From Geomatics to Geospatial Science and Surveying: Undergraduate curriculum review at the University of Cape Town, South Africa

Simon HULL, Siphiwe MPHUTHI, Patroba ODERA, Moreblessings SHOKO, Kaveer SINGH, Jennifer WHITTAL, South Africa

Key words: curriculum review, geospatial science, geospatial data science, land surveying, geographic information science, accreditation, credit limits, undergraduate education

SUMMARY

The current BSc Geomatics curriculum at the University of Cape Town has been in place for two decades. Despite numerous minor reviews to keep the curriculum up to date, a holistic and comprehensive curriculum review was needed. The triggers for this review include:

1. Shifting the focus from predominately spatial data measurement to include modelling, monitoring, mapping, management, and analysis to prepare graduates for a dynamic profession.
2. Curriculum creep.
3. Lack of differentiation between streams.
4. Low student enrolment.
5. Low progression rate and overly prescriptive pre- and co-requisites.
6. Heavy workload for students and staff.

The objective for the review is to design a curriculum that addresses new and emerging knowledge areas, is attractive to new students, improves throughput and reduces the credit load.

We adopted Tyler's Model of curriculum development, as modified by Wheeler, and began by imagining our ideal graduate through an identity statement and defining six graduate attributes, with several associated learning outcomes and knowledge areas. To give expression to these changes, we decided to rebrand the Division and the degree from Geomatics to Geospatial Science and Surveying. The bachelor's will be offered in two streams: Geospatial Surveying (to be accredited for land surveying) and Geospatial Data Science (to be accredited for geographic information science). These streams have a common first and second year, focussing on Mathematics, Physics, Computer Science, and foundations in surveying and GIS (Geographic Information Systems).

The process of curriculum review was made difficult by the constraints of the COVID years, absence of key staff while on sabbatical, credit limits and accreditation frameworks. But the benefits outweigh these challenges. Through collaboration on this project over several years, the staff has grown in strength and cohesion. We have reimagined our identity and defined suitable graduate attributes and learning outcomes for the modern geospatial specialist. Every knowledge area and credit has been discussed and agreed upon. There is better alignment of knowledge areas between courses and through years of study. The process and outcomes described in this paper should be useful to other programmes embarking on similar projects.

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1. INTRODUCTION

1.1 Background

The Geomatics Division at the University of Cape Town (UCT) is a part of the School of Architecture, Planning and Geomatics (APG) within the Faculty of Engineering and the Built Environment. The Division has a rich and varied history, stretching as far back as 1811 when Louis Michael Thibault, an officer of the new British colonial government at the Cape, introduced the concept of the examination of competency of land surveyors. Following over a century of change, in 1929 a recommendation was made for a university degree course in the professional education of surveyors for the benefit of society (Leipolt 1929). After 1929, the degree in Land Surveying was offered at the University of the Witwatersrand (until 1990), the University of Fort Hare (until 1992), the University of Pretoria (until 1999), the University of KwaZulu-Natal (UKZN) and UCT. These last two are the only remaining universities offering four-year degree programmes in Geomatics (UCT) or Land Surveying (UKZN) leading to professional registration with the South African Geomatics Council (SAGC). Although the programme at UCT was begun in 1929 (Landman *et al.* 2013), it is likely that the first students enrolled would have completed mathematics and science courses in their first two years and would only have advanced to the third year, covering more advanced surveying content, two years later. Hence the current Division of Geomatics at UCT traces its origins back to 1931.

The Division has a strong teaching focus, both at undergraduate and postgraduate levels, and research activities that are aligned with the distinct expertise of each of the six academic staff members. These include land administration and cadastral systems, geodesy and geodynamics, remote sensing and earth observation, and geographic information science. The Division of Geomatics has a formidable reputation within industry for producing good quality graduates. We are the only South African academic member of the International Federation of Surveyors (FIG). We are also a member of the Network of Excellence for Land Governance in Africa (NELGA). The Division is respected for leading impactful research and communicating this broadly.

At the time of the start of the curriculum review, the offerings in the Division were as follows:

- BSc Geomatics (4 or 5 years, taught) in Surveying or Geoinformatics. The latter has specialisation in either Environmental and Geographical Sciences (EGS) or Computer Science (CSC). This programme has been in place since 2003 (Barry and Whittal 2003).
- BSc Honours in Geographical Information Systems (1 year, taught)
- Master of Science (by research)
- Master of Philosophy (by research)

- Doctorate (by research)

These degrees are approved by the Council on Higher Education (CHE) and are in line with the National Qualifications Framework (NQF). In this curriculum review we are only considering the BSc Geomatics programme, which is accredited by the SAGC in terms of the Geomatics Profession Act 19 of 2013 in the following categories:

- BSc (Geomatics) in Surveying: Professional Land Surveyor, Professional Engineering Surveyor, Professional Photogrammetric Surveyor, Professional Geo-Information Sciences Practitioner
- BSc (Geomatics) in Geo-informatics: Professional Geo-Information Sciences Practitioner

The student numbers (see **Error! Reference source not found.**) have been consistent over the past 15 years. What is pleasing to note is the steady increase in intake (AYOS1) over these years.

