

## **Report on the Review of the**

### **French South African Institute of Technology (F'SATI) Postgraduate Programme in Satellite Engineering at the Cape Peninsula University of Technology (CPUT)**

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#### **Review Panel Members:**

Prof FJW Hahne, Stellenbosch Institute for Advanced Study (STIAS)  
P Maruping, Technology Innovation Agency (TIA)  
Dr DM Moeketsi, Centre for High Performance Computing (CHPC)

June 2013

## 1. Executive Summary

Around the time when the Department of Science and Technology (DST) made known its action plans with the Grand Challenges of which Space Science and Technology was one, a group of young engineers launched a satellite project at the Cape Peninsula University of Technology (CPUT) under the banner of French South African Institute of Technology (F'SATI). They chose to focus on the very small satellites, called CubeSats, which were becoming a training platform for satellite engineering at many universities worldwide. A substantial grant awarded over three years was approved by the DST and subsequently transferred to the National Research Foundation (NRF) for administration purposes. It was to be reviewed after three years.

The primary aim of the grant was human capacity development (HCD) in satellite engineering. The approach was to use both local and, specifically, international expertise for the training and for the development of the programme. Through the F'SATI connections, the doors to French and, in general, European know-how were opened.

The Review Panel finds that despite various challenges, the programme was managed very well. It produced 38 engineers with MTech degrees at CPUT, of which most obtained in addition, to an MSc from a French university. The doctoral programme is also taking off with five students working at CPUT on satellite related projects. Furthermore, in total over the period, twelve alumni were retained for experience as engineers in training.

Members of the group are engaged in initiating research projects and in developing technologies, some of which have already found their way to market. There are also clear activities in networking locally, in Africa and worldwide. Locally, the group initiates and participates in outreach projects, which is laudable, particularly because the group is so far not faring well in attracting black South African students. Sadly, female participation is also very low. However, this problem needs to be put in the context of similar challenges which are faced by many training and education projects in the STEM field. While encouraging the group to continue with renewed vigour on this challenge, the Review Panel also recommends that a better representation within the STEM education requires national intervention.

While in the first place this is a retrospective review, the Review Panel wishes to express its view that this project requires assistance to continue. Too much momentum would be lost if it were to scale down significantly. On the other hand, its long-term sustainability, which was not studied here, needs attention by SANSA and the National Space Programme once fully functional.

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## **2. Background**

The French South African Institute of Technology (F'SATI) initially started as collaboration focussed on electronics between the now Tshwane University of Technology (TUT) as well as various bodies in France including technical universities. In 2008, the Cape Peninsula University of Technology (CPUT) joined this collaboration, putting forward its own programme on satellite engineering.

In 2009, a funding proposal from CPUT was submitted to the NRF.. This had also been discussed with members of staff at DST, and as some say, this proposal came at an opportune time as it was well-aligned with DST's ten year innovation plan in which Space Science and Technology were identified as one of the grand challenges. At that time the funding situation was also less restrictive than it is at present. Since France is a leading European space nation, the connections which CPUT was establishing through F'SATI were also fortunate.

Dedicated funding was provided by DST and project management became the responsibility of NRF, but the proposal did not fit into any typical NRF grant programme. Therefore there was really no long-term vision associated with this programme. It was nevertheless stipulated that a review was to be undertaken after the three-year funding lapsed. The review took place in the week of 27 to 31 May 2013.

## **3. Material made available and questions addressed**

### **a. Material made available**

The Review Panel was given extensive documentation for preparation well in advance of the review itself. It contained the original proposal and the self-evaluation written by the director Prof Robert van Zyl (see Appendix A). In addition there were the three annual reports with the final one containing a résumé for the full three-year period. Policy documents on human capacity development and other details of the agreement were also included. There was an additional list of background reading as well. There was a document on ZACUBE-1, the first CubeSat by this group, which explained the interest in the space weather experiment. The Review Panel also received a very well prepared video clip showing some details about the F'SATI project. The Review Panel was happy and impressed by the careful preparation of the NRF and that of CPUT. The various groups of stakeholders interviewed are listed in Appendix B.

## **b. Questions addressed**

During the interviews and deliberations, the Review Panel engaged in broad questions in order to gain understanding of the spirit, approach and philosophy of the project, as well as more specific questions on details. These covered the education and training component as well as research, technology development, networking and outreach. Questions about the management style were also posed.

Education and training questions included:

- How good is the student's background when they enter the programme?
- Do they cope with the material which is presented?
- Does the curriculum broadly cover the field or discipline in terms of breadth and depth?
- Did the programme achieve the set targets for student training?
- Does the programme offer sufficient intellectual challenges and engagement?
- What steps have been taken to provide students with enriching learning experiences (e.g., experiential or co-operative learning opportunities)?
- How well does the dual South African and French system succeed?
- What are the challenges and how are they met?

Research questions included:

- Is the research output of the group of a high international standard?
- Have they produced results which have made an impact?
- Are they well set up to be able to do excellent research?
- How important is this for SANSA and the development of National Space Programme?
- How significant is a CubeSat for Space Science Research in South Africa?
- How much research collaboration with local institutions is taking place?
- How much collaboration takes place on an international level?
- What are the prospects of securing other research funding?

