The Evolution of Geomatics at the University of Botswana

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Key words: Geomatics, Land Surveying.

ABSTRACT

The Diploma in Land Surveying programme at the University of Botswana has undergone changes and will now run as a Diploma in Geomatics. This programme is to be introduced in August of 2002. The paper will examines the current the current status of Geomatics and the future plans of Geomatics in the Department of Civil Engineering. It looks at the Diploma in Land Surveying from the time it was introduced in 1992 and compares it to the new semesterised programme in Geomatics. The paper shows the introduction of new technologically based courses such as the satellite surveying and digital cartography. The introduction of new programmes has meant the department has had to re-equip itself to meet the new challenges.

The paper further addresses the future prospects of introducing a degree in Geomatics and examines the prospects of acceptance by Government and industry. It follows a needs survey assessment carried out to determine industry requirements in the area of spatial information. It is observed that the Geomatics Engineer is still an unknown species in most organisations. A lot still requires to be done to convince the employers of the capabilities of the Geomatics Professional. Employers still do not know what a Geomatics Engineer is capable of doing. A new degree in Geomatics will hopefully bring relief to former students who could only obtain such qualifications outside the country.

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1. INTRODUCTION

1.1 Background

The University of Botswana was established by an Act of parliament in 1982. Its forerunner was the University of Botswana, Lesotho and Swaziland (UBLS) which was established at the time of Independence in 1966. The UBLS then became UBS consisting of the University Colleges of Botswana and Swaziland in 1975 when Lesotho constituted its National University. The two campuses existed as UBS until 1982 when they were promulgated as two separate universities. The university of Botswana is only university in the country and is the only institution providing formal training in Land Surveying. The university offers a Diploma in Land Surveying, which is obtained after a two-year study period. Upon graduation most of the graduates are absorbed, as technical officers in the Land Boards-these are quasi-government departments responsible for the administration and management of tribal land. Some of the graduates work for the Department of Surveys and Mapping which is the main provider of spatial data in the country.

The Diploma in Land Surveying was started at then Botswana Polytechnic in 1992. Before then the Polytechnic was running a Diploma in Land Use Studies. The main focus of the Diploma in Land Surveying as introduced in 1992 was to service the Land Boards and the Department of Surveys and Mapping as the graduates ended working in the Land Boards and the Department of Surveys and Mapping as survey technicians. Others who studied Land Use Studies ended working as technicians in government departments and district councils.

In 1996 The Polytechnic was incorporated into the University of Botswana and became the Faculty of Engineering and Technology. The Diploma in land Surveying fell under the Department of Civil Engineering. All the programmes conducted by the Polytechnic were incorporated into the university and began to run as university Diploma programmes. The Diploma in Land Surveying was a two-year programme with an admission of about 20 students each alternate year. The reasons for alternating the admission were among others the insufficient numbers of teaching staff and the small market for survey technicians.

2 CURRENT SURVEYING CURRICULUM

The current Diploma programme is a Diploma in Land Surveying. The Department no longer offers the Diploma in Land Use Studies. The main focus of this programme continues to be training of technicians who would work for the Government's Department of Surveys and Mapping and the Land Boards. Private practitioners in Land Surveying can also take on a few

of the graduates, although there are only about 14 registered private companies engaged in Land Surveying.

Table 1 Course structure (1992 to 2001)

Course Building block	Year 1	Year 2
Maths, Physics	• Maths • Measurement Science*	• Maths II
Surveying and Survey camp	• Introduction to surveying	• Land Surveying II and Project • Field Camp
Photogrammetry, Cartography	• Photogrammetry I • Cartography I	• Photogrammetry and Remote Sensing II • Cartography II
Cadastral and Land Management	• Land Law & Admin. • Environmental Studies and planning	• Land Info. Management • Physical Planning
Computing	• Computer Science	• Computer applications
Communication	• English & communication skills	

*Course running for half the year.
Field camp is 3 weeks

Given the bleak employment opportunities in the purely Land Surveying field the Department took advantage of the intention of the university to semesterise all University courses to come up with a new programme that will not restrict employment of the graduates to Land Surveying firms.

3 SEMESTERISED DIPLOMA IN GEOMATICS PROGRAMME

This programme is expected to start in academic year 2002. It will replace the Diploma in Land Surveying. It was felt that a new programme be introduced which would reflect the changing role of the surveyor. The new programme, will address the narrowness of land surveying so that the Geomatics Technician will not only work in traditional "land surveying" and civil Engineering fields but some will seek employment in the following fields and many more.

land and natural resources inventories, environmental management, engineering infrastructures and utilities, local government administration, urban planning and service delivery and assets management.
In designing a new curriculum the following criterion should be met (Li X and Derenyi E.(1996))

- The curriculum should provide the students with the fundamental principles which are time invariant
- The curriculum should reflect the current state of the art
- And the curriculum should anticipate the future change

The Department took such points into consideration in designing the new curriculum. As can be seen in the Table 2 the new programme will include Digital Mapping, GIS and Satellite Surveying.