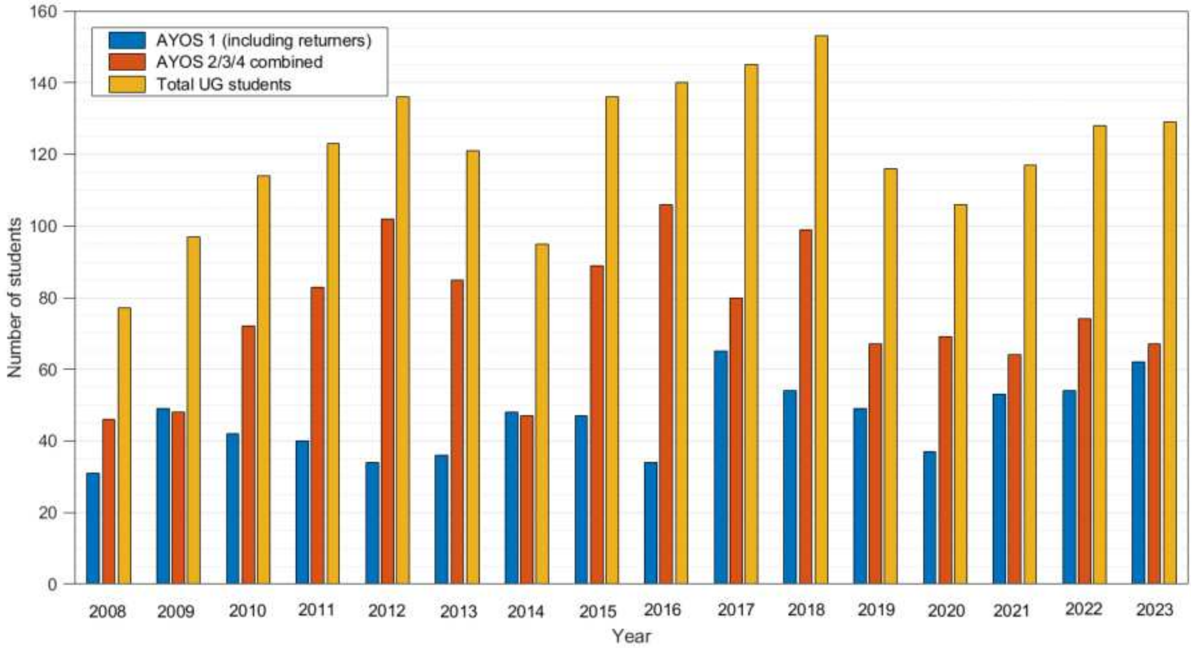


***Figure 1** Registered undergraduate students since 2008. (Note: AYOS = Academic Year of Study. AYOS1 = 4 years to graduate, AYOS2 = 3 years to graduate, AYOS3 = 2 years to graduate, AYOS4 = 1 year to graduate.*

1.2 Drivers for curriculum review

The main triggers for this curriculum review are summarised as follows:

1. **Shifting the focus** from spatial data measurement to incorporate more aspects of spatial data mapping, modelling, monitoring, analysis, and management. There are numerous automatic data measurement systems and sensors collecting geospatial data, hence any

discipline based on geospatial data collection alone will not be competitive in the next 10 years (Jeansoulin 2016, Stefanakis 2023). It is clear geospatial data measurement, mapping, modelling, monitoring, analysis, and management is the future, hence the need to develop a broad-based geospatial programme to offer job flexibility and diversity for our graduates.

2. **Curriculum creep:** Although the current curriculum has been in place for the last two decades (Barry and Whittal 2003), curriculum reviews have been ongoing in response to student feedback, technological push/pull, the evolution of the discipline, etc. Hence, several significant changes have been made and the current curriculum no longer matches that which was introduced two decades ago.
3. **High level of similarity** between the three undergraduate specialisations in Geomatics. The difference between the three specialisations in terms of courses is between 22% and 28%. This high overlap in the courses does not support objective existence of the three specialisations.
4. **Low student enrolment**: although **Error! Reference source not found.** indicates stability and slow growth, the total undergraduate student numbers over all four years of the degree barely exceeds 120.
5. **Low progression rate** occasioned by 1) low pass rates in Mathematics and Physics courses, mostly in 1st and 2nd year of study, and 2) many restrictive pre- and co -requisites for several courses in 2nd, 3rd, and 4th year.
6. **Heavy student workload** ranging from 576 to 608 credits (1 credit = 10 notional hours of work) for a 4-year-degree programme. The HEQSF (Higher Education Qualifications Sub Framework) and SAGC recommend a maximum / minimum respectively of 480 credits. In general, the credit load should be no more than 10% above HEQSF maximum. This translates to a desired maximum of 528 credits.
7. **Heavy staff workload** for six academic staff running two undergraduate streams, Honours, MSc, and PhD programmes. One of the six academic staff does not teach in the undergraduate programme but teaches surveying courses in the departments of Civil Engineering and Construction Economics and Management, hence the workload for the undergraduate teaching is carried by five academics plus support staff.

2. METHODOLOGY

To safeguard against designing a new curriculum that mirrored the existing one too closely, we took a blue sky / clean slate approach. This was aided by the fact that the SAGC was concurrently revising their accreditation criteria, which meant we were initially unconstrained by their academic framework. Thus, the entire undergraduate curriculum was reviewed, beginning with our identity. We thence described the ideal graduate – one that embodies the attributes of both key aspects of the profession vis. surveying and geoinformation science. This led to defining graduate attributes (GAs), learning outcomes (LOs), knowledge areas (KAs), and course templates – see Section 3. We thus followed a deductive design approach, moving from the general to the specific (Mehmood Bhuttah *et al.* 2019).