Technology development and information brokerage questions included:

- What key technologies have been developed?
- How is the Intellectual Property (IP) managed within the programme?
- What is the nature of the relationship with partners and how effective is the management of the IP?
- What is the strategy for commercialisation of technology?
- How well is the programme networked with local players?
- What new information has been contributed to the local space industry?
- What has worked and what hasn't worked?

Management questions included:

- What is the management style like?
- Does the team work together well?
- Is the funding sufficient?
- Is the composition of the team well balanced?
- What is done to attract funding from other external sources?

- What is done to attract a more representative student body?
- In particular, what is done to attract more black South African students?
- What is done to attract more female students?

A general question which was repeatedly raised was:

- Did the programme meet all its intended goals and objectives?

#### **4. Challenges for the Science System**

The programme at its inception faced a combination of generic and specific challenges and opportunities, some of which are pointed out here:

1. In the process of transforming from the technikon level, the universities of technology faced challenges in both human and institutional capacity building to develop post-graduate programmes at master's and doctoral level.
2. In attaining know-how for development, there is a need for universities of technology and other universities, and both need to acknowledge and respect each other's mandate so that optimal collaboration can take place.
3. The F'SATI support links the CPUT initiative to technical universities and industries in France which is of great benefit, but it is also a challenge to align the study programmes of both systems.
4. South Africa is still in the process of developing its National Space Programme (NSP), in which it wants to play a rightful and meaningful role
  - a. Globally,
  - b. In Africa through AU,
  - c. In SADC,
  - d. And, most importantly, at home.
5. South Africa, through the DST, wants to develop its own human capacity in a representative manner with an emphasis on more black and female students.
6. Additional support for awareness of science and engineering in all fields including space science needs to be targeted at all communities, commerce and industry.

#### **5. Education and Training**

The main emphasis of the F'SATI project is on Human Capacity Development (HCD) at postgraduate levels in engineering with hands-on training concentrating in the main around one project viz. a very small satellite type called CubeSat, with a volume of one litre and a mass of one kilogram. This is in line with activities at many universities world-wide. At CPUT, a small number of students are supported by funds from the project at BTech level mainly

with the intention of drawing prospective students towards entering the MTech study. It was hoped that South African students in particular would enter these BTech places, but this turned out to not always be the case.

The main emphasis of the project was at the master course level through which it also became the vehicle to develop the doctoral programme. Another innovative provision was made in addition for post-master alumni by appointing them on a temporary basis as engineers in training. These different parts of the programme are described below:

**a. Master's**

The main novel feature in the Master's programme is that students can obtain a double qualification namely an MTech at CPUT and an MSc from French a partner university, ESIEE. This in itself is a great incentive for the students. What's more is that the students receive a really unique education.

Common to both M degrees is a single successful thesis for which students take at least two years. However, together with that, they follow substantial advanced coursework, 50% of which is presented by lecturers from France. Students obtain the MSc only if, in addition to the thesis, they pass the coursework. Students find these courses very challenging but are generally happy once they have completed this part. Most of them value the experience of having to adapt to this French system which requires a more independent approach to studying. The other 50% of the courses are taught by lecturers from various institutions in South Africa.

The Review Panel had a brief look at the summary of the content of all the courses and was impressed by the topics which were offered and by their relevance.

For the MTech, awarded by CPUT, it is sufficient to pass the thesis only. This is externally evaluated as is common at most universities in South Africa. Normally, submission of a publication is also required together with the completion of the thesis.

Thesis topics vary from satellite engineering projects to other complementary areas of engineering and computing. The supervisors are drawn from within CPUT, other institutions like SANSA Space Science (in Hermanus), iThembaLABS, Stellenbosch University and from industry. Completion times for a set of 37 students who have already passed were as follows:

- 14 in 2 years
- 12 in 2,5 years

- 6 in 3 years
- 5 took longer.

With respect to student composition, it was observed that in general the participation of South African black and of female students is much too low.

For example of the 27 students supported in 2012, only eight were from South Africa (plus one with permanent residence status) and only five were females originating from various countries.

At present the Master's programme relies heavily on external part-time teaching and supervision. In the long run this is not healthy and some additional continuous support for students is considered to be desirable.

It was pointed out that many of the students are only able to follow the Master's programme because they were receiving adequate bursaries. It has been said that without the bursary scheme the numbers would be greatly reduced, making the programme unviable.

It was mentioned that the MSc coursework has not been registered locally and hence CPUT does not receive funding from the Department of Higher Education for the teaching portion. The Review Panel recommends that negotiations commence to register such courses in order for CPUT to qualify for funding from DHE.

#### **b. Post-Master's**

Questions often arise as to where the students go after they have completed a specific degree. In this specific case the question is of particular concern because emerging national programmes like NSP are not yet fully established. Even though many new staff members with appropriate know-how are expected to be appointed in such programmes at some later stage, positions are currently not plentiful. Without having detailed information, one would expect that a similar situation exists in the emerging space industry.

