AN UP-TO-DATE APPROACH IN TRAINING CARTOGRAPHY STUDENTS

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ABSTRACT

The recent technological developments in cartography is almost inseparable with the revolution in the Information Technology specifically within the framework of Geographical Information System (GIS). A lot of conventional cartographic processes have been automated hence yielding efficiency and effectiveness in map production.

Many fundamental cartographic problems are now solved in GIS environment. Therefore the role of the Cartographer is not confined to that of producing paper maps but the Cartographer should be aware of the numerous technical aspects and issues of the information systems which facilitate the transformation of spatial data.

It means that great attention has to be paid to training cartography students in the sphere of mastering the basis of GIS-design technology but at the same time teachers have to give lectures at a very high level on the theory of mapping.

The present paper will discuss the features of training of cartographers in PNG regarding new tendencies of mapping development.

INTRODUCTION

The modern development of *cartography* can not be separated from information technologies within the framework of *Geographical Information Systems* (GIS). Numerous fundamental cartographic problems are now solved in GIS-environment. The role of a cartographer is not limited to the creation and production of paper maps, rather he should be aware of the information systems where the transformation of spatial data take place.

As a result of the wide use of GIS-products applications, specialists (not cartographer) need the knowledge of traditional cartographic principles, which are the basis of the GIS-design origin. These are well described in cartographic literature, their adaptation to digital GIS-mapping and the competent application of these principles are necessary. In many cases the competent application of cartographic solutions in GIS-design is the task of a professional cartographer. Traditionally, the professional strength of cartographers is needed in compilation of cartographic maps in GIS systems. This involves working with a map mathematical base (co-ordinate systems, cartographic projections, and datum), map design and cartographic generalisation. At the same time cartographers should be educated and trained in skills of GIS and remote sensing technologies.

At a time of rapid technological and scientific changes, cartography is being affected by contradictory trends. Cartography is the combination of art, science and technology of map making. The different disciplines, which make up cartography, are affected to a different degree. Correspondingly, the new courses are introduced to respond to the new tendencies. Some courses may demand more changes; others inhered mostly from conventional cartography.

The speed of the changes in some cases are significantly fast and so the course programs should be reviewed regularly

(Cartographic Education in Transition. an International Perspective, 1996).

The factors that impact of course changes are:

- technology revolution especially in computer and information spheres;
- demands of the market and consumer;
- lack of quality standards of cartographic training.

This paper presents the recent developments in cartographic education in PNG.

THE CARTOGRAPHY COURSES AT UNITECH

Formal cartographic education and training in PNG has been going on for over thirty years now. It all started at Konedobu in 1967 under the joint auspices of then the Department of Lands and Mines, and the Department of Forests. It then moved to Bulolo Forestry College and eventually to its present location at the UNITECH in Lae. The level of education, training, duration and awards have also evolved from a two-year certificate to the three-year diploma to the current four-year degree program.

The Cartography section of the Department of Surveying and Land Studies performed a major review of the cartography course to improve teaching and curricula of Computer Mapping, GIS, Remote Sensing and development subjects. This review was timely because it coincident with the departments aim to embrace the 'state of art technology' and produce graduates to became the *drivers/operators of the technologies* in the work place.

Rationale for Change

The cartography course has also gone through number of structural and curriculum changes over the past years. The reasons for these changes vary depending on what was considered important at the time. The present cartography programs are the result of changes instituted in 1996. The rationale for changes is to address the pressing quality issues relating to education and training of cartographers and surveyors, (Little & Taugaloidi, 1995). The time is right to implement changes to cartographic curricula and introduce teaching methods that will affect our next generation graduates.

Following are the underlying principles considered in making the changes to the present courses.

a) The courses are not recognised regionally at an appropriate level. There is no formal accreditation process for the courses from professional or academic bodies. Surveying and Cartography graduates from UNITECH are no longer considered to be at an appropriate entry level for some postgraduate studies in Australia.

b) Discussions with private and public sector organisations reveal the general opinion that our graduates are not of an acceptable standard. In fact, most commentators believe that the standard has dropped markedly in the last few years. The best graduates are still highly sought but a common complaint is that the range of graduate skill and knowledge is too broad, i.e. there are degree graduates who perhaps should never have proceeded beyond the diploma level.

c) Surveying and cartography are greatly affected by technology changes especially in work practices, in equipment, computational methodologies and in management practices. Additionally the market is demanding a wider product range from the professions.