As course templates were produced and discussed, we found that the GAs, LOs and KAs needed to be revisited. In some cases, these were either missing or needed refinement based on proposed course requirements. The curriculum review hence did not follow a linear progression but spiralled to convergence onto a finally agreed set. Thus, the approach resembles Tyler's linear, deductive design as modified by Wheeler, who advocates for a cyclical, continuous process of curriculum review (Adirika and Okolie 2017). The process is illustrated in **Figure 2**, with bidirectional arrows to indicate continuous movement and updating between all stages of the process.

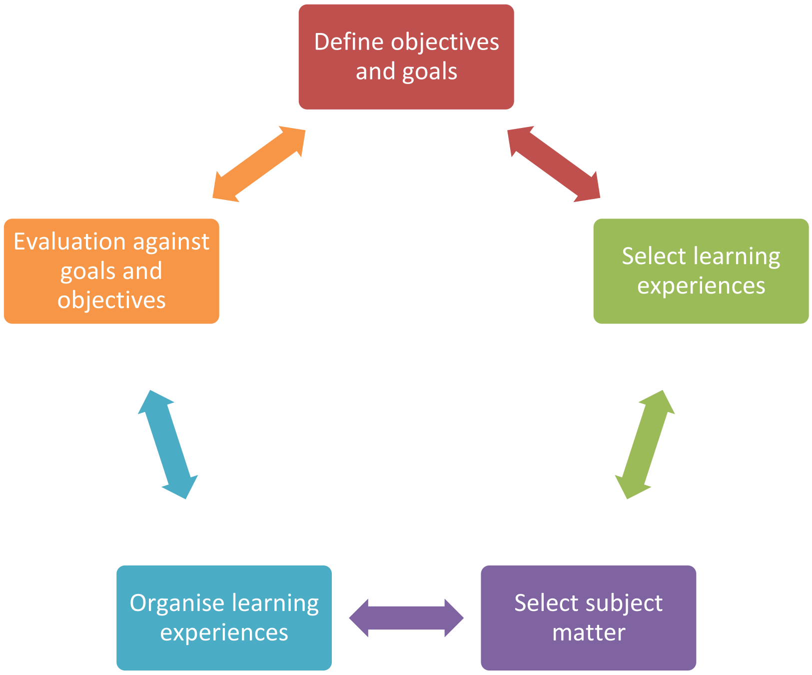


Figure 2 Wheeler's cyclical, continuous model of curriculum development

Once the SAGC draft academic accreditation frameworks had been released, we tempered our vision to fit the constraints of the accreditation body and the maximum allowed credits. This led to the (re)creation of two streams as explained in Section 0.

We also engaged students and industry through an online survey to gauge interest and uptake in a rebranding of the degree and Division name. The survey was circulated via the SAGC and affiliated bodies and 157 responses were received. The results are presented in Section 4.

3. THE NEW CURRICULUM

3.1 The Desired Graduate

The identity of the Division was discussed, and after some debate, we settled on the following identity statement:

‘We are specialists in the measurement, mapping, modelling, monitoring and management of spatial features and phenomena of interest, designing solutions to help address current local, regional, and global societal and environmental challenges (focussing particularly in Africa), by using cutting-edge technologies and developing innovative procedures for critical and creative analysis, and applying professional skills to manage and communicate through suitable platforms.’

This identity is realised through the following GAs that have informed the LOs and core KAs of the curriculum. Our graduates can:

GA1: Measure/Record Spatial and Attribute Data

GA2: Manage Spatial Data and Projects

GA3: Produce and Interpret Spatial Models (including Maps and Spatial Development Plans)

GA4: Understand, Analyse, and Interrogate Spatial Data and Legislation

GA5: Apply interdisciplinary skills and knowledge

GA6: Identify with spatial science profession and domain of work.

3.2 Reality Check

During the review process, the SAGC released their draft accreditation frameworks for the different professional geomatics categories. Once these were available, we compared our ‘blue sky’ wish-list to the accreditation framework to identify knowledge areas where we were over- or under-credited. We hence adjusted our knowledge areas to ensure that our curriculum covered all the requirements for accreditation. A challenge with meeting the geoinformatics accreditation framework is that these are designed for a three-year BSc plus 1-year Honours programme, whereas ours is a four-year BSc (undergraduates exit at Honours level).

With a leeway of 10% on the CHE’s maximum, we were able to design a curriculum of up to 528 credits. This was a key constraint on the curriculum review. We had to decide which professional categories we would pursue because it became apparent that, at 528 credits, we could not design a curriculum that would satisfy all criteria for all students. We therefore needed to retain the current streams within the degree (one for surveying and another for geoinformation science) to present a manageable workload for students. The two streams are now better designed to be identical in years one and two, as compared to the current curriculum. However, there is a loss in that the Surveying stream will now only satisfy the accreditation requirements for Professional Land Surveying, not photogrammetric surveying, engineering surveying and geoinformation science as well.

3.3 Course Structure

The proposed course structure is illustrated in the following tables. Table 1 shows the common years 1 and 2 for both the Geospatial Surveying and Geospatial Data Science streams. In these foundation years, the focus is on exposing students to the basic principles of surveying (including land, photogrammetric and hydrographic surveying) and geographic information science (GISc, including satellite-based remote sensing). Students are also equipped with the necessary mathematics, statistics, computer science and physics knowledge to support them through the degree.

Table 1 Common course structure for years 1 and 2.