There is also the concern expressed regarding what happens to the students who are trained in South Africa. How many stay here to support the South African knowledge base? Hence the whereabouts of the 37 MTech alumni who completed the MTech are reported here:

- 5 (who are from Kenya) and are now in Kenya



- 1 in Namibia
- 1 in Nigeria
- 1 in Lesotho
- 1 in Indonesia
- 1 in USA
- 27 in SA or part-time in France on a joint project.

Another innovative approach was the Professional Skills Retention programme. Within it, eight alumni are currently appointed as engineers in training. The Review Panel interviewed seven of these (One of them being absent for personal reasons.)

This seems to be an excellent approach. All seven alumni indicated that they are passionate about what they are doing because they are working on real projects connected to satellite engineering. Some of them indicated that they would want to stay on longer than what appeared to be envisaged. An external referee, who was contacted by the Review Panel, commented very positively about this innovative idea. The Review Panel wishes to suggest that these engineers could possibly also be used to help in tutoring MTech students in their course work and in their research.

### c. **Doctoral**

The doctoral programme is only starting in earnest now as some of the MTech alumni indicate their interest to continue with the higher degree. Apparently there are few appropriately-trained candidates from other institutions who wish to join this doctoral programme. The Review Panel interviewed five active on-campus DTech students of which one was doing the double DTech/PhD degree of which the PhD part is to be awarded in France. They had previously completed the MTech at CPUT. All five students appear to be progressing well.

One very senior part-time DTech students who had not come through the MTech route, indicated that he had difficulty in finding direction and sufficient support.

There remains the challenge of having enough supervisors with interesting problems if one wants to increase the number of doctoral students significantly. However, it is from these students and their supervisors that one would expect to obtain most research publications and other output in future.

## 6. Research

The field of research in satellite engineering at CPUT is still in a pioneer phase and these studies are very rare across the African continent. Within the research scope of this flagship programme, the panel focused on the following aspects:

### a. Research capacity building

Although the project's primary goal was on training postgraduate students in satellite engineering with a strong component of advanced course work not catered for before by South African traditional universities of technology, part of this training was dedicated to research projects as discussed in Section 4. The emerging research areas within the programme are in the field of communications, power systems, electromagnetic compatibility, antennas, and ADCS. On this endeavour, the self-evaluation report states that the programme achieved the following:

- Produced 37 MTech/MSc theses
- Nine peer-reviewed journal publications in accredited journals
- One peer-reviewed book
- 40 peer-reviewed conference articles

All these deliverables contributed to development of the South African CubeSat which will be launched 2013. However, in terms of research impact, the panel felt that more effort needs to be placed on publishing articles in peer-reviewed journals than on conference proceedings.

Members of the F'SATI team hosted, facilitated and participated in numerous successful research capacity building workshops in the field of satellite engineering. These include: First International African CubeSat Workshop, the International Astronautical Federation's (IAF) Nano-Satellite Workshop, SANSA COSPAR advanced workshop on land surface characterisation, space industry seminar etc. These workshops were attended by both local and international stakeholders (including participants from government and industry) in the space systems domain.

### b. Research collaboration

In order to expand and strengthen its research activities, the CPUT has established research collaboration with the following institutions, members of which were interviewed by the Review Panel:

- SANSA Space Science Directorate

They designed experimental payloads aboard CubeSat for Space Weather Research. Data from these instruments will allow SANSa to investigate some leading topics in space science such as the Southern Atlantic Magnetic Anomaly, and to characterise the ionosphere parameters (e.g. electron densities etc.) of the Southern African region. SANSa has supervised CPUT students to build a beacon transmitter to be carried aboard the CubeSat in order to characterise the polar ionosphere. Two students from CPUT were trained at SANSa and they spent time at the SANAE-IV base in Antarctica as part of the summer hand-over-team. CubeSat with science experiments can be used in future internationally important space weather research campaigns, especially with emerging groups in Africa.

- iThemba LABS

iThemba LABS has established a deep space radiation and satellite test facility. This facility is already being used for testing of materials by neutron radiations of components from the German and Algerian space agencies; testing of materials by gamma and neutron radiations of components from Sunspace South Africa and testing of materials by proton radiation of components from the company Heliocentric Technologies South Africa. The Review Panel was informed that CPUT had signed a MoA with iThemba LABS for space radiation testing for future space technology missions and smart nano-materials. There is one PhD student enrolled in the programme working on material for space radiation and space material involving UNISA and iThemba LABS.

- MoA with international organisations

The Review Panel noted the strong collaboration established between CPUT and international institutions on areas related to space engineering. In particular, CPUT signed MoUs with ESIEE, Paris; the University of Florida, North Carolina AT State University, Polytechnic of Namibia, EADS Astrium, and Paris Chamber.

The allocation of a Research Chair to CPUT by DST-NRF in 2012 is a significant achievement and this will consolidate and strengthen space science and engineering at CPUT as well as contribute significantly to HCD in this domain in South Africa.

## **7. Technology development**

From the outset there was acknowledgement that a successful post-graduate programme requires a hands-on application of knowledge through a satellite development project. The key success factors identified for the satellite projects were:

- Real satellite hardware – this was to motivate students by exposing them to real satellite hardware as part of their training.
- Affordable satellite hardware – this was to ensure that the scope of the programme is not constrained by expensive hardware.
- Complete satellite system including payload – this allows the programme to expose students to all disciplines required in developing a complete satellite system including exposure to project management and system engineering.

