sri Lanka and helps in evaluating the qualifications obtained from overseas institutions. As such, all government and private educators have to follow the indictors specified by the SLQF. Thus, the Faculty of Geomatics integrated these indicators in the curriculum.

In accordance with the latest developments related to the field of Geomatics, the FOG of the SUSL was prompted to amend the curriculum of the Bachelor of Science (Surveying Sciences) to meet the needs of the industry and the rapid development of technology, and also to align with the national qualification framework. The broad objective of the degree programme is to make the recipient graduate a person with academic qualifications and technical expertise to practice the sciences of Earth and Space measurements. Geodesy, Surveying, Hydrography, Land Management, Remotes Sensing and Geospatial Information Science are the core areas of the curriculum. The Board of Studies/External Advisory Panel's discussions with representatives from industry, as well as the findings of stakeholder feedback, point to specific needs in the field of geomatics, including the need for graduates with a high level of technical proficiency who are also sensitive to the demands of work related to geomatics.

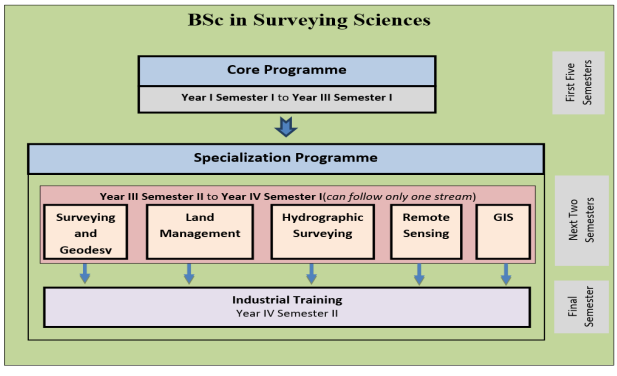

Figure 1: The structure of the curriculum of Geomatics, FOG/SUSL.

The FOG followed the guidelines set by the SLQF, Subject Benchmark Statements (SBS), and University Grants Commission Circular No: 901 when preparing the curricular of the degree programmes Figure 1 shows the structure of the curriculum of the FOG.

3.1 Graduate Profile and Programme Learning Outcomes (PLOs)

The graduate will contribute to the social and physical development of the country by using geospatial science knowledge in practice and research, as well as by taking the necessary steps to continuously improve his knowledge, skills, and interpersonal abilities in order to act appropriately and fulfill the requirements in his profession (FoG, 2014). Based on these requirements, the PLOs of the degree programme have been carefully developed, and are shown in Table 2.

Programme Learning Outcomes (PLOs)	
Programme Outcome (PO)	**Description of the Learning Programme**
(a) Knowledge	
P01	An adequate theoretical knowledge to plan and conduct geomatics related projects
P02	Ability to use techniques, skills & modern tools to solve geomatics related problems effectively & creatively
P03	To manage geo-spatial data effectively
(b) Skills	
P04	Ability to apply his knowledge and skills to enhance the management of the natural and anthropogenic resources for the sustainable development of the nation
P05	Ability to think critically and solve problems efficiently
P06	Ability to lead a team effectively to achieve a common goal
P07	Ability to communicate effectively
P08	Ability to apply skills in financial, operational and human resource management
P09	Ability to apply entrepreneurial skills effectively
(c) Attitudes	
P10	Ability to work independently & in collaboration with others
P11	Care of instruments and other resources
P12	Intellectual integrity, respect for truth & for the ethics of research & scholarly activities

P13	An ability to lead the community and the willingness to accept social & civic responsibilities
P14	Respect the values of the other individuals and groups, and an appreciation of human and cultural diversity
P15	Continuous professional and personal development

Table 2: Outcomes of the Programme (Source: FoG, 2014)

The students must demonstrate the individual course learning outcomes at the end of the programme including the various soft skills including ICT, intellectual ability in terms of solving problems, effective decision making, effective communication, critical thinking and the necessary attitudes and behaviour of a responsible citizen as well.

Mapping of the PLOs with the prescribed outcomes by SLQF level 6 is shown in the Appendix.

3.2 National and International Accreditations and Recognitions

Graduates in the surveying sciences are in high demand, and there are positions available in the public and private sectors as well as abroad. Thus, the faculty is moving with a very high employment rate. According to the annual employability report of the geomatics graduate, Figure 2 shows the employment statistics.