Course Name	**Semester**	**Credits**	**Status**
Introduction to Geospatial Sciences	1	8	New
Introduction to Earth and Environmental Sciences	1	18	Existing
Mathematics IA for Engineers	1	18	Existing
General Physics A	1	18	Existing
Spatial Measurement Techniques	2	18	New
Introduction to Programming	2	16	Existing
Mathematics IB for Engineers	2	18	Existing
Statistics for Engineers	2	12	Existing
Total Credits – year 1		***126***	
Fundamentals of GISc	1	16	New
Cartography	1	16	New
Plane and Construction Surveying	1	16	New
Introduction to Remote Sensing	1	12	New
Linear Algebra and DEs for Engineers	1	16	Existing
Vector Calculus for Engineers	2	16	Existing
Geometrical Geodesy	2	16	New
Spatial Data Adjustments	2	16	New
Photogrammetry	2	16	New
Applied Surveying and GISc	2	6	New
Practical Training	X	0	New
Total Credits – year 2		***146***	

Table 2 describes the 3rd and 4th years of the Geospatial Surveying stream. Here the focus is on surveying-related subjects such as geodetic control networks, cadastral surveying, and land administration. Courses in italics (e.g. Spatial Statistics) are common to both streams.

Table 2 Course structure for Geospatial Surveying stream years 3 and 4

Course Name	**Semester**	**Credits**	**Status**
Spatial Control Network Design and Analysis	1	18	New
Spatial Statistics	*1*	*16*	*New*
Cadastral surveying	1	16	New
Real Property Law	1	16	Existing
Land tenure and land law	2	16	New
Coordinate Systems and Map Projections	*2*	*18*	*New*
Satellite and Space-based Positioning Systems	*2*	*18*	*New*
Advanced Spatial Measurement	2	16	New
Total Credits – year 3		***134***	

Course Name	Semester	Credits	Status
Research Methods	*1*	*8*	*New*
Physical Geodesy	1	16	New
Precise Engineering and Deformation Surveying	1	18	New
Geospatial Sciences Project	*1&2*	*32*	*New*
Land Development and Planning	2	24	New
Business Practice and Professional Project management for Geospatial Scientists	*2*	*12*	*New*
Professional Practice and Ethics in Geospatial Sciences	*2*	*12*	*New*
Total Credits – year 4		***122***	
Total Credits for Geospatial Surveying stream		***528***	

Table 3 describes the 3rd and 4th years of the Geospatial Data Science stream. Here the focus is on GISc-related subjects such as Geo-visualisation, spatial data architecture, and 3D scene reconstruction. Courses in italics (e.g. Spatial Statistics) are common to both streams.

Table 3 Course structure for Geospatial Data Science stream years 3 and 4

Course Name	Semester	Credits	Status
Spatial Statistics	*1*	*16*	*New*
Design and Development of Geospatial Systems	1	18	New
Geo-Visualisation	1	16	New
Spatial Data Architectures	1&2	24	New
Practitioners Portfolio	1&2	20	New
Coordinate Systems and Map Projections	*2*	*18*	*New*
Satellite and Space-based Positioning Systems	*2*	*18*	*New*
Total Credits – year 3		***130***	
Research Methods	*1*	*8*	*New*
3D scene Reconstruction and Data Science	1	18	New
Computing and Data Infrastructures	1	18	New
Geospatial Sciences Project	*1&2*	*32*	*New*
Application elective	1 or 2	18 - 24	New
Business Practice and Professional Project management for Geospatial Scientists	*2*	*12*	*New*
Professional Practice and Ethics in Geospatial Sciences	*2*	*12*	*New*
Total Credits – year 4		***118 - 124***	
Total Credits for Geospatial Data Science stream		***520 - 526***	

The Geospatial Surveying stream thus exhibits 26% (140/528) unique credits, while the Geospatial Data Science stream exhibits 25-26% (132/520 or 138/526) unique credits. The third driver for curriculum review listed in Section 1.2 is the high degree of similarity of the existing streams, which was given as between 22 – 28%. The two streams in our proposed curriculum hence do not exhibit a much-improved differentiation. This may indicate that surveying and geoinformatics fields are gradually merging.

4. REBRANDING

Brown (2018) notes that beyond "our community … the term 'geomatics' is unfamiliar and ill defined." This concern led us to question whether the name of the Division and degree presents an obstacle to student enrolment. It is desirable to find a name that resonates with the market yet is descriptive of the scientific discipline. After some debate and discussion, we proposed the name *Geospatial Science and Surveying*.

Google's Ngram Viewer displays the frequency of occurrence of terms in Google's corpus of books up to 2019. Figure 3 displays the results for 'geomatics' and 'geospatial science.' (The latter term is not as common as the former, so to make the results comparable on one set of axes, 'geospatial science' results are multiplied by 10.) Figure 3 suggests that 'geomatics' appeared soon after 1980 and peaked around 1998. It has since declined and been stable since 2013. 'Geospatial science' appears around 1990 and has been growing in popularity ever since.