A CubeSat was, therefore, adopted as a platform to provide the hands-on experience for the programme and meet all the elements of the key success factors outlined above.

The introduction of CubeSats started in 1999 when the California Polytechnic State University (Cal Poly) and Stanford University developed the CubeSat specifications to help universities worldwide to perform space science and exploration. Despite the small size of 10 x 10 x 10 centimetres and weight of 1kg, CubeSats require the same engineering disciplines required by larger satellites. For this reason they offer a unique hands-on experience to space engineering students in designing, developing, testing and operating a real spacecraft system and its ground segment.

In line with the development of the CubeSat project, a range of research topics were identified to support specific aspects of the project. The outputs of the research are discussed in Section 5 above.

The outputs of the technology development projects were:

- Technology demonstrator CubeSat with deployable antenna, de-orbiting mechanism, communications subsystems , UHF/VHF transceiver and VHF/UHF transceiver
- A flight model 1-unit CubeSat called ZACUBE-01 was developed and prepared for launch.
- Another 3-unit CubeSat prototype called ZACUBE-02 is being built
- For UKube, a CubeSat Mission (UK Space Agency) the S-band transmitter and antenna were supplied.
- For the broader CubeSat market the following are offered:
  - S-band transmitter
  - S-band patch antenna
- Afri-Cansats – this is a satellite in a soda-can developed for space awareness programmes in Africa for which the team received orders from Dubai. In addition, some of the students participated in the Mission Idea contest in Japan with the team winning in Category 2.

The developments indicated above are supported by the outputs of the research project and the industry projects are undertaken by graduates who have been retained as interns.

The group uses established industry players to identify opportunities for commercialising the technologies developed. Craig Clarke of Clyde Space confirmed that his company is working with the group to help sell some of their products. He also indicated that this is now starting to gain considerable traction. His views are that over the long term, the group may consider either spinning off a commercial company or license the technologies. In the near term, the group should be able to generate some revenue from the sale of existing developments that they have in-house.

It is the view of the Review Panel that the group should continue with this arrangement such that the focus remains on the core activities of the programme. It is also advisable that CPUT obtains professional advice on how to structure the relationship with all external partners to properly protect any IP generated within the programme.

## **8. Networking, Information Brokerage and Outreach**

As mentioned previously the CPUT team undertook several initiatives in developing partnerships to support their programme and attracting participants to the programme. The details are discussed below under headings of networking, information brokerage and outreach.

### **a. Networking**

During the first year of implementation, the programme focussed on creating partnerships to alleviate capacity constraints. Over time, the partnerships were expanded through targeted industry seminars. Some of the key partnerships included:

- ESIEE, Paris – collaboration on joint post-graduate degree at Master’s level and lecturing.
- SANSA Space Science – cooperated on defining the scientific payload that was developed for the first CPUT CubeSat. The Space Science group also delivers lectures on the programme.
- Stellenbosch University Electrical Engineering Department – cooperate on satellite attitude and control systems and the development of the control system of the CPUT CubeSat.
- iThemba LABS – joint research projects and student supervision.

- EADS Astrium – a MoU was signed with CPUT to partner in organising industry seminars.
- Clyde Space – initially partnered in knowledge transfer in the area of satellite power system design. This subsequently developed into a partnership for distributing sub-systems developed by the CPUT team.

The Review Panel was impressed with the quality of partnerships that have been developed locally and internationally which seem to benefit the programme immensely. The partners that were interviewed were extremely complimentary of the achievements of the programme and the working relationship with CPUT.

#### **b. Information brokerage**

The information brokerage was primarily in the form of industry seminars which were organised in partnership with F'SATI and Astrium EADS supported by the DTI. Six seminars were hosted from 2009-12. The participants included students, academia, government departments, agencies, industry and research facilities. The DTI, as the main sponsor for the seminars, confirmed that they were satisfied with the organisation of the seminars.

The first international African CubeSat workshop was hosted in September 2011. The group managed to secure the participation of the co-inventor of CubeSats, Prof Jordi Puig-Suari, who also wrote a very positive letter of support for their efforts.

The programme staff participated in the development of the National Space Programme which was led by SANSA, focusing on the HCD components. SANSA expressed appreciation for the engagements with the CPUT team and felt that they were doing valuable work in increasing the HCD capacity.

#### **c. Outreach**

To promote space engineering and develop space science interest among schools and the general public in South Africa, the programme formed a partnership with the South African Agency for Science and Technology Advancement (SAASTA). Highlights of major achievements are as follows:

- Cansats rocket launch project

Four Afri-Cansats were developed by CPUT, UCT and schools in the Bellville and Khayelitsha area. They were to be launched with a rocket at the Overberg Test Range by

a group from the Technical University Delft, Netherlands but unfortunately the launch was not successful.

- Mpumalanga Space Science Awareness

CPUT participated in an open day event outreach in Piet Retief to promote science and technology among the learners. The event was organised by SAASTA and DST in conjunction with the Mpumalanga Mondi Science Centre.

- Namibia Space Science Week

CPUT was invited by the Namibia Ministry of Education to facilitate a Cansats activity during the National Science Week in Windhoek.