The total contact hours in the 1996 curriculum is 1596 hours while in the new programme the hours are reduced to 1204. The overall reduction in contact hours is of course in keeping with the educational theories which emphasize on less contact hours. As indicated by Trinder et. Al (1996) the aim of curriculum should be to concentrate on education rather than training. This we hope to achieve in this new programme. A comparison of the two programmes is shown Figure 1.

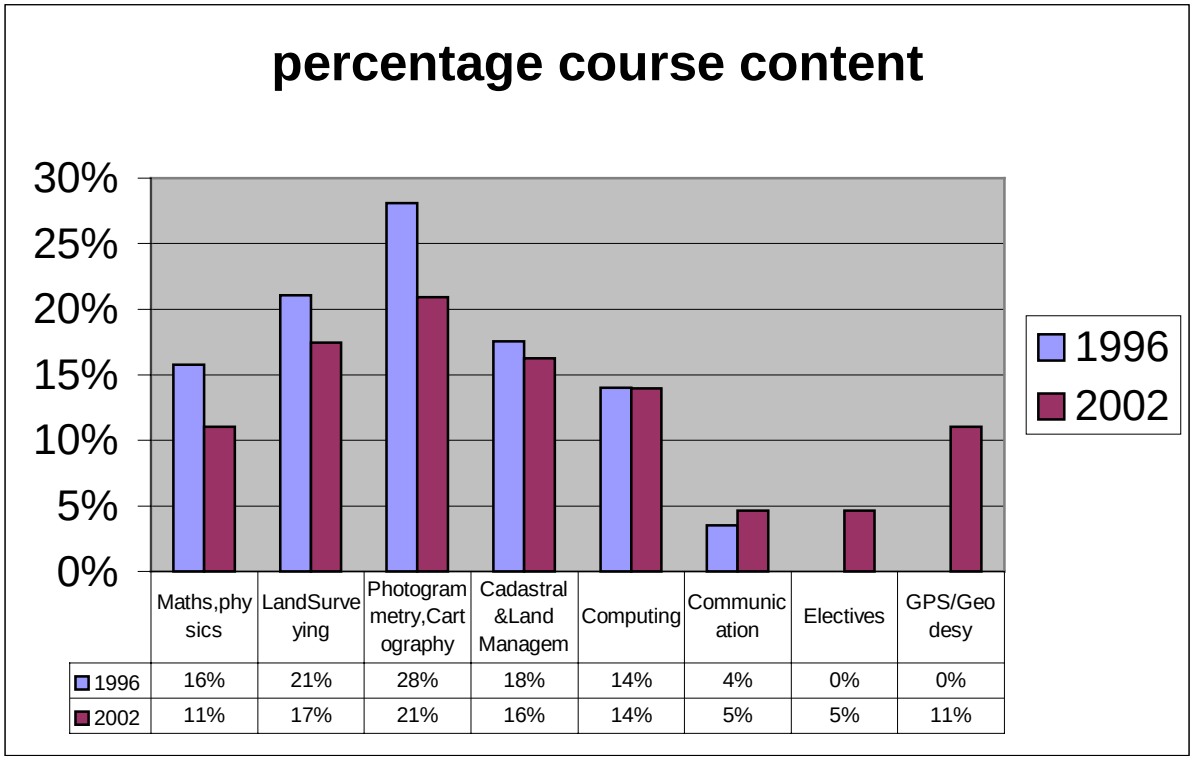
The new structure of the programme is as shown in Table 2 below

Table 2: Semesterised programme starting Aug. 2002

Course Building block	Year 1		Year 2	
	Semester1	**Semester2**	**Semester1**	**Semester2**
Maths, Physics	• Maths1 • Measurement Science	Maths II	Survey Maths (opt.)	
Surveying and Survey camp	Plane Surveying	Residential Survey Camp	Engineering Surveying (option)	
Photogrammetry, Cartography	Introduction to Cartography	Introduction to photogrammetry		Digital Photogrammetry (opt.) Remote Sensing (opt.) Digital cartography Cadastral Studies and Land admin.
Cadastral and Land Management	Introduction to GIS	Topo & cadastral surveying Planning and Environmental Science	Applied GIS (option)	Cadastral Studies and Land admin.
Computing	Computer skills	CAD for Geomatics	Adjustment of survey measurement (opt.) Introduction to programming & database management	
Communication/ project	Communication and study skills	Communication and study skills II		Student project
Geodesy			Geodesy	Satellite Position

*The semesterised programme will also allow for two electives in any field of study.