The degree programme offered by the Faculty of Geomatics is recognized nationally and internationally through different world leading professional bodies in Surveying and Geomatics. In Sri Lanka, the degree programme is recognised by the Surveyors Institution of Sri Lanka (SISL) and Land Survey Council (LSC) of Sri Lanka. The LSC of Sri Lanka is the governing body of surveying activities of the country, which is constituted under section 27 of the Survey Act No. 17 of 2002. This Act is established by repealing The Land Survey Ordinance (Chapter 458) and The Surveyors Ordinance (Chapter 108). According to the Act, LSC recognizes the Bachelors' degree in Surveying Sciences, awarded by the Faculty of Geomatics, as an academic entry qualification to become a professional Surveyor in Sri Lanka (Survey Act, 2002).

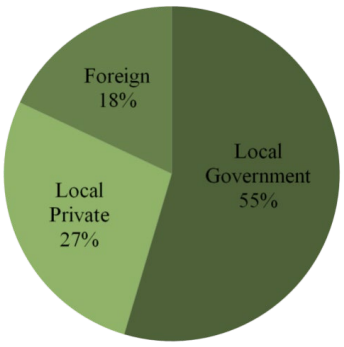

Figure 2: Employment statistics of the Geomatics graduates

The Royal Institution of Chartered Surveyors (RICS) is a global professional body for those working in the Built Environment, Construction, Land, Property and Real Estate. It works at a cross-governmental level and aims to promote and enforce the highest international standards in the valuation, management and development of land, real estate, construction and infrastructure. Since 2015, all degree programmes offered by the faculty have been accredited by the RICS. As of 2015, the International Board on Standards of Competence (IBSC) for Hydrographic Surveyors and Nautical Cartographers in Category B level (FIG/IHO/ICA-CatB) has additionally acknowledged the specialist degree in Hydrographic Surveying. Additionally, the faculty joined the International Federation of Surveyors (FIG) as an academic member in 2015.

3.3 Postgraduate Studies

A thorough education in the technical, analytical, and professional facets of contemporary and advanced surveying, geodesy, management, and environmental topics is provided through the Master of Science in Surveying Sciences program. Land surveying professionals with a Bachelor's degree in Surveying Sciences or an equivalent degree and at least two years of experience in the geomatics sector are the target audience for this postgraduate program. In accordance with the requirements outlined in the SLQF created by the Quality Assurance and Accreditation Council of the University Grants Commission, Sri Lanka, chosen candidates must complete coursework as well as a research project to get their degree.

The program's major goal is to give students solid exposure to cutting-edge technologies in this industry so they may specialize in the administration of real-world projects. As a result, graduates will work as top technical personnel in the surveying and geographic domains. The program's goal is to give the necessary scientific information, in-depth training in management and environmental topics, as well as advanced surveying and geomatics skills, in order to accomplish this goal. The program also strives to foster the transferrable abilities that companies usually look for, such as those related to teamwork and verbal and written communication.

The Faculty has unmatched physical resources, including software, polling equipment, and reading materials, in addition to a diversified collection of professionals with various levels of training. The program will be delivered in a new manner so that the student obtains hands-on experience, taking into account the teaching faculty's years of academic and practical experience. All course modules are taught using this practically based methodology.

4. COLLABORATION WITH EMPLOYERS, EDUCATORS AND POLICY MAKERS

The professional organization, practitioners and the academia are the three important pillars of any successful profession. These three must work collaboratively and closely towards a common goal to uplift the profession. The trust must be developed between each other and a constant dialog should be there to move forward (Gunathilaka et al., 2019). FOG is maintaining consistent connections between various organizations and professional bodies. The faculty, the Survey Department of Sri Lanka, and the National Hydrographic Office-NARA currently work closely together to organize field trips and give undergraduate students chances for industrial training. Annual

discussions are held between these organizations and professional bodies, and feedbacks, suggestions and comments are collected on the degree programme to be incorporated in the next cycle of curriculum revision. Few Memorandum of Understandings (MoUs) have been signed with some these institutions in order to provide best hands on experience to students.