In conclusion, more than 500 schools were reached in which learners were taught the basics of satellite construction and launch. SAASTA expressed their appreciation for the efforts and commitment demonstrated by the CPUT team.

## **9. Management**

In this section various comments on various aspects of management are grouped together under appropriate headings.

### **a. Daily operational management**

General comments by interviewees indicate that an efficient and excellent management on a daily basis was in place. Staff and students were aware of the tasks at hand and performed them well.

Documentation on the management was transparent and it was available to the Review Panel. Everything is very neatly filed and any relevant information was extracted quickly on request.

Teaching and laboratory areas were well organised and appeared to be well planned. Leadership to staff and students was apparent.

### **b. Staffing**

The full programme has five full-time/permanent staff members, and three of these positions are fully funded by CPUT while the other two are partly funded by the grant received from DST. Four other CPUT-funded staff members are also engaged to a much lesser extent in the running of this programme. Furthermore, two additional part-time

lectures/supervisors partly funded by CPUT are employed as Adjunct Professors on a contract basis. In addition seven Junior Engineers in Training are employed on contract and these are funded by the F'SATI project from various grants from DST, DTI, CPUT and from France.

The CPUT position of Research Chair, which was approved by NRF, is still vacant. Mention also needs to be made of a position for a French technical and/or teaching expert which has been approved and will be funded from French sources.

In view of the small number of teaching staff, some non-teaching positions do not seem to be justified on a full-time basis.

### **c. Level of funding and return on investment**

Financial expenditure is in line with the initial proposal and auditing appears to be in place, the F'SATI programme having received a clean audit at CPUT and NRF. The grant allocated was sufficient to implement the programme. At the end of the period 96 % of all income had been expended.

The staffing and travel costs appear to be on the high side, but it needs to be said that the Review Panel did not receive nor ask for the breakdown of these costs.

As far as return on investment is concerned, mention is made of some of the graduates from F'SATI having joined industry. This contributes to needed technical skills in industry for socio-economic development of South Africa. As stated above, there are 37 graduates of which 27 are at present in South Africa. Mention was also made that eight of these were currently accommodated as engineers in training.

It should also be mentioned that a CubeSat is ready for launch with a science experiment payload which will provide data for space weather research. It is, however, not the product itself which is of greatest value. The main value lies in developing the know-how which resides in the team and in the alumni who participated.

The granting of a DST Research Chair in Innovative Small Satellite Technology Applications for Africa and the additional position funded by French sources clearly indicate that the programme has attained considerable recognition. More effort needs to be made to broaden its support base, however.



#### **d. Host institution**

For the successful management of a programme of this kind, the attitude of the home institution is of crucial concern. In this respect the Review Panel reports that CPUT indicated its enthusiastic commitment towards hosting the programme which it considered as a flagship.

It can also be reported that CPUT invested resources on refurbishment of the facilities valued at R1,2 million. Furthermore it committed funding through the Innovation Fund to support innovation of the IP which emanate within the F'SATI programme. As mentioned above, it funded the positions of permanent staff and partly funded the positions of staff appointed on contracts within the F'SATI programme.

CPUT is in the process of registering F'SATI Space as a Research and Innovation Centre to operate as a department. This will enable the university to secure subsidies from government.

#### **e. Governance**

In the self-evaluation report several pages deal with elaborate past and changing governance structures. The Review Panel was requested to comment on these. Our comment is that there are too many boards and committees (called executive, management and/or advisory) without a clear understanding of where the ultimate responsibility resides. It should also be mentioned that as a matter of general policy the chairperson of any of these boards/committees and the director (or chief executive officer) should not be the same person.

The financial and human resources responsibility appears to reside within the normal CPUT structures and spending is audited within it. Also the NRF grant appears to be determined and audited by the NRF who then report to DST.

The Review Panel is not in a position to propose a new set of structures, but it urges the stakeholders to agree to streamline the governance structure for efficient management indicating ultimate responsibility and clear line functions. Most additional external sponsors would require a clear, efficient and transparent picture before approving a grant.

### **10. Recommendations**

The Panel recommends to DST and NRF (and possibly to SANSA) that:

- a) The F'SATI project on satellite engineering should be continued and for this funding is needed.
- b) The CPUT group should not be required to commercialise prematurely.
- c) The group needs to be encouraged to integrate further nationally and to be involved, at least peripherally, in the needs of larger satellites through the leadership of SANSA.
- d) In view of the unsatisfactory participation levels of South African black and female students which this group shares with similar postgraduate programmes, an overall national approach is needed to resolve the uneven participation levels in STEM education.
- e) The funding of students from other African states, particularly those in recognised SADC and AU programmes, needs to be resolved at the appropriate higher level.

The panel recommends to CPUT to:

- a) Continue to focus on strengthening student training and research base.
- b) Strengthen relationships with local industry.
- c) Formalise relationships with other Higher Education Institutions with complementary capabilities in well-selected fields in order to collaborate with them.
- d) Engage the Department of Higher Education for funding of emerging post-graduate courses such as the MSc coursework of the F'SATI project.
- e) Work more with the Technology Transfer Office to obtain a clear strategy for technology development.