In summary there is a quality problem due to the number of unsuitable students proceeding to degree level. The cartography course is four years without industrial training. This is comparable to all regional courses, which are at least four years without industrial training. The level of high school matriculates is below that in Australia and New Zealand. The aim is not to produce graduates at the highest level of similar courses in Australia and the region but rather to peg a level that is at least regionally considered graduate level. The Department carried out the last industry profile in 1992. This showed that the demand for surveyors and cartographers would be low (4-8 per annum per profession) but steady over the next decade. The industry demands a consistent academic level from all graduates.

Course Change Methodology

The cartography programs were evaluated using a top-down assessment procedure that aims at following a quality control approach. The approach is a top-down process with industry and academic requirements being identified at the graduate and five-year postgraduate periods. The three areas to be identified were:

1. *Technical Skills:* The technical knowledge that allows a person to carry out the motor skills required in the industry.

2. *Cognitive Skills:* These are the skills that allow a person to develop solutions to problems that are not "straight from the text or experience" These skills are often said to differentiate the professional from the technician.

3. *Social Skills:* These skills are often overlooked in formal education. They relate to how well a person communicates (orally and written), how they manage and relate to other people in the same or different professions and how they can formulate solutions with feeling for the human consequences. They also include ethics and responsibility to nation and community.

The intention of the review was to develop strategies based on industry and community demand and academic requirements. The review then uses the three skill areas as the bases for developments. Each area will contain high, medium and low priority items. These then would be traced through the curriculum to see how they are met in terms of theoretical and practical sessions. To assist with the planning, a flowchart of subjects has been developed for the various courses where annotations can be made and where references to further explanatory notes can be made.

The identification of skill requirements in the postgraduate period would also act as an indicator of industry short course requirements. It was critical that industry put some effort into the compilation of the various inputs. To assist with this we developed a standard proforma for the annotation of details. The courses review process is best described by way of an example as shown in Figure 1.

The skill requirements are then traced down from graduate level requirements to the subjects in the course. This allows the reviewer to isolate problem areas and overlaps and he relevant timing and content of subjects.

TYPICAL SKILL LEVEL EVALUATION

LEVEL: GRADUATION LEVEL SKILLS

SKILL AREA		**PRIORIY LEVEL (H = High, M = Medium, L = Low)**	
Technical		**B. Car.**	**Dip. Car.**
T1	Transformation coordinates on a projection surface	H	M
T2	Map compilation	H	M
T4	Map production	H	M
T5	Map publishing	H	M
Cognitive			
C1	Map design and layout	H	M
C2	Data structure and geo-coding systems	H	M
Social			
S1	Technical report writing	H	M
S2	Oral presentation proposal	H	L
S3	Production management	M	L

Figure 1

Industry Interaction on Course Changes

The planning methodology for the course changes was presented to the Departmental Advisory Board in September 1994. The industry groups were asked for responses before the end of March 1995. There was very little response, consequently departmental staff did the planning and assessment, and informal discussions held with industry individuals. It was also accepted that industrial training was a responsibility of industry with the view that post graduation industrial framing was the forerunner to professional recognition.

Change Parameters

Staff of the Department carried out the planning exercise outlined above. Additionally a number of important points and issues were addressed:

(i) There would be a clear distinction between the Diploma and Bachelor levels. Only the best students would progress beyond the Diploma level thus assuring a high quality standard at a bachelor level and a high cartographic competence level at Diploma level.

(ii) The issue of industrial training and its relevance to advancement of skills of the student must be addressed.

(iii) The course must adapt easily to changes in technology, legislation and markets and allow the emphasis to shift between topic areas.

(iv) The course must allow the students exposure to other Departments and where possible broaden their horizons.

(v) The course must attempt to expose students to community needs and responsibilities to the community.

(vi) There must be a clear core program that includes the optimal mix of practical and theoretical work. The practical component was to be increased with longer single periods assigned to fieldwork to allow for efficiency and effectiveness.