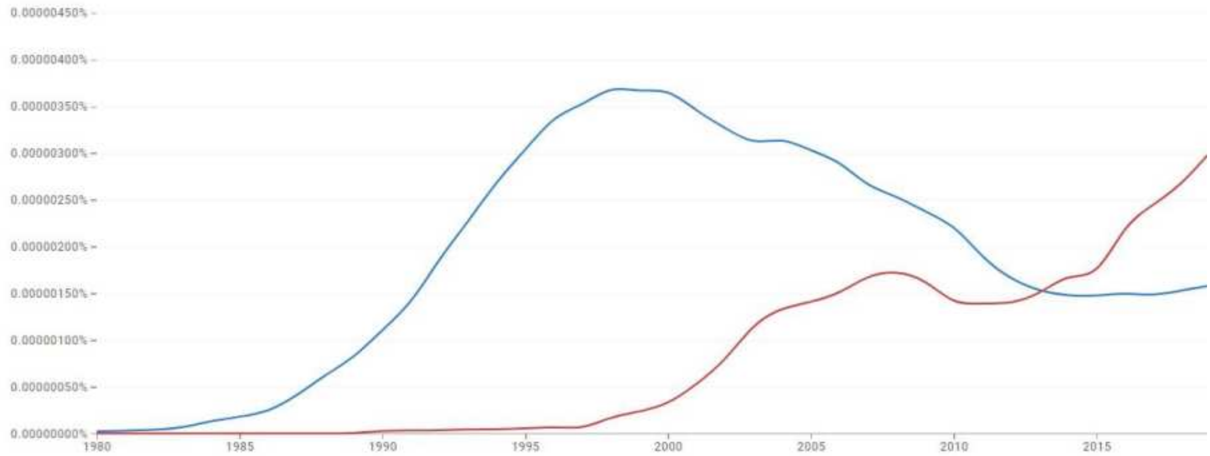
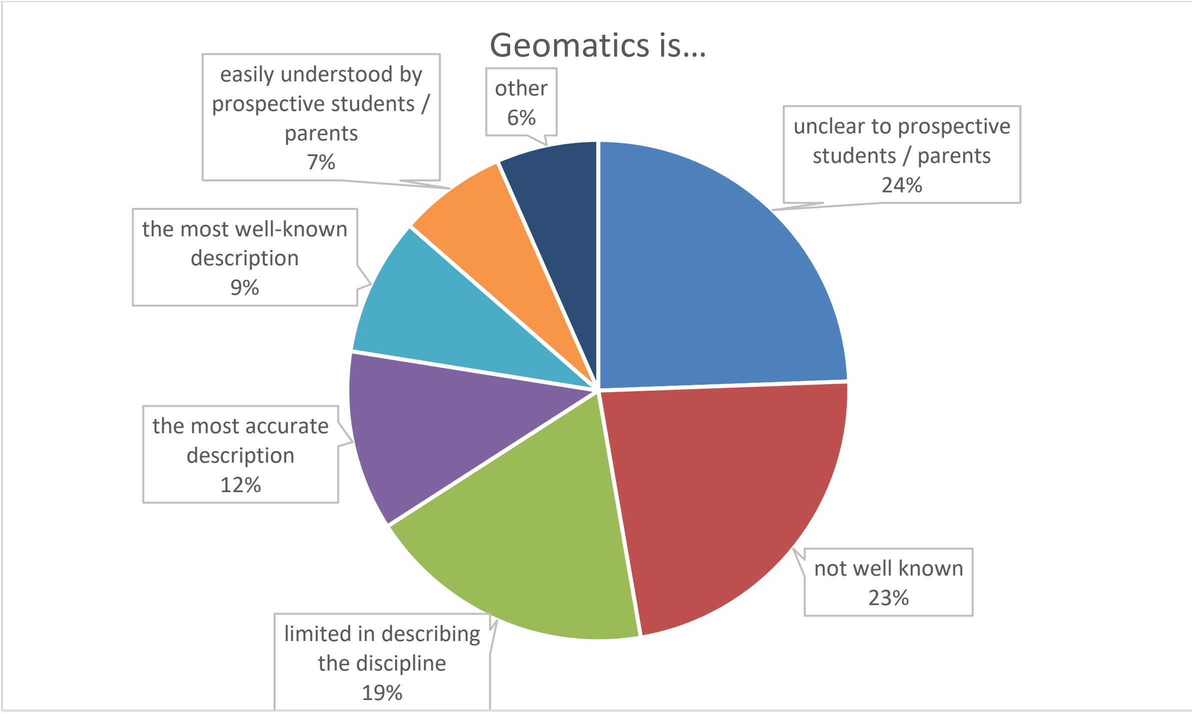


Figure 3 Google's Ngram viewer for "geomatics" (blue) and "geospatial science" x 10 (red)

To test industry response to this suggested change, we conducted an online survey, distributed via the SAGC and affiliated organisations. We received 157 responses, mostly from industry specialists with professional registration (111). 71% of respondents indicated that they thought it was a good idea to change the name from Geomatics; only 57% supported the change to Geospatial Science and Surveying, 34% indicated they did not like the proposed name, and 9% were indifferent. Reasons for their choices are given in Figure 4. It is evident that 66% of respondents have a negative view of the name 'Geomatics': 23% said it is not well-known, 19% said it does not describe the discipline well, and 24% said it is unclear to prospective students / parents / sponsors. Considering 'Geospatial Science and Surveying', only 7% of respondents said it is not well-known, while 9% thought it is unclear to prospective students / parents / sponsors, and 10% thought it does not describe the discipline well; whereas 28% thought it would be easily understood by prospective students / parents / sponsors and 24% considered it to be the most accurate description of the profession.