## 11. Appendices

### Appendix A: Self-evaluation report for 2009 - 2012

[Available as link to this review report](#)

## **Appendix B: List of interviewees**

Interviewed Stakeholders in Alphabetical Order Per Slot

### **Management of F'SATI**

Mr Siyabonga Copiso, Government and Industry Relations Manager

Mr Eugene Jansen, Executive Committee Member

Mr Francois Visser, Chief Technical Architect

Prof. Robert van Zyl, Director

### **Research and Development / Part-Time Lecturers**

Prof. Malik Maaza, Chairman: NANOAFNET, iThemba LABS

Dr Lee-Anne McKinnell, Managing Director: Space Science, South African National Space Agency (SANSA)

Dr Ursula Reader, Part-time lecturer: Ethics

Prof Herman Steyn, Head of Department: Electrical and Electronic Engineering, University of Stellenbosch

### **Hosting Institution: CPUT**

Dr Nawaz Mahomed, Dean: Faculty of Engineering

Prof. Anthony Staak, DVC: Academic

### **Internal Collaborator**

Mr Jacques Wheeler, Acting Head: Centre for Instrumentation Research

### **F'SATI Staff Members**

Mr Angus Brandt, Academic Officer

Ms Cindy Engel, Secretary

Mr Ian van Zyl, Manager: Operations, Finances and Communications

### **Lecturing Staff**

Prof. Elmarie Biermann, Adjunct Professor, CPUT (part-time)

Mr Ben Groenewald, Head of Department: Electrical Engineering

Prof. Robert Lehmensiek, Adjunct Professor, CPUT/EMSS Antennas (part-time)

### **ZACUBE-01 Development Team**

Mr Charl Jooste

Mr Etnard Louw

Mr Enrico Louw  
Mr Tony Lumbwe  
Mr Jason Quibell  
Mr Nyameko Royi  
Mr Leon Steenkamp

#### **MTech/MSc Students**

Mr Stephen Cupido  
Ms Kgomotso Makolomakwe  
Mr Motlokwe Maleka  
Ms Fenni Shidhika  
Mr Thinawanga Tshilande, MTech

#### **DTech and PhD Students**

Mr Vernon Davids, DTech/PhD  
Mr Patsa Khotso, DTech  
Ms Zhao Liu, DTech  
Ms Electdom Matandirotya, DTech  
Mr Morné Roman, DTech

#### **Former students**

Ms Siyandiswa Bangani  
Mr Zak Blomerus  
Mr Daniel de Villiers

#### **SANSA Management**

Dr Sandile Malinga, CEO  
Mr Francois Denner, Space Programme Manager, SANSA

#### **NRF Representatives**

Dr Romilla Maharaj, Executive Director: Executive Director: Human and Infrastructure  
Capacity Development  
Ms June-Rose Ngcobo, Programme Officer: Human Capacity Development  
Dr Ndanduleni Nthambeleni, Executive Director: Grants Management Systems  
Administration

## **Sponsors**

Mr Kaizer Moroka, Deputy Director: Space Science, DST

Mr Humbulani Mudau, Chief Director: Space Science and Technology, DST

MsTumisang Sebitloane, Deputy Director, Earth Observation, DST

## **Board members**

Prof Yves Blanchard, Scientific Director: F'SATI, Tshwane University of Technology, F'SATI Management (National)

Dr Pierre le Monde, Acting Counsellor, Attaché for Science and Technology, Embassy of France, Board member

## **Community engagement**

Mr Hans van de Groenendaal, South African Radio League and the Southern Africa Amateur Satellite Association

Dr Lorenzo Raynard, Manager: Science Communication, South African Agency for Science and Technology Advancement

## **Regulatory, Industrialisation**

Ms Nomfuneko Majaja, Chief Director: Advanced Manufacturing, Department of Trade and Industry

## **DTech and former student**

Dr Wilfred Fritz, Lecturer, Electrical Engineering, CPUT

Mr Rob Thomson, DTech

## **International collaborators**

Mr Craig Clark, CEO: Clyde Space, Glasgow, Scotland, Commercialisation, industry partner

Prof Norman Fitz-Coy, Director: ASTREC, University of Florida, Research and development, information brokering

Prof Jordi Puig-Suari, Professor, California Polytechnic State University, Strategic, information brokering (North Carolina A&T State University)

Ms Smita Francis, Senior Lecturer, Polytechnic of Namibia, Research and development, information brokering

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**TERMS OF REFERENCE**

**REVIEW OF THE FRENCH SOUTH AFRICAN INSTITUTE OF TECHNOLOGY  
POSTGRADUATE PROGRAMME IN SATELLITE SYSTEMS ENGINEERING**

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**1. Assignment title**

Review of the Department of Science and Technology-National Research Foundation (DST-NRF), French South African Institute of Technology (F'SATI) Postgraduate Programme in Satellite Systems Engineering at the Cape Peninsula University of Technology (CPUT).

**2. Background**

F'SATI initiated a Postgraduate Programme in Satellite Systems Engineering at the CPUT in 2009 to address the human capacity development (HCD) required to support the national space industry. In the F'SATI model, students may be awarded Master's degrees from CPUT as well as from l'Ecole Supérieure d'Ingénieurs en Electronique et Electrotechnique (Paris). The CubeSat (miniaturised satellite used for space research) standard has been selected as a practical and low-cost technology platform to provide the students with hands-on experience in satellite technology.