(vii) The course must maximise the use of expertise in the Department and industry through:

a. Not limiting a subject to one lecturer

b. Introducing visiting lecturers from the industry

c. Encouraging close supervision of project work

(viii) The course, especially at Bachelor level must encourage innovation and appropriate problem solving to cope with changes in industry demand and changes in technology.

(ix) The course must install an attitude of professionalism in its students through not only academic studies but also through participation in industry and community affairs.

(x) Subject assessment should, where possible, be one of the three options below:

- 100% Examination assessment or 100% continuous assessment;
- minimum 50% Examination and remainder as continuous assessment, where students must obtain at least 40% in each part.

(xi) The course changes must include provision for the existing students under current course schedules. The aim is to allow existing students to adopt the new program without academic penalty.

(xii) The class contact hours should be evened out between semesters to allow for efficient use of human and equipment resources.

(xiii) The students have very little spare time under the current "break" times. Where possible all field camps should be run during the academic semester and leave the breaks for student revision and completion of assignments and projects.

This could be summarised as aiming at producing better qualified, better focused yet more versatile graduates who meet national objectives and industry requirements. The course design will provide for effective and efficient use of scarce resources. The course will clearly differentiate between diploma and degree students in terms of depth and scope of studies.

Summary of Major Changes

The following notes summarise the major changes.

1. Industrial training will be dropped from both programs. Industrial experience of 12 weeks will become a requirement for the bachelor degree.

2. The duration of the diploma programs will not change except that industrial training will not be a requirement. The diploma courses will then be two academic years.

3. The degree courses will now be four academic years. This will mean an increase of one semester for the surveying undergraduate degree and two semesters for the cartography undergraduate degree. These increases in academic time are instead of the existing industrial training components.

4. Both programs will have core 10 contact hour subjects in each year. This allows for a more focused professional and academic approach and greater flexibility in content delivery and setting of priorities.

5. The practical component will be increased with more continuous time made available for core areas.

6. The program changes will even out the contact loads between semesters. Uneven semester loads have caused staffing difficulties in the past

7. Courses in the cartography program were renamed to Diploma in Cartography and Bachelor of Cartography.

8. The Department is one of the founding departments of UNITECH and as such has reached the mathematical limits on subject number combinations without repeating previous subject codes. All new subjects will be ceded as SLxxx. Over the next year or so all-existing subjects codes will also be amended.

9. The new programs were implemented in 1996. There is no need to slowly phase out the existing course. The transition will be achieved through the introduction of temporary subjects in years two, three and four. These "catch-up" subjects will allow students who started under the old system to receive instruction on new course material. This system will not bring the existing students to the level aimed at in the new course structure but it will certainly provide the maximum possible benefit to existing students.

THE NEW COURSE STRUCTURE

The general structure of the new cartographic program is shown in Figure 2. The hours have shown represent the total hours per week for practical, tutorials and lectures. The main points with respect to the new structure are:

(a) Year one is a common year for surveying and cartography students with foundation subjects in communications, computing, mathematics, physics, environmental studies, and surveying and mapping.

(b) There is a clear cartography core from year two to year four.

(c) The core subjects include six hours practical each week.

(d) The core subjects allow for innovative teaching.

(e) Fieldwork is undertaken in year two, three and four. The fieldwork provides practical training and also serves as competency test on individual student basis.

(f) The fourth year fieldwork is a part of the real-life Final Year Project that require the student to carry out planning, negotiation and other project management skills as well as the implementation.

(g) Each student is required to obtain a First Aid Certificate before the end of year two.