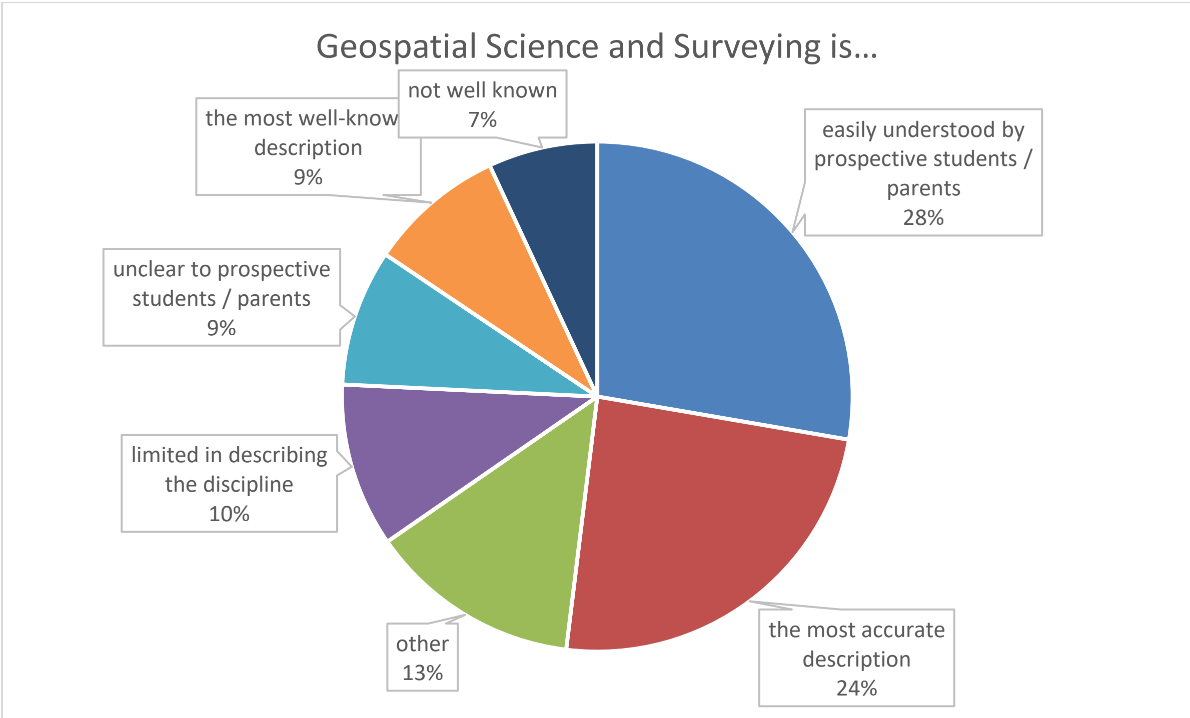


Figure 4 Reasons given for / against name change.

Respondents were also asked whether they had any other suggestions for degree names that clearly describe the discipline; 71 suggestions were received (response rate of 45%). Figure 5 is a word cloud of the responses. 'Surveying' has the highest frequency (34) followed by 'land'

(23), ‘geospatial’ (22), ‘science’ (22) and ‘geomatics’ (18). Figure 6 illustrates the most popular suggestions, with ‘Land surveying’ and ‘Geomatics’ sharing first place, followed by different combinations of ‘Geospatial Science,’ ‘Geomatics’ and ‘Surveying.’

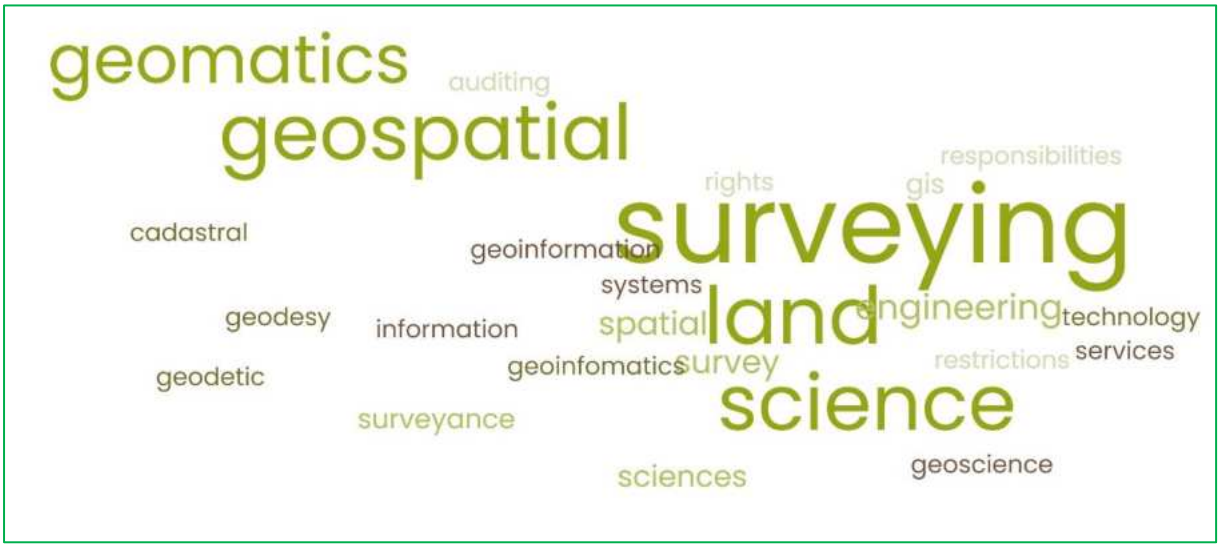


Figure 5 Word cloud based on suggestions for new degree / division name.