The F'SATI model, which fuses an internationally recognised postgraduate degree with practical experience on a real satellite, close linkages with industry, and community involvement, provides an effective and comprehensive human capacity development framework.

## The role of the National Research Foundation

The NRF through one of its Directorates, Human and Institutional Capacity Development, is responsible for managing a three-year grant for the period 2009/2010 to 2011/12 for the CPUT F'SATI Postgraduate Programme, through a contractual agreement with the DST. The grant mainly focuses on attracting the right calibre of students and retaining them in the postgraduate programme so that they are suitably equipped to enter the space industry. The initial focus is on acquiring the specialised know-how to support the required space curriculum and to provide technical guidance for student satellite projects. Activities commenced after the CPUT F'SATI Postgraduate Programme received a three-year grant on 14 July 2009. In addition to this DST/NRF grant, funds were also received from CPUT.<sup>1</sup> A grant from the DST was also made available to bring researchers from France and other African countries to visit the F'SATI Postgraduate Programme. Key activities funded by the DST/NRF grant include research, education and training, information brokerage and technology development, networking, service provision. The DST has informed the NRF that there should be no expectation of further funding from the Department for this Programme.

### **3. Assignment Principal**

The Assignment Principal is the NRF represented by the Deputy CEO: Research & Innovation Support & Advancement. The role of the Assignment Principal is to ensure that the review is completed in line with the terms of reference.

The tasks of the Assignment Principal are to:

- amend and approve the terms of reference;
- advise on the budget;
- approve the members of the review panel;
- approve the review plan and time frame for the review process;
- consider and suggest suitable interviewees for the review panel;
- ensure that the review report addresses the terms of reference;
- accept the draft and final report by the review panel; and
- accept the response of the management of the NRF Programme to the report.

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<sup>1</sup> Note however that a separate agreement and funding stream for this activity is with F'SATI at Tshwane University of Technology (TUT), although the graduate programme that is under review of course benefit from the visiting lecturers. The F'SATI – TUT grant is not directly being reviewed.



#### **4. Service Provider**

The Monitoring and Evaluation (M&E) unit of the NRF will act as the service provider to manage the review process. The responsibilities of M&E are to:

- provide input into the terms of reference for the review;
- prepare the letters of invitation for the approved members of the review panel for the Assignment Principal's signature and distribute them;
- develop a programme for the review, including a budget;
- coordinate and manage the review process, including logistics for members of the review panel;
- provide support to the review panel;
- source the necessary documents stipulated in the Annexure with the help of the Programme staff and make them available to the review panel four weeks prior to the commencement of the on-site review;
- receive the draft and final reports by the review panel and submit them to the Assignment Principal for acceptance;
- receive the Programme management response in terms of factual inaccuracies in the draft review report and forward it to the convenor of the panel consideration and possible further action;
- receive the Programme strategic management response to the final review report and submit it the Assignment Principal for approval; and
- place the final review report and the management response on the NRF website within one month of the acceptance of the review report by NRF management.

#### **5. The purpose of the review**

The purpose of the review will be to:

- assess the conception, implementation and management of the F'SATI Postgraduate Programme in Satellite Systems Engineering at CPUT ("Programme") from its inception on 01 January 2009 to 31 March 2012;
- report on the achievements of the Programme in relation to its objectives; and
- make recommendations for consideration in future similar programmes.

## **6. The scope of the review**

The focus of the review will be a retrospective view covering the period from 1 January 2009 to 31 March 2012. The review will also highlight both positive and negative points from which future similar programmes could learn from.

## **7. Review dimensions**

7.1 The Programme is largely focused on student training through technology development, education and training. Hands-on training on a real satellite platform forms the cornerstone of the student training programme. The CubeSat platform is used as a training vehicle. The review panel is requested to assess the performance of the Programme as per approved proposal submitted to the NRF and its subsequent evolution. In addition, the review panel is asked to take into consideration the stated key success factors outlined in the approved proposal together with the following key activities as appear in conditions of grant:

### **7.1.1 Education and training**

Human resource development is done through support for BTech, Honours, Master's, Doctoral and Postdoctoral programmes, support for students to study abroad, joint ventures in student training, high technology skills training and innovation. In creating, broadening and deepening research and innovation capacity, the conditions of the grant stipulated particular attention to race and gender disparities.

### **7.1.2 Information brokerage and technology development**

The Programme is expected to: provide access to a highly developed pool of knowledge, maintain databases, promote knowledge sharing and knowledge transfer, in support of the National Space Landscape. It is expected that relevant research and innovation will contribute to a space technology development base.

### **7.1.3 Networking**

The Programme is expected to actively collaborate with reputable individuals, groups and institutions. Equally, it must negotiate and help realise national, regional, continental and international partnerships.

### **7.1.4 Service provision**

The Programme is expected, within its scope, to provide information, analysis, policy, and other services, including informed and reliable advice to government, business

and civil society.

#### 7.2 Management of F'SATI Postgraduate Programme in terms of:

- Leadership;
- Staffing;
- Commitment of CPUT towards hosting the F'SATI Postgraduate Programme;
- Location of the Programme; and
- Level of funding and return on investment.