Figure 1:Comparison between 1996 programme and the new semesterised programme



	Maths,physics	LandSurveying	Photogrammetry,Cartography	Cadastral &Land Managem	Computing	Communication	Electives	GPS/Geodesy
1996	16%	21%	28%	18%	14%	4%	0%	0%
2002	11%	17%	21%	16%	14%	5%	5%	11%

4 LABORATORY FACILITIES

The Department in modernising its programme had to acquire new technology to reflect the proposed changes. In terms of office equipment the Department has a computer teaching laboratory with 30 PII computers. The Department has 11 licences of ArcView, 2 DVP Photogrammetric Workstations, AutoCAD and Microstation for CAD, and Civil Designer for Civil Engineering designs.

The survey studio laboratory has the following equipment:
Several ordinary Levels and theodolites; Total stations (2 TRC307 Lieca, 6 Nikon DTM 500, 6 Topcon GTS-220); Planimeters; compasses, 6 ZExtreme Ashtech GPS receivers, 3 Trimble (5700) receivers 2 Geoexplorers, and 6 Lieca digital levels,

It is envisaged that with the new degree programme the department will have to acquire Arc-Info for advanced GIS analysis, Survey computation and remote sensing software as well as increase the photogrammetric workstations. More laboratory space will also be required.

5. PROPOSED DEGREE PROGRAMME

In order to develop the Geomatics field in the country it is proposed to develop a degree in Geomatics. To develop a meaningful programme, which will serve the needs of the industry for which all the training is done, it is required to look at the market segment and whether the introduction of the programme will add value in industry. It has to be recognised that the

survey industry is relatively small and therefore an assessment based on the current industry alone will not truly reflect the demand. Such a survey can be likened to a study on the introduction of computer education in an area, which has no computers. (Demand for such a course would appear to be low, even when it is recognised that the future of the office revolves around the computer.) So a study of industrial demand for Geomatics professional should be viewed in this context. Apart from the industrial assessment the planning of such a programme required an analysis of the current trends in mapping, information and communication technology.

5.1 Findings of survey

Questionnaires sent to 16 organisations involved in geospatial data capture and manipulation showed

Table 3 Percentage of organisations involved in spatial information activity

Application area of spatial information	% of organisation
Field data collection	94
Remote sensing and photogrammetry	18
Natural resource management	50
Map production	31
Database Management	50
GIS	56
Planning	69
Software application development	31

Table 3 shows that 94% of respondents are involved in field data collection with about 18% involved in Remote sensing activity. The respondents selected were mostly those that deal in Land administration at both urban and rural area level.. Going by the industrial trends elsewhere utility companies such as water, telephone (including cellular), power will require to use geodata in the provision of their services. Already for example, Utility companies like Botswana Power Corporation were involved in field data collection using hand-held GPS receivers. It was their intention to introduce a GIS.

The new Geomatics programme would have to reflect the future prospects of geodata handling. The skills mix requirement could be gleaned from the number of personnel required in the organisations visited in the survey. Table 4 below indicates the future demands for personnel in key skills areas. Clearly GIS and field data collection are the major skills area to be included in the new Geomatics degree programme. The table also reflects the need for the new programme to include data handling and manipulation as well as database management skills.

Respondents perceived Software application development to be highly specialised and felt that computer scientists would better handle it. Virrantaus(2000) has however has suggested a hierarchy for those developing a Geoinformation Science curriculum as shown in the pyramid below. (N.B. the pyramid is our adaptation of Virrantaus's suggestions)

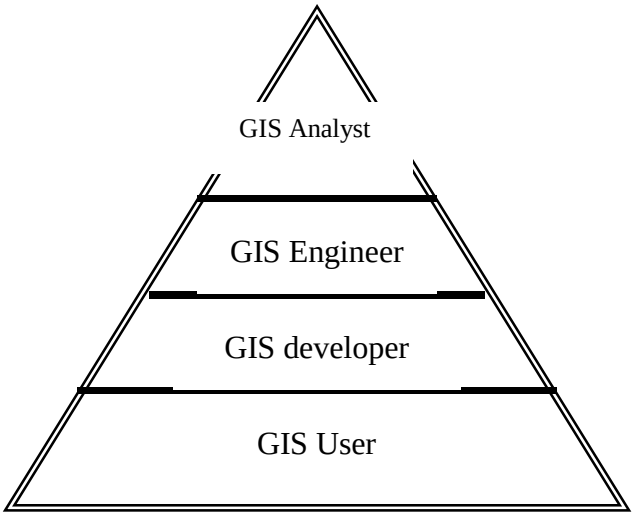


Figure 2: Hierarchy Geoinformation Science Education

As suggested by Virrantaus in designing a new programme it is necessary to define the educational goal. If the goal is to provide the market with a GIS user the training needs of such a professional will be slightly different compared to one who is being trained to be a GIS analyst. It is suggested that university level training should, as a minimum, be up to the GIS developer level. The GIS developer is a person who has an overall understanding of the GIS system as an Information System as well as the design and implementation process of a GIS application (Ibid.) In this context the new degree programme will have to include aspects of software development if we hope to achieve the minimum level as proposed above.