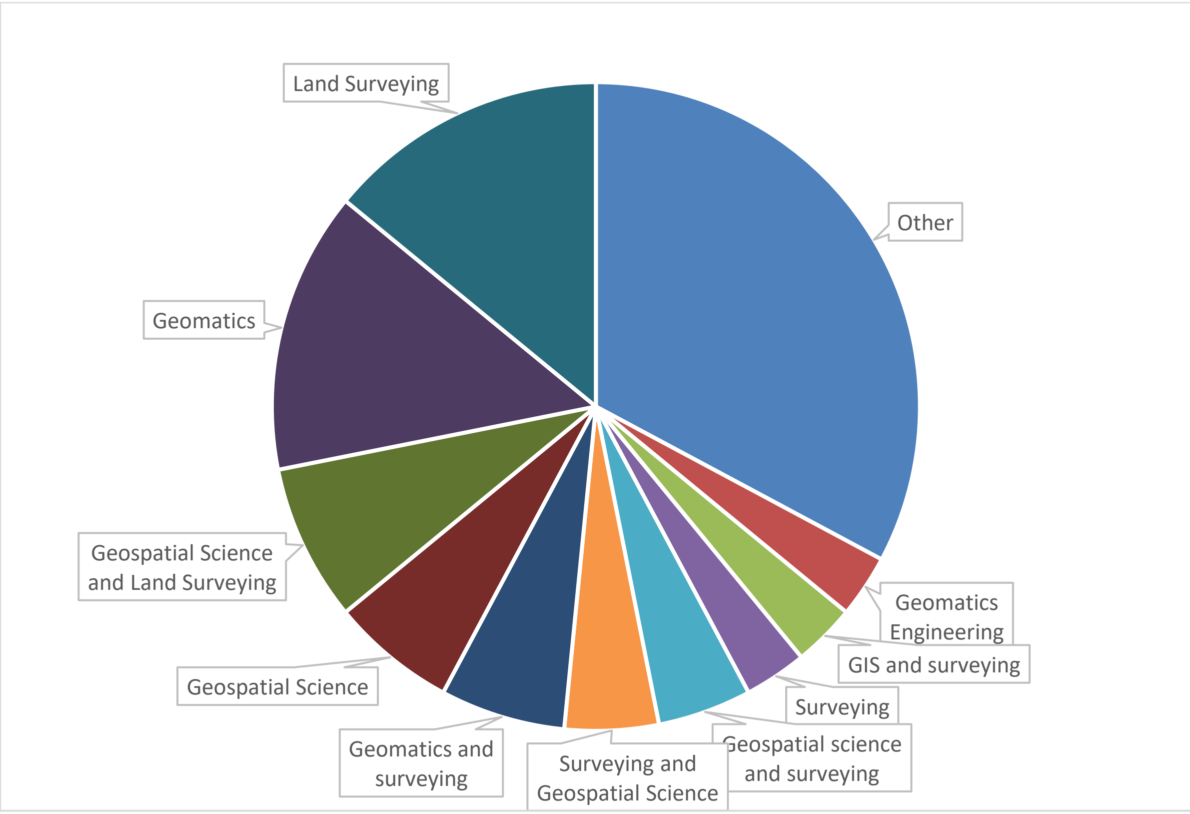


Figure 6 Most popular suggestions for degree / division name.

Taking the above into consideration, and after lengthy discussion and debate, we settled on Geospatial Science and Surveying as the degree and Division name that best matches the proposed new curriculum. The two streams thus become 1) Geospatial Surveying and 2) Geospatial Data Science. These streams will seek accreditation by the SAGC for professional land surveying and professional geoinformatics practitioner, respectively.

5. CONCLUSION

This was an opportunity to develop a fresh curriculum perspective, repositioning the identity of the current BSc Geomatics curriculum through a thorough review process, refocusing the programme to produce graduates with broad-based geospatial knowledge and skills who are prepared for the modern workplace. This resulted in key changes to several aspects of the programme. The primary changes were around the programme rationale and design that focuses on developing geospatial managers in addition to data collectors, armed with a comprehensive set of skills to solve contemporary challenges.

Unlike its predecessor, the common foundation in the first two years of the new curriculum seeks to provide graduates with a discipline advantage allowing them to take up new and established roles in industry. The subsequent streaming into geospatial surveying or geospatial data science in the last two years of the mainstream programme provides specialist knowledge and skills aligned with professional registration requirements. Further, the issues of student progression (throughput), evolving learning needs (andragogy), and credit load reduction, were considered. The resulting proposed programme has a maximum credit load of 526 - 528 credits, compared to the 576 – 608 credits for the current programme. An existing academic support programme allows for a five-year equivalent of the same content, where the first year of the mainstream programme is spread over two years.

From the foregoing, we can say with certainty that triggers one (shifting the focus) and two (curriculum creep) have been satisfactorily addressed. While trigger three (similarity between the streams) has only been addressed marginally, we can confirm that each stream meets its respective accreditation criteria while retaining a solid foundation in spatial data capture and management – this will be what sets graduates apart from those from other professionally accredited degrees of this nature. It remains to be seen whether triggers four (low student enrolment) and five (low progression rate) will be achieved during implementation of the proposed programme. We hope that with rebranding and a strong marketing campaign, student numbers will increase, and we trust that the curriculum redesign will address the progression barriers that students have been facing in the current curriculum. Trigger six (high student workload) has been addressed through the credit reduction. Trigger seven (high staff workload) has not been addressed. In the current curriculum, a substantial portion of credits in the geoinformatics stream are taught in the Science Faculty. We do not have this luxury in the proposed curriculum, meaning that the expected workload for staff will increase. To see our hard work bear fruit, we have therefore made a request to Faculty for an additional two academic and one technical support staff.