7.3 The review panel is also requested to assess the performance of the NRF Programme management in terms of its management of the grant awarded to the F'SATI Postgraduate Programme.

#### 7.4 Recommendations

Evaluate the merit of the Programme based on the aspects outlined above in relation to human capacity development required to support the national space industry.

### **8. The review structure and process**

8.1 A panel consisting of at most three members will be appointed for the review of the Programme. Ideally, at least one of the members should be a scientific expert from abroad in the field of space engineering. The other member(s) with appropriate experience and skills should be from South Africa. The panel will be requested to compile and submit a report to the NRF.

8.2 The resource documents for the review will be made available to panel members four weeks in advance of the commencement of the review.

8.3 The NRF's Monitoring and Evaluation Unit will draw up a programme for the review in consultation with the Assignment Principal and the NRF Programme management.

8.4 The panel will have the opportunity to interrogate the proposed programme and to recommend amendments and additions should the need arise. The panel will have the opportunity to interview a selection of relevant stakeholders.

8.5 The logistical arrangements for the reviewers will be made by M&E. All arrangements for the on-site programme, including meals and logistical arrangements for the interviewees invited to interact with the reviewers, will be made by the F'SATI Postgraduate Programme in consultation with M&E.

8.6 The review panel will decide on and pursue their own line of enquiry during interviews.

## **9. Deliverables by**

### **9.1 F'SATI Postgraduate Programme**

9.1.1 A self-evaluation report compiled by the F'SATI Postgraduate Programme should be submitted to M&E four weeks prior to the commencement of the review. The report should cover the period from inception of the F'SATI Postgraduate Programme on 1 January 2009 to 31 March 2012. The report should address items 7.1 to 7.4 above and should not exceed 40 pages with annexures.

9.1.2 A list of stakeholders arranged according to the various categories e.g. Programme management, Programme staff, sponsors, hosting institution, collaborators etc. The list could also include stakeholders with whom the Programme has interacted with since inception.

9.1.3 A list of current and former students per level of study indicating demographics, contact details, names of supervisors and whereabouts.

9.1.4 Arrange appointments/discussions with stakeholders in conjunction with the M&E unit to facilitate the task of the reviewer.

9.1.5 Logistical arrangements including transport, accommodation for the stakeholders invited to interact with the reviewers and meals for the on-site programme.

9.1.6 A proper financial report showing: Income i.e., funds received by the F'SATI Postgraduate Programme from national (including all sources in the NRF) and international sources. Expenditure i.e., bursaries, remuneration, honorarium, running costs, etc. per year for the period under review. Also indicate if there are unused funds and where they are held.

9.1.7 Details of F'SATI Postgraduate Programme highlights.

9.1.8 Documents listed in Annexure to the terms of reference for the review which are not in the public domain are to be supplied to the M&E unit for onward transmission to the reviewer four weeks in advance of the commencement of the on-site review.

9.1.9 Other documents considered important reading for the review panel should be made available to reviewers during the review.

9.1.10 Names, affiliations and contact details of possible reviewers for consideration.

9.1.11 A written response to the draft review report pointing out factual inaccuracies to be submitted to M&E unit a week after receipt of the draft review report.

## 9.2 NRF Programme management

A written strategic management response to the final review report submitted to M&E unit within two weeks after receipt of the final review report.

## 9.3 Review panel

9.3.1 Verbal feedback to the Deputy Vice Chancellor of the CPUT, the Director of the F'SATI Postgraduate Programme as well as to representatives of the DST and the NRF;

9.3.2 Compile a preliminary report on completion of the stakeholder interviews;

9.3.3 Submit a final report within three weeks of completion of the stakeholder interviews. The report should include:

- an executive summary;
- background to the review;
- evaluation questions that were addressed;
- key findings;
- recommendations;
- conclusions; and
- appendices containing, for e.g. terms of reference, persons interviewed.

**10. Time frames**

Date for the on-site review is dependent on the availability of suitable reviewers.

**11. Budget**

M&E will submit a budget for the review to the NRF Programme Management for approval and payment.

**The terms of reference may be amended should the need arise.**

**Approval of terms of reference**

**Approved by:**

\_\_\_\_\_ Date\_\_\_\_\_

Dr Dorsamy (Gansen) Pillay

DEPUTY CHIEF EXECUTIVE OFFICER:

RESEARCH AND INNOVATION SUPPORT AND ADVANCEMENT

**Documents for review panel**

**Essential reading:**

- Self-evaluation report
- Project proposal
- Annual progress reports: 09/10, 10/11 and 11/12
- Conditions of grant
- Space science framework document
- Contract
- Allocation letter
- F'SATI Research and Innovation (R&I) Centre registration
- ZACUBE mission definition
- List of Alumni with additional information
- Course outlines combined
- Academic Programme

**Additional reading:**

- DST National Space Policy and Strategy
- Human Capital and South African knowledgebase
- Review of the NRF Astro-geosciences cluster as part of the NRF Institutional Review, 2010
- SANSA Strategic plan 2011/13 to 2013/14
- Ten-Year Innovation Plan of DST