We could not read much into the demand for planners as most respondents were actually planning authorities and would naturally require planners on a regular basis. However, the demand does indicate the need for the Geomatics Engineer to have some knowledge of basic planning.

Table 4: personnel requirements in key skill areas

Key skill area requirements	**No. of personnel required***
Field data collection	17
Data handling and Manipulation	11
Database Management	10
Environment and Natural Resource Management	2
GIS	19
Planning	12
Software application development	6

*Total number required in the next year for all the respondents

The introduction of Geomatics professional would not go without being challenged. In this survey some questions were asked as to whether the programme would not duplicate what was already at the Department of Environmental Science which had a functioning GIS laboratory. One comment advised thus: “it is important to clearly indicate the relationship

between the intended programme with existing programmes such as Environmental Science to avoid duplication and possible conflicts over who should do what and who is the rightful owner of the programme (i.e. Environmental Scientists or Civil Engineers). Such comments reflected the genuine apprehension on the role of the new Geomatics professional.

Some respondents felt that the Department of Civil Engineering was trying to roll out a multi-purpose professional who would be a jack-of-all-trade and master of none kind of person. Even some Land Surveying professionals had difficulties accepting the concept of a Geomatics Engineer. Undoubtedly the romantic clinging to the image of a Land Surveyor whose main function was to conquer virgin land and establish corner beacons still conjures nostalgic memories to many an old surveyor. However it is recognised that the profession needs to make a paradigm shift if it is to continue to survive in a fast changing technologically driven world.

Taking cognisance of this, we decided that a programme be tailored in a way that would anticipate future geospatial data needs. The new programme is to be worked will have a similar structure as the new semesterised Diploma in Geomatics but will take into account the current demand outlook as well.

As Lemmens(2000) has stated there is need for us to change our role from that orientated towards primary data acquisition to one combining geo-information and provision of services to highly demanding customers. It is with this in mind that the new degree programme is to be designed.

6. CONCLUSIONS

The paper has sketched the evolution of Geomatics at the university of Botswana from the time the Polytechnic was incorporated into the university in 1996 to the new programme to be launched in 2002. Although the comparison does not show huge significant differences it does show that there is more emphasis in digital systems and introduction of new courses based on the new technologies in the field and a reduction in contact hours in the new programme.

The future desire to introduce a degree is also highlighted based on the needs survey assessment done. Although a number of organisations did not know who a Geomatics Engineer was they appreciated the different skills that such a professional would impart into an organisation. It is hoped that the new programme will open up wide employment opportunities for our graduates. The new degree programme will also offer opportunities for our Diploma graduates who hitherto have had to go abroad when they wanted to further their education.

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BIOGRAPHICAL NOTES

Mr. Emmanuel Tembo obtained his Bachelor in Engineering degree in Land Surveying in 1987 from the University of Zambia after which he worked as Site Engineer with Damelin Contractors of Lusaka, Zambia. In June 1988 he joined the Lusaka City council as the city Land Surveyor in which he was involved in the planning and design of city infrastructure. In 1991 he joined the University of Zambia as a Staff Development Fellow. In September of 1991 he went for studies at the Royal Institute of Technology in Stockholm where he obtained a Masters in Geodetic Engineering in 1993. Upon his return to Zambia was appointed lecturer with the University of Zambia until 2000 when he moved to the University of Botswana where he lecturing in Surveying and photogrammetry. He has published over 12 conference publications and is a member of the Surveyors institute of Zambia in which he held the positions of Chairman of the Lands Chapter and Hon. Treasurer. He is also a member of the newly formed Botswana Surveying and Mapping Association.

Mr. Mike Manisa obtained his Bachelor of Science in Surveying and Mapping Science at the University of East London in 1993. He worked for one year and 3 months at the Department of Surveys and mapping before joining the then Botswana Polytechnic in November of 1994. He left for his Master in 1995 obtained an MSc in 1996 from the University College of London. Mr. Manisa is a registered surveyor and member of the Botswana Surveying and Mapping Association.