However, it is required that the faculty must go for long term formal MoU between many institutes, especially with the specialization program in Hydrographic surveying. In addition, the faculty must also work hard to establish much closer relationships with the other geomatics-related institutions in the public, semi-public, and private sectors. As a result, the faculty is eager to establish stronger relationships with international universities and research institutions in order to facilitate student training, student exchange programs, potential staff exchange programs, and the annual recruitment of a few foreign undergraduate students.

5. QUALITY ASSURANCE (QA) MECHANISM

Traditional academic controls are inadequate for today's challenges, and more explicit assurance about the quality is required, especially in the context of higher education's globalization, according to policy makers and other stakeholders in the higher education sector around the world (PR manual, 2015). The key goal for industry regulators in addressing these issues is to concentrate on the caliber of education delivery and standards of rewards. For every nation, creating a system of quality assurance will be a significant undertaking. All parties involved in the initiative, including colleges, regulators, and other governmental organizations, must work together. The types of new structures that will be suitable for evaluating the quality of education supply and standards of rewards need to be clarified and come to a consensus. In this context, UGC of Sri Lanka has implemented a manual of programme reviews which provides set of standard procedures and good practices in higher education.

In accordance with this, the faculty employs the following techniques to assess, maintain, and enhance the quality standards of teaching and learning methods:

- Students performance – completion rate, performance of graduates, feedback from industry training, and FGPA (every six months)
- Employability – Market and alumina survey conducted annually
- Lecturer performance – input from peers and students every six months, and annual records from lecturers
- Curriculum review – Yearly assessments by the Faculty Board, Course Adversary Committee, Curriculum Monitoring Committee, and Stakeholders

The faculty QA cell compiles all of the comments and suggestions twice a year. and send to the University QA unit for annual internal review process. Additionally, external QA process will be conducted through UGC.

6. CONCLUSIONS

The BSc programme in Surveying Science with specialization in Geodesy, Hydrography, Land Management, Remote Sensing and Geospatial Information Science is a unique programme in Sri Lanka conducted by the Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, under the purview of University Grants Commission. The curriculums of these programmes have been developed to meet various national and international standards and the requirements of professional bodies. A high employability rate is kept from its inception, and various national and international professional bodies have accepted the qualification. More collaborations are sought in future through which capacity building, research, and training to be enhanced.

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Appendix: Mapping of Programme Learning Outcomes to SLQF LEVEL6's Requirements (Source: SLQF, 2015)

PROGRAMME OUTCOMES		SLQF Level 6 REQUIREMENTS									
		Demonstrate a substantive knowledge and understanding of the core aspects	Critically analyze data, make judgments and propose solutions to problems	Use practical skills and enquiry efficiently and effectively	Construct and sustain arguments and use these arguments, ideas and techniques in problem solving	Demonstrate awareness of the current developments	Engage in independent learning using scholarly reviews and secondary sources of information	Communicate information, ideas, issues and solutions efficiently and effectively;	Exercise initiative, personal responsibility and accountability;	Undertake further training and develop additional skills;	Exercise leadership in the professional environment/work place;	Demonstrate positive attitudes and social responsibility.
P01	An adequate theoretical knowledge to plan and conduct geomatic related projects	X										
P02	Ability to use techniques, skills & modern tools to solve geomatic related problems effectively & creatively		X			X						
P03	Manage geo-spatial data effectively			X								
P04	Ability to apply his knowledge and skills to enhance the management of the natural and anthropogenic resources for sustainability	X		X								X
P05	Ability to think critically and solve problems efficiently		X		X							
P06	Ability to lead a team effectively to achieve a common goal										X	X
P07	Ability to communicate effectively							X				
P08	Ability to apply skills in financial, operational and human resource management			X								X
P09	Ability to apply entrepreneurial skills effectively											X

P10	Ability to work independently & in collaboration with others						X						X		
P11	Care of instruments and other resources							X						X	
P12	Intellectual integrity, respect for truth & for the ethics of research & scholarly activities							X							
P13	An ability to lead the community and the willingness to accept social & civic responsibilities												X	X	
P14	Respect the values of the other individuals and groups, and an appreciation of human and cultural diversity													X	
P15	Continuous professional and personal development					X	X					X			
TOTAL		**2**	**2**	**3**	**2**	**2**	**1**	**1**	**2**	**1**	**3**	**7**			