6. ACKNOWLEDGEMENTS

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8. BIOGRAPHICAL NOTES

Simon Hull is an Associate Professor and 2019 PhD graduate at the University of Cape Town (UCT). His doctoral research was in the field of customary land tenure reform. He graduated with his BSc in Surveying from the University of KwaZulu Natal in 1998. He then completed his MSc at UCT in the field of digital close-range photogrammetry in 2000 whereafter he spent two years working as a marine surveyor. He spent a further four years completing his articles and is a registered South African Professional Land Surveyor. In 2006 he changed careers and became a high school Maths and Science teacher in a rural village in northern Zululand, completed a Postgraduate Certificate of Education through the University of South Africa in 2009. He has held his current position at UCT since 2012, where he lectures in the foundations of land surveying, GISc, and cadastral surveying. His research interests are in land tenure, land administration and cadastral systems, and the use of GIS to address Sustainable Development Goals.

Siphiwe Mphuthi is a Lecturer in the Division of Geomatics at the University of Cape Town (UCT). He is a seasoned professional with a rich academic foundation in Geomatics and a well-established track record spanning various facets of this dynamic field. With more than 13 years of dedicated experience, he consistently showcased exceptional leadership and technical prowess, enabling him to thrive in diverse roles, including lecturing, consulting, and overseeing extensive geospatial projects. His educational journey includes a Ph.D. in Geomatics, an M.Sc. in Engineering specialized in Geomatics, and a B.Sc. in Geomatics from UCT. He is a registered Professional Land Surveyor and Sectional Title Practitioner. His primary research niche revolves around the domain of physical geodesy, with a particular focus on gravimetric geoid modelling and the establishment of vertical datums. This encompasses the modernization of both horizontal and vertical geodetic reference frames, as well as the meticulous adjustment and analysis of gravity data.

Patroba Odera is an Associate Professor of Geodesy and Spatial Science, and the current undergraduate programme convenor for Geomatics at the University of Cape Town. He obtained his BSc and MSc in Surveying from the University of Nairobi (2001, 2005), and PhD in Earth and Planetary Sciences from Kyoto University (2012). His core research interests focus on geodetic reference systems/frames, geodetic network design and adjustments, gravity and geoid modelling, determination and monitoring of Earth deformations and related plate tectonics movements, and investigation of surface and subsurface geologic structures. In addition, he is involved in multidisciplinary research related to spatial modelling such as, siting optimal location for renewable energy installations, crime mapping using spatial intelligence, biomass estimation, flood / landslide susceptibility and vulnerability analysis, siting for surface / underground water harvesting structures, and spatial-temporal land use/cover change analysis.

Moreblessings Shoko is a Senior Lecturer in the Geomatics Division at the University of Cape Town. She obtained a B.Sc (Hons) in Surveying and Geomatics; Masters in Earth Observation and Geoinformation Science, Masters in Business Administration and PhD in Geomatics. She is also a Registered UAV remote pilot, a Professional Geospatial Scientist, Professional Education and Training Practioner as well as a Professional Career Information Officer. Moreblessings presents both undergraduate and postgraduate courses. Her research interests lie in Education and Capacity Development, Numerical Computations, 3D Scene Reconstruction, Photogrammetry, LiDAR, Remote Sensing and GIS for land administration, built environment, urban , environmental planning.

Kaveer Singh is a Lecturer in the Geomatics Division at the University of Cape Town. He obtained a B.Sc. (Surveying) and an M.Sc. (Surveying) specializing in Remote Sensing from the University of Kwa-Zulu Natal. Currently, he is undertaking his PhD at the University of Cape Town focusing on modelling how urban areas in Cape Town develop over time given their unique town planning and zoning characteristics. He is a Professional Land Surveyor and lectures construction surveying. Research interests include the application of remote sensing and GIS to monitor and modelling geospatial phenomena, invasive plant species, informal settlements, urban development and spatial planning.

Jennifer Whittal is a Professor in the Geomatics Division at the University of Cape Town. She obtained a B.Sc. (Surveying) and an M.Sc. (Engineering) specializing in GNSS from the University of Cape Town. In 2008, Jenny obtained her PhD from the University of Calgary applying critical realism, systems theory and mixed methods to a case of fiscal cadastral systems reform. She is a Professional Land Surveyor and lectures advanced surveying and land law. Research interests are land tenure and cadastral systems, sustainable development and resilience in landholding for the poor, historical boundaries and property holding, and cadastral issues in the coastal zone.

9. CONTACTS

All authors are academic staff at the University of Cape Town

Department of Architecture, Planning and Geomatics
Division of Geomatics
Private Bag X1
Rondebosch, Cape Town
South Africa
Website: https://ebe.uct.ac.za/geomatics

Associate Prof Simon Hull: Tel: +27 21 650 3574; simon.hull@uct.ac.za

Dr Siphiwe Mputhi: Tel: +27 21 650 4043; Siphiwe.mphuthi@uct.ac.za

Associate Prof Patroba Odera: Tel: +27 21 650 1234; patroba.odera@uct.ac.za

Dr Moreblessings Shoko: Tel: +27 21 650 1503; m.shoko@uct.ac.za

Mr Kaveer Singh: Tel: +27 21 650 3569; Kaveer.singh@uct.ac.za

Professor Jennifer Whittal: Tel: +27 21 650 3575; jennifer.whittal@uct.ac.za