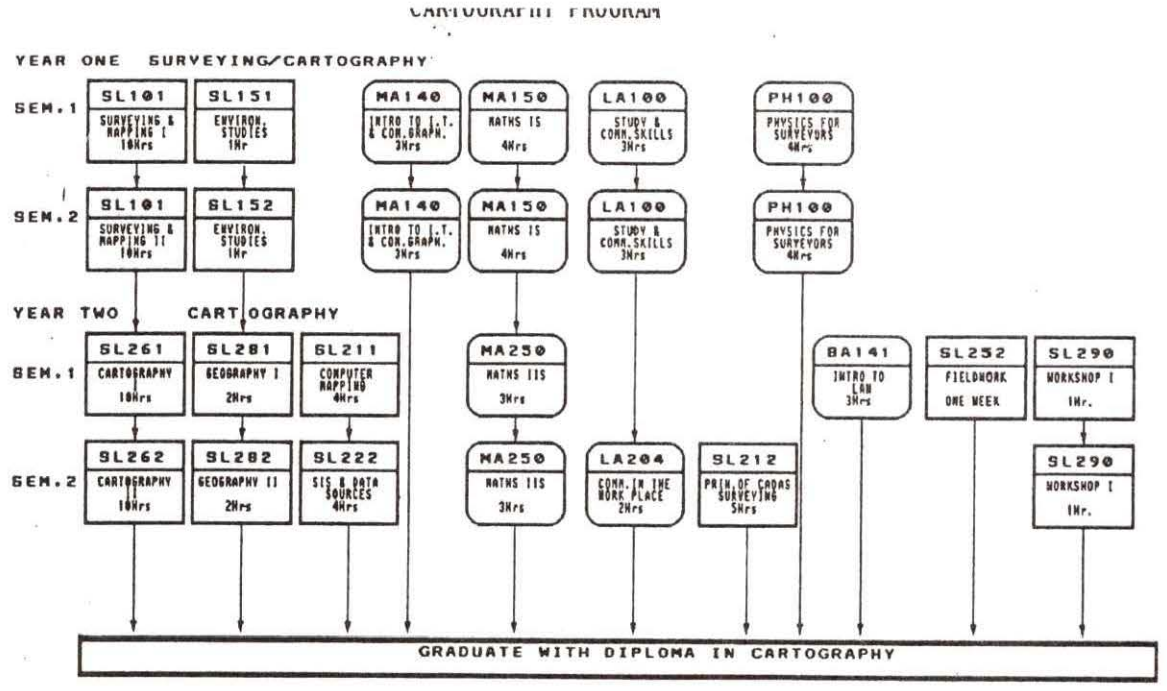
(h) There is a clear-cut off point at the diploma level. The diploma graduates will have covered the necessary theoretical, technical skills and computer training to enable them to undertake computer drafting, cartography and electronic publishing. The diploma holders are eligible for consideration for cartographic technician positions in the public service and private organisations.

(i) The diploma students will have additionally received a basic introduction to land information systems, remote sensing, photo interpretation, and physical and human geography.

(j) Only the best students will be allowed to proceed to the degree program. The third year will include considerable strengthening of techniques in mathematical cartography, cartographic design and layout, thematic cartography, GIS and remote sensing data manipulation and use.

(k) The fourth year core program include specialised cartography, including resource mapping, hydrographic and aeronautical charting, geological mapping, statistical mapping, socio-economic mapping, environmental mapping and tourist mapping. Cartographic management includes production planning and control, management practices and other related topics. The students also do a course on basic accounting for small business.

(l) The fourth year project is designed to incorporate the cognitive and social skills required in the cartographic profession. The project is presented as a report and orally to staff and visitors.



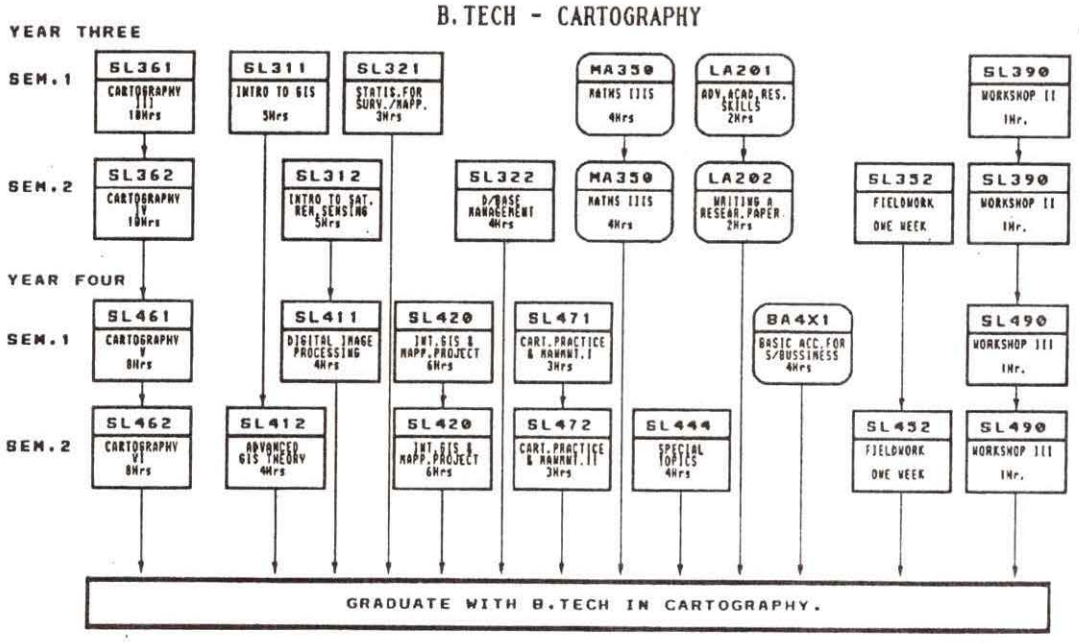


Figure 2. The New Course Structure

LOOKING AHEAD

The cartography course is the only course in the country producing graduates with GIS and knowledge and skills. Basically, the course is designed to produce graduate at both the diploma and degree level. Graduates with diploma in Cartography should have adequate GIS knowledge and skill base to be attributed the title of GIS operators. This category of people should possess knowledge in computer operations, fundamental concepts of data types and

structures, data captures methods, spatial databases, digital mapping techniques, GIS and limited knowledge in databases. Further, they should use Digital Mapping and GIS systems such as AutoCAD, MapInfo and Intergraph MicroStation to gain hands on experience on GIS and Digital Mapping applications. The bottom line is, this group of people is essentially operators, and hence the emphases must be *how and not why*.

The Bachelor of Cartography graduates does two extra years of studies. In these extra years, students are taught extra GIS and Digital Mapping subjects including Remote Sensing. At the same time students enhance their computer knowledge and GIS and Digital Mapping knowledge and skill base. Students are taught the fundamentals of application and technical issues of GIS such as co-ordinate systems and geo-coding, user requirements, database design and concepts, spatial analysis and so fort and advance Digital Mapping concepts such as image mapping.

Degree graduates are comparative better operators. They should have respectable degree of knowledge and skills of GIS and Digital Mapping. In other words, they should have a high competency level of how and why certain GIS and Digital Mapping activities are performed. Given ample time and professional training this group of people should take leading role in the planning, design, implementation and operations of GIS set ups.

The knowledge and skills required by this category of people is adequately catered for in the current cartography course. The current trend in the market place tends to indicate demand for this category of people. This demand will mostly likely increase in the next five to ten years as more organisations embrace GIS and Digital Mapping technologies. To date, DSLS is not producing enough graduates in this category to meet the market demand. As an interim solution, a one-year GIS certificate course is being serious considered to satisfy the current market demand. The course should be structured in such a way to produce calibre of people as illustrated by GIS market indicators. The course syllabus should be similar to the diploma in Cartography syllabus with a subject or two in Remote Sensing, Data base design and related concepts and Introduction to programming. The target group for this course should be old graduates from the DSLS and related professional (Natural Resource Departments) departments from University of Technology.

The other suggestion is a well-rounded four-year degree course aimed at preparing the graduates for a broad range of career in Digital Mapping, GIS and Remote Sensing. This is in recognition that graduates may be called on to act as consultants, managers, teachers or researchers. The course should cover general scientific principles as well as specialist subjects in computing, surveying, geography, mapping, remote sensing and GIS. Through out the course the theoretical studies are complemented by practical exercises in the field and laboratories. Students to make use of state-of-art technology and equipment.

There should be a formal accreditation process for this course from professional or academic institutions. Graduates should be considered as an appropriate qualification for entrée to postgraduate studies in Australia and other English speaking countries.

CONCLUSION

The new courses are intended to be broad with many subjects common with the new surveying courses. This structure is intended to create option for students to switch courses any time and also to expose students to working in muti-disciplinary teams. It also teaches students to communicate effectively across disciplinary boundaries. Specialised courses in various fields are offered at postgraduate